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Research About Mathematics Achievement in the Rural Circumstance

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Rural education scholars have noted that many educators presume rural schooling suffers when compared to national norms. This review takes a closer look at this common presumption by placing the issue in historical context and then focusing attention on mathematics achievement. Because mathematics is arguably the most teachable of subjects, determining the comparative status of rural students' achievement in this subject seems a good test of the presumption. The review shows that available evidence falsifies the presumption, but a more critical issue persists: What is the place of meaning in mathematics education, and what role does "place" occupy in such meaning? An unpacking of this issue, together with a list of salient research topics, concludes the discussion.

Interest in the achievement of rural students is understandable as, in part, an issue of equity. Rural education scholars (e.g., Herzog & Pittman, 1995) have pointed out that rural schooling typically has been viewed as deficient. Raymond Williams, professor of literature at Cambridge University and author of perhaps the finest book on the topic of the cultural relationship of country and city (Williams, 1973), observed that this prejudice is difficult to unseat because metropolitan norms have been established as universal norms. "The World City," he later wrote, became the standard of cultural propriety (Williams, 1989)[1]. Cultural deficiency, of course, translates rather directly into presumed educational deficiency (see Johnson & Howley, 2000, for a review of Williams's work addressed to rural educators). For many such reasons, rural education, on the whole, is presumed to be nationally deficient. The politics of poverty rely on continued propagation of the impression of deficiency as a route to continued assistance and attention (and sources of local power; see, e.g., Gaventa, 1980; Whisnant, 1980).

Does the presumption stand up to evidence—and to current evidence about mathematics achievement, in particular? And what if it does not? These questions matter, first, because the rate of poverty in nonmetropolitan counties exceeds that in metropolitan counties, and poverty of course carries strong achievement costs. On one hand, then, observers have an empirical reason, not directly related to cultural and ideological arguments, to presume deficiency. On the other hand, the observed differences in nonmetro and metro poverty rates are modest—13.4% as compared to 10.8% (United States Department of Agriculture [USDA], 2002). Insofar as achievement is concerned, empirical tests of the presumption of rural deficiency actually are possible; one need not rest with inferences based on overall poverty rates in metro and nonmetro counties. This article reports the evidence on rural differences in mathematics achievement, setting the synthesis first in historical context.

The presumption is shown not actually to be warranted by the available evidence. This "discovery" relates to the importance of the second question. In light of the bad habit of claiming rural deficiency as a warrant for resources and attention, one must address what *other* significance being rural might actually possess. For this reason, the discussion closes with a consideration of the place of meaning and the practical meaning of place to *rural* mathematics education.

Historical Background

Historical data on mathematics achievement are not available, but literacy rates and educational attainment data illustrate historical trends related to rural educational accomplishment from the mid-20th century to now. Illiteracy and educational attainment were regarded as distinctive rural problems as short a time ago as 50 years.[2]

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[1] The World City is the standard to which all other settlements are compared, with London being the first world city, followed rapidly by others—Paris, New York, Singapore, and Hong Kong among many others. Cosmopolitan standards, of course, prevail today and are embedded in the phrase "world-class."

Illiteracy was somewhat more prevalent in rural areas than elsewhere, and within rural areas, it was more prevalent among farm rather than nonfarm populations.[3] In 1947, the Bureau of the Census estimated the national illiteracy rate at 2.7% (among the population aged 14 years or older; Bureau of the Census, 1948). For the "rural-farm" population the rate was 5.3%; the "rural-nonfarm" rate was 2.4%. In other words, the illiteracy rate for farmers was about twice the national average.

This seems to be a wide gap, but it is important to observe that illiterates constituted a very small proportion of the population whatever the locale (nation, rural-farm, or rural-nonfarm). The failure in many discussions to make that distinction reinforces the prevailing misconception of rural cultural, intellectual, and educational inadequacy.

The Census Bureau itself, however, observed that illiteracy at mid-century was continuing to decline for the nation as a whole, and that economic conditions accounted for the small (and shrinking) rural-urban disparities. The anonymous bureau analyst (Bureau of the Census, 1953) attributed rural illiteracy to three possible causes: (a) outmigration of individuals with more schooling; (b) the exigencies of operating a family farm; and (c) the remoteness of schools. None of these hypotheses reinforced the longstanding message of cultural deficiency identified by Williams (1973).

Data on educational attainment in the 1953 report parallel those for literacy: The median years of formal schooling was 8.5 years in rural farm areas, 9.7 in rural nonfarm areas, and 10.8 in urban areas. Comparable data on educational attainment from 1950 to 2000 in rural versus other areas does not appear to be available. Table 1, the result of library and Internet research, assembles somewhat inconsistent data; changes in the way the Census Bureau has reported educational attainment data reflect the changes that transformed rural areas in the 20[th] century.

About 1950, graduation from high school was hardly the norm among the adult population, and about twice as many urban as rural farm adults had graduated from high school (42% versus 23%). By the end of this time period (1950-2000; see Table 1), the Census had given up reporting farm and nonfarm distinctions, replacing *rural* with *nonmetropolitan*. Educational attainment in metropolitan and nonmetropolitan areas was nearly identical. As farming declined as a rural way of life, high school graduation became the expected norm for all Americans. The slight difference in rates may be the joint result of continuing outmigration among younger residents and the concurrent disproportionately older population in rural areas.

Information about illiteracy and educational attainment show that for much of the 20[th] century, rural Americans were somewhat less schooled than other Americans. However, the comparison is clouded by several ongoing circumstances. Until about 1950 or so, farming did not require a large capital investment; it was widely understood, moreover, that one could farm successfully without graduating from high school. Second, those who did complete high school were more likely to abandon rural areas for urban areas seeking industrial employment or, after receiving university credentials, to take up metropolitan careers (e.g., Berry, 1978/1990; Gruchow, 1995). Third, and as a result of the previous fact, academic talent was exported to the metropolis. Rural areas were a major contributor of human resources to the construction of an industrialized and bureaucratized 20[th] century America, and rural migrants to urban areas shared in the accomplishments there of nonmigrants. Indeed, it is a wonder that rural areas no longer exhibit "deficiencies" in literacy and attainment. We might expect, then, that, overall, rural achievement levels in mathematics should approximate those prevailing elsewhere.

National Assessment of Educational Progress Reports of Rural Mathematics Achievement

The National Assessment of Educational Progress (NAEP) makes it possible to assemble consistent information on the contemporary mathematics achievement of rural students. NAEP has provided comparable reports of mathematics achievement nationally since 1978,[4] and at the state level since 1992, beginning with a state-level "trial assessment" that year.

In the first part of the discussion, we examine national aggregations based on official NAEP reports. These reports provide only descriptive data, but test no theories or hypotheses and cannot by themselves provide much insight into the causes of any observed differences or variations. NAEP nonetheless has been very careful to distinguish statistically nonsignificant from statistically significant differences among states and to provide the basis for making

[2] Illiteracy in Census reports of this time was self-reported inability to read or write among that portion of the population with fewer than 5 years of formal schooling; those with at least 5 years of schooling were presumed to be literate, a presumption applied by the U.S. Army when it screened draftees during the Second World War.

[3] Rural areas for the 19[th] and 20[th] centuries were divided by the Census Bureau into two segments due to the prevalence of agriculture as a way of life: "rural-farm" areas and "rural-nonfarm" areas. The "rural-farm" population included people living on farms (defined as such according to a low annual sales threshold, e.g., $1,000 in 1989); "rural-nonfarm" was the residual rural population. During the course of the 20[th] century, the rural-farm population shrank from about 65% of the rural population to about 6% by 1990, the last decennial census for which the distinction was made.

[4] NAEP began operations in 1969 and produced its first mathematics assessment in 1976. The 1976 data are not comparable to those provided in later years, especially as the U.S. Department of Education assumed management of the program, which had begun under the auspices of the Education Commission of the States.

Table 1
Educational Attainment in the United States for Rural Areas, Urban Areas, and the Nation

Year[a]		Rural Farm[b]	Rural Nonfarm[b]	Nonmetro[c]	Urban/Metro[d]	Nation
1952	(YRS)	8.5	9.7	—	10.8	10.1
	(HS+)	(23.2%)	(35.9%)	—	(42.1%)	(38.4%)
1960	(YRS)	8.8	9.5	9.2	11.1	10.6
	(HS+)	(29.5%)	(34.4%)	(33.2%)	(44.3%)	(41.1%)
1970	(YRS)	10.0	11.8	11.6	12.3	12.2
	(HS+)	(39.9%)	(48.9%)	(47.9%)	(59.3%)	(55.3%)
1981	(HS+)	63.5%	66.1%	65.9%	73.4%	71%
1991	(HS+)	76.8%	—	71.8%	80.1%	78.4%
2000	(HS+)	—	—	80.0%	83.8%	83.1%

Notes. Census Reports P-20, No. 45, Table 12 (1952); PC(S1)-20, Table 76 (1960); P-20, No. 207, Table 2 (1970); P-20, No. 390, Table 7 (1981); P-20, No. 462, Table 10 (1991); and P-20, No. 536, Table 11 (2000).
[a] "YRS" indicates median years of schooling. After the 1970 report, educational attainment was not reported as median years of schooling, but only as percentage of persons completing a specified numbers of years. "HS+" indicates the percentage of persons completing at least 4 years of high school. For 1952, 1960, and 1970, this figure is the sum of the percentages for the relevant categories; parentheses indicate these sums. For 1981-2000, apparently equivalent totals were supplied in the captioned tables. For the 1952, 1960, and 1970 data, the statistics pertain to the population 18 years and older, whereas for the 1981, 1991, and 2000 data, the statistics pertain to the population 25 years and older.
[b] "Rural-Farm" and "Rural-Nonfarm" categories were eliminated with the 2000 decennial census.
[c] "Nonmetro"—a county-level designation—appears first in this series of reports in the 1970 Table. The statistic for 1960 is for "rural total," a designation that does not appear in the captioned 1952 Table.
[d] The "urban/metro" column gives statistics for all urban areas through the 1960 report, and metropolitan statistics (a county-level designation) thereafter.

the distinctions among variously constituted population subgroups.

Interpreting NAEP data requires appreciation of the changes in NAEP administration and design. From 1978 through 1992, NAEP's rural category was "extreme rural" (contrasting "extreme rural," for instance, with "advantaged urban" and "disadvantaged urban" locales). "Extreme rural" was portrayed in NAEP reports from about 1970 as home to farm families and agricultural workers—even as this characterization was becoming less apt. Worse still, the function of locale in this conception was essentially to draw a geographic line around disadvantaged groups: a deficit model of locale.

Starting in 1996, this shortcoming was corrected. For 1996 and 2000, locale breakouts of NAEP data were inclusive of all students, not just an exceptional fraction understood as disadvantaged or somehow deficient. The new categories were "central city" (central cities of Metropolitan Statistical Areas); "urban fringe/large town" (metro areas adjacent to the central cities of 250,000 or more population and towns of population 25,000 to 50,000); and "rural/small town" (nonmetro towns of no more than 25,000 plus outside towns or villages of 2,500 or less and the open countryside in both metro and nonmetro areas).[5]

In 1992, NAEP began to replace its previous assessment system, which provided only national estimates of achievement, with a system that now incorporates state-level estimates. This change provides researchers the opportunity to investigate variability among state systems, including rural within-state comparisons. (NAEP itself reports mean differences but does not usually attempt to sort out relationships among contributing influences.)

[5] See Johnson (1989) and NCES (2002) for further details on the development and use of "locale codes." Johnson provides the original development and the latter citation the current overview, as well as links to numbers of schools, districts, and students by locale. Between 1996 and 2000, however, the methods for assignment of locale codes were altered slightly, to take better account of the "more information about the exact physical location of the school" (Braswell et al., 2001, p. 223).

Table 2
NAEP Scale Scores for 1978-1992, National Means Versus "Extreme Rural" Means

		Year				
Grade	Locale	1978	1982	1986	1990	1992
4	nation	218	219	221	230	218
	extreme rural	212	211	219	231	216
	difference	-6	-8*	-2	+1	-2
8	nation	264	268	269	270	268
	extreme rural	255	258	270	265	267
	difference	-9*	-10*	+1	-5	-1
12	nation	301	299	302	305	299
	extreme rural	295	293	305	304	293
	difference	-6*	-6*	+3	-1	-6

Note. Source for 1978-1990: Stern (1994, p. 110); Source for 1992: (Mullis, Dossey, Owen, & Phillips, 1993)
* = difference significance at $p \leq .05$ (1978-1990 per Stern; 1992 difference computed by author as standard error difference based on reported SEMs ($SEM_{dif} = SQRT[(SEM_1)^2 + (SEM_2)^2]$.

Finally, it is important to recognize that scores generated by the NAEP testing and reporting system are, for each student tested, *predicted* and not actual scores. Each student takes a fraction of the entire assessment, and procedures based on Item Response Theory predict the score a student would have received had the whole test been administered. Nonetheless, there seems to be little doubt that aggregations at the state and national level provide valid and reliable assessments of aggregate achievement levels.

Table 2 reports NAEP data about the mathematics achievement of rural students from the national assessments from 1978 through 1992. Table 3 reports data about rural student achievement from the 1996 and 2000 assessments.

As suggested previously, the 1992 and 1996 "rural" data are by no means comparable, since they represent the performance of substantially different national populations (data in Table 3 for 1996 and 2000 represent, by comparison, slightly different national populations). Observed differences for 1992 and 1996 (+6, +9, and +7, respectively, for grades 4, 8, and 12) are statistically significant at the 8th and 10th grades. These reported differences, however, doubtless are explained by the problematic differences in the two populations (particularly socioeconomic status).

However, two inferences about trends seem evident. First, across 25 years of testing, there has been little change in the mathematics performance of rural students. Second, the performance of rural students differs little from the national average in all this time.

The second claim needs some justification, since Tables 2 and 3 show negative differences in about two thirds of the cases, and this fact might appear to indicate a deficit. But most of the given differences are not statistically significant. For those that are, we can calculate effect sizes. Effect sizes give the change in standard deviation units associated with a treatment or a condition. Moderate effect sizes are in the range of +/- 0.20 to +/- 0.50, with strong effect sizes ranging from +/- 0.50 and up.[6]

What effect sizes do the differences provided in Tables 2 and 3 yield? The largest difference in both Tables is for the 1982 eighth grade (-10, $p < .05$). It represents an effect size of roughly -.25 (based on an approximate standard deviation of 40). For the last 14 years (1986-2000), however, none of the differences attained statistical significance.

On the basis of nearly 25 years of NAEP data, there is little evidence for the claim that rural mathematics achievement is deficient. The observed differences between rural areas and the nation as a whole are small; the practical import of pre-1986 statistically significant differences is doubtful; and observed positive differences are almost as frequent as

[6] Compare to Cohen (1988), who quite reluctantly offered $d = .20$ as "small," $d = .50$ as "medium," and $d = .80$ as "large." His reluctance stemmed from his appreciation of the very diverse research contexts in which the rule of thumb might be applied. With respect to influences on achievement, the authors believe that an effect size of one-half standard deviation merits characterization as "large" and one tenth ($d = .10$) as "small." Roughly speaking, a difference of a full standard deviation on measures of composite achievement is tantamount to a year's difference in learning (but this too is a rule-of-thumb), and an effect of that magnitude ($d = 1.0$) would be not "large" but very nearly *miraculous*.

Table 3
NAEP Mathematics Scores for Rural/Small Town Students, 1996 and 2000

Grade	Locale	Year 1996	Year 2000
4	nation	224	228
	central city	218	222
	urban fringe	229	232
	rural/small town	222	227
	difference	-2	-1
8	nation	272	275
	central city	265	268
	urban fringe	275	280
	rural/small town	276	276
	difference	+4	+1
12	nation	304	301
	central city	301	298
	urban fringe	309	304
	rural/small town	301	300
	difference	-3	-1

Note 1. Because NCES changed slightly the method for assigning type of locale codes between 1996 and 2000, data for 1996 and 2000 are not strictly comparable, though the overall influence of the changes might well be random (as compared to the 1992-1996 change, which was clearly systematic). The comparisons reported here should be regarded cautiously with this complexity in view.

Note 2. Locale means from NCES (2002). National means from Braswell et al. (2001). Differences listed are those prevailing between rural/small town means and national means. None of the differences is statistically significant. Since standard deviations equal about 35 scaled score points, the (nonsignificant) effect sizes can be estimated to vary between .029 and .11. The national sample contains approximately 15,000 students at each grade level, with approximately 25% of the sample at each grade level reported to have attended rural or small-town schools.

observed negative differences (though none of the positive differences proves statistically significant).

Current Research on Math Achievement in Rural Areas

We turn now to empirical studies with an explicit base in theory. The extant literature is indeed thin, but three excellent recent studies nonetheless provide a surprisingly comprehensive picture of mathematics achievement among rural students

Haller, Monk, and Tien (1993). Emil Haller, David Monk, and Lydia Tien examined the 1987-1989 mathematics scores of 10[th] grade students on tests administered by the Longitudinal Study of American Youth (LSAY), a panel study of mathematics and science achievement funded by the National Science Foundation. Previous studies, based largely on different tests and samples among state-level studies, showed no significant difference in test scores for students in small, rural communities compared with national averages. Haller et al. sought to test the hypothesis that those earlier findings were principally the result of norm-referenced tests that lacked items assessing "higher-order thinking." The LSAY tests were constructed using NAEP items and were thus notably different from norm-referenced measures used in the previous literature at that time. Haller et al. detail the way in which the NAEP-developed items more closely reflect achievement related to higher-order thinking. The sample was nationally representative (including nearly 2,300 12[th] grade students from 51 schools). Tests included both mathematics and science.

The issue for Haller et al. was the possible handicap that rural status and small school size—especially the association of smaller rural high schools with fewer advanced mathematics and science courses—might impose on higher-order learning. Controls included in the study's regression analysis included school size, rurality, poverty, advanced course offerings, and enrollment rates in the advanced courses.

Neither rurality nor school size correlated significantly with the outcome measures, including higher-order learning in mathematics. The number of advanced course offerings showed no relationship with either outcome measure, but the degree of student participation in these courses did show such a relationship ($r = + .38$ for mathematics). In regression analysis, the only significant predictor variable was prior achievement. Haller et al. (1993, p. 71) conclude, "While large schools offer more advanced courses than do small ones, those offerings appear to have no influence on average levels of student achievement." As it relates to the often more narrow mathematics curriculum of rural schools, this conclusion is quite provocative, particularly when one remembers that "achievement" included the demonstration of higher-order skills, which Haller et al. (p. 68) define as "identifying and using a problem-solving strategy, screening relevant information, formulating a problem or selecting a model of a problem situation, determining what information would be needed to solve a problem, and organizing given information to represent a problem."

One possible shortcoming of this study is its use of a nationally representative dataset. Regional and state-level conditions (economics, politics, history, culture of education policymaking, and so forth) exert strong influences on schooling. These influences are sufficient to structure sharp differences in student performance and in the conditions of schooling at state and regional levels (e.g., Beeson & Strange, 2000). National data—as in the NAEP reports and in Haller et al. (1993)—answer an important question at the same time that they raise additional questions about variability at levels closer to real experience: regions, states, districts, and schools. In addition, the number of schools involved ($N = 51$) may embed a restriction-of-range problem for rurality and size, although the authors state that schools—not students—were selected in a random sample proportional to enrollment size in 12 sampling strata. Nonetheless, 51 schools seems a size unlikely to capture well the locale or size variability of 25,000 high schools.

Fan and Chen (1999). Xitao Fan and Michael Chen published an assessment of the academic achievement of rural students as compared to suburban and urban students. Their assessment included regional comparisons. They examined test scores for reading, mathematics, science, and social studies using the National Educational Longitudinal Survey (NELS:88) data set. Separate analyses were conducted for 8th, 10th, and 12th grade students. As with the previously considered study, mathematics was one among several achievement outcomes. These researchers sought primarily to test the hypothesis that rural students in the U.S. received an inferior education compared with their metropolitan counterparts, with parity of achievement the criterion. Methodologically, Fan and Chen aimed to overcome five shortcomings of previous studies: sampling issues; inconsistent definitions of locale; and socioeconomic status, ethnicity, and sector as potentially confounding variables.

The analyses were carefully executed and comparatively sophisticated, and the results are simply stated: With careful controls in place, no practically significant differences between test scores existed by locale (rural, suburban, and urban). This includes locale comparisons by ethnicity, region of the nation, grade level, sector, and even for Caucasian students by locale by region. Small, statistically significant differences were found, but with large sample sizes, the effect sizes of these small differences (generally hovering around 0) were judged to be of no practical importance whatever. Marginal means (adjusted for the influence of SES) were higher in private than in public schools, though the authors did not compute ANCOVA statistics for this comparison since between-sector comparisons were not a focus of study. Within sectors, though, there were no meaningful differences by locale (e.g., rural private-school students performed comparably to their urban and suburban counterparts).

The Fan and Chen data exhibit the familiar achievement differences regarding ethnicity and socioeconomic status, but within comparison groups they found few significant differences by locale and none that would be judged as practically important. In sum, looking systematically for differences between rural students and other students, Fan and Chen (1999) found none.

Lee and McIntire (2000). Jaekyung Lee and Walter McIntire used NAEP eighth grade data for 1992 and 1996 to investigate state-level variability in rural versus nonrural mathematics achievement, as well as to investigate the potential influence of six schooling conditions on that variability. Information from 35 states was available for comparison. The study also examined state-level changes for rural and nonrural student segments from 1992 to 1996.

Lee and McIntire's six schooling conditions were derived from perceptions self-reported to NAEP by teachers and principals: (a) instructional resources (percentage of teachers responding all or most to a question about provision of resources for teaching mathematics); (b) professional training (based on 11 NAEP items having to do with training or course-taking); (c) eighth grade algebra offering (one NAEP item: yes or no); (d) progressive instruction (10 items concerning small-groups, calculator use, and so forth); (e) safe/orderly climate (7 items relating to school-level disorder); and (f) collective support (7 items about school-level relationships). This study, among the two others cited, is notable for its specific consideration of mathematics achievement, which allowed the researchers to make hypotheses about, and investigate the variation in, the conditions of mathematics instruction that might influence rural mathematics achievement at the state and national levels.

Lee and McIntire first reported national averages for rural/nonrural comparisons. For 1992, the national-level difference is 265 (rural) versus 267 (nonrural), which was not statistically significant. For 1996, the rural mean was 276 and the nonrural mean was 268. With standard errors of 1.92 and 1.80, the standard error of the difference (5.26) indicates a statistically significant difference in 1996 favoring rural students. The difference equates to an effect size of +0.23. This positive difference (favoring rural students) is equal in magnitude to the largest pre-1986 negative difference between disadvantaged "extreme rural" and the national average, noted previously in the discussion of historical NAEP reports.

Results for the 1992 and 1996 assessments, predictably, varied a great deal at the state level. In some states, the nonrural portion of the population performed better or worse than the rural portion, but in other states there was no significant difference. In fact, in 21 of the 35 states with data for both years, a statistically significant rural vs. nonrural gap did not exist. In the 14 states with such gaps, however, the direction of the difference varied. In half these states, in fact, nonrural student aggregate scores were higher than those of rural students (Georgia, Kentucky, Maryland, North Carolina, South Carolina, Virginia, and West Virginia).

Such state-level differences can be accounted for, at least in part, by differences in the conditions of schooling. These conditions themselves are linked to state-level policies regulating or shaping the way districts, schools, and classrooms operate. In this study, those conditions were limited to the six schooling conditions previously described. Across the 35 state cases, these six conditions account for fully 84% of the variation in state-level NAEP eighth grade mathematics achievement among the rural portions of the respective states' populations; the comparable statistic for the nonrural segment was 69%. According to the Lee and McIntire,

> *Rural students* in states where they have access to instructional support, safe/orderly climate, and collective support tend to perform better than their counterparts in states where they don't. (emphasis added, p. 171)

However, it is important to observe that the magnitude of correlations (of achievement) with the conditions of schooling across the 2 years changed substantially. Progressive instruction, in fact, was moderately related ($r = .52$) to 1992 achievement for nonrural, but not for rural students. Among rural students in 1992, the correlation was $r = .70$, accounting for *nearly 50%* of the variance in state-level achievement, but in 1996, the correlation was a more moderate $r = .50$, accounting for just 25% of the variance in state-level rural achievement (the same as for nonrural students in 1992). The analysis, comparatively fine-grained as it may be, does not permit generalization to future years. Instead, these data provide substantial material for hypotheses in subsequent studies.

Lee and McIntire also correlated state-level differences in rural vs. nonrural achievement with state-level rural vs. nonrural differences in the six conditions of schooling for both 1992 and 1996. The strength of the association of these measures and rural/nonrural difference varies across the years, but the researchers report that the six conditions account for about 45% of the variance in the achievement gap. On this basis, they conclude that parity of schooling conditions is associated with minimizing or eliminating the state-level rural/nonrural achievement gap in states where such gaps exist. The researchers illustrated their conclusion with a contrast of schooling conditions in Connecticut and Virginia: Favorable rural learning conditions existed in Connecticut, where rural students exhibited higher scores than nonrural students. In Virginia, the opposite case prevailed. Of course, rural populations differ significantly by region (USDA, 2000), and the Lee and McIntire analysis did not take such differences into consideration.

Lee and McIntire also examined conditions associated with rural achievement gains from 1992 to 1996. The researchers contrasted 12 states with statistically significant gains for their rural populations with 23 states where such gains were not evident; they concluded that the gains were associated with the conditions of schooling. Such an exhibit (see Lee & McIntire, Figures 2 and 3, pp. 175-76) supplies some warrant for the claim, but a comparatively weak one.

Although not conclusive, the Lee and McIntire analyses illustrate the complexity of the landscape of rural mathematics achievement at state and national levels. In particular, they point out that the most interesting and useful work to be done lies below the national level and ought particularly to address issues of state context.

Conclusions and Extensions

A number of conclusions seem reasonable in view of the foregoing discussion. Together they point to an historical convergence, with prevailing national norms, of educational outcomes in rural places. It seems clear that, since about 1975, this national convergence is reflected in levels of mathematics achievement, whether statistically controlled for the effects of poverty and other influences or not.

Four specific conclusions seem evident. First, over the course of the 20th century, as farming declined as an occupational choice for Americans, gaps in literacy rates and educational attainment rates among rural-farm, rural-nonfarm, and metropolitan areas narrowed, until metropolitan and nonmetropolitan rates of educational attainment had converged by the close of the 20th century, while a national rural vs. urban mathematics achievement gap existed at the start of the last quarter of the 20th century. Second, a national rural vs. nonrural mathematics achievement gap does not now exist, either in the form of a national rural vs. suburban gap nor a national rural vs. urban gap. Third, at the state level, a rural/nonrural achievement gap exists in just 40% of the states, favoring nonrural students in 20% of states and favoring rural students in the other 20% of states. Fourth, conditions of schooling account for about 70% of the variance associated with the rural/nonrural, state-level achievement gap.

These conclusions falsify common assumptions about rural deficiency in mathematics achievement. At least in comparison to national averages, the common assumptions prove to be unwarranted. Of course, if national averages reflect sharp deficiencies in teaching and learning as, say, Stigler and Hiebert (1999) insist, then rural achievement must also be considered deficient—but such a "deficiency" cannot be singled out for special scorn. Additionally, variability is at least as characteristic of rural and small-town schools as it is of schools in other locales. These second thoughts about the meaning of the evidence developed in this review demonstrate that perhaps the significant work is not the repudiation of deficiency but the elaboration of significance that touches on the place of *meaning* in schooling (including the learning of mathematics) and the meaning of *place* with respect to rural schooling. In other words, now that we can dispense with misconstructions of rural performance that damage rural places, what constructions of mathematics teaching and learning are needed to benefit rural places? The answers are not simple—and maybe not even forthcoming—but the questions must be asked.

Rural Mathematics Education: The Place of Meaning and the Practical Meaning of Place

Rural people have struggled under the burden of cosmopolitan portrayals that render them as ill-informed, uneducated, and stupid (e.g., Williams, 1973; Herzog & Pittman, 1995). Jim Goad (1997), in particular, points out that anyone can ridicule rural Appalachians without suffering criticism for unfair discrimination—except from Appalachians, of course, whose complaints need not be regarded seriously by those sponsoring the ridicule. The basis of such safety is cultural power, not (of course) justice.

One seminal sociological study of educational, occupational, and economic attainment among adults with rural origins (Howell, Tung, & Wade-Harper, 1996) found that, historically, the effect of rural origins has been mediated by educational attainment, which in turn was shaped by the expectation of parents and peers for less schooling: "the influences of parents and friends serve to transmit the lion's share of the negative effect of rural origins" (p. 82). In other words, across the entire 20th century, farming culture and limited access to schooling may have been responsible for the observed differences in the educational, occupational, and economic standing of rural versus urban citizens.

Howell et al. (1996) also found that rural-to-urban migration produced a predicted increase of about $3,200 in adult family income (1985 constant dollars), whereas urban-to-rural migration produced a similar *decrease* in predicted adult family income. This finding, combined with the aforementioned convergence in educational attainment and performance in rural as compared to other areas suggests that rural residence alone exerts a negative effect on adult occupational status and income.[7] As Howell et al. conclude,

> One inference from the NLS-72 data is that it seems to be rural areas [per se] that produce lower family incomes rather than the socioeconomic origins or human capital characteristics of persons choosing to remain there or to move there from urban origins. (p. 83)

Allegations of inferiority derive from cultural and ideological dominance, as well as from a long line of misinterpretations of available evidence.

Circumstances of likely interest. Given the finding of approximate achievement parity, it is time, as Kifer (2001) advises, to examine more closely variability within rural contexts. As Lee and McIntire (2000) show, variability exists at the state level, sometimes favoring rural students and sometimes not. We can be certain that conceptually and practically interesting variability is greater still at the district, school, and classroom levels. While some of this variability might be random, much of it is probably not. Some of that variability, in turn, may be related to features of the rural circumstance over which humans might exert some influence for the common good of more and better mathematics learning. Those circumstances may include:

- structural features of the educational system (e.g., class size, school size, district size);
- equity of local resources (e.g., income distribution in the community, parity of instructional resources among district schools, patterns of assignment of the best teachers among a district's schools);
- the local culture of schooling (e.g., the extent to which the school is embedded in the community and vice versa, conceptions of educational purposes and effects);
- intentions of teachers and administrators (e.g., school climate, professional collegiality, relationships among students and between students and educators);
- adequacy of resources (e.g., school funding levels in view of challenges, tax effort, staff turnover); and
- degree of collective purpose (e.g., student-centered focus, extent of tracking, equity of educational outcomes).

Many studies have considered these issues, but practically no investigation of them has as yet been attempted with respect to mathematics achievement in rural schools and districts.

Contradictions, dilemmas, and complexities. Some work related to rural achievement (including mathematics achievement) has been done with respect to the first of these circumstances: structural issues of size and scale (e.g., Bickel & Howley, 2000). This circumstance is important to rural communities because schools and districts are smaller than elsewhere, while state-level consolidation efforts continue to make both schools and districts larger. Interpreting the related findings to policymakers is difficult enough. Suggesting practical courses for policymaking is even more difficult, and that difficulty means that even the most thoughtful policy recommendations will exhibit infidelity not merely to the

[7] Ironically, the GSS analyses suggest *no* systematic effects of migration earlier in the 20th century: During the first three quarters of the century, rural youth moved in great numbers to urban areas in the expectation of social and economic benefits, but this migration is shown by Howell et al. (1996) *not* to have yielded these benefits systematically.

research findings but to a proper (and respectful) research agenda. The slip between cup and lip is not an accident: It is inevitable because the real world is unimaginably complex and contingent.

The relationship of rural lifeways to future research. The American preoccupation with excellence and its comparative disregard for equity have produced a dilemma for rural education. The United States, though perhaps the wealthiest nation on the planet, is also one of the most inequitable among developed nations. Despite this situation, and also because of it, liberal Americans have spent much effort to address the symptoms of inequity—among which are educational outcomes. Thus, as part of the effort to call attention to the nation's real inequities, journalists, practitioners, and researchers have dramatized rural inequities. For that reason, the findings summarized here would probably *not* be considered good news by most rural practitioners, or by many researchers, as they would seem to threaten the established political economy of interest that secures attention to rural issues.

Mean differences, of course, are not the point with research into the conditions of rural education:

> Educational research, unfortunately, often focuses on findings of statistical difference between overall means or averages. Most media reports of results of such research routinely give those differences and little else: they report means and mean differences as though that is all one needs to know in order to understand the findings of the research and what the implications might be for practice. (Kifer, 2001, p. 44)

In fact, qualitative researchers—whose work is seldom considered by popular media—have a better understanding of the importance of locale than many quantitative researchers. Unlike most quantitative researchers, most qualitative researchers are interested to discover and articulate the *meanings* attached to circumstances, places, and experiences. The meaningfulness of rural places (and of rurally attuned educations) is more likely to exhibit itself in variation, interaction, contradiction, dilemma, and even paradox than in simple measures of difference on conventionally (e.g., nationally) valued quantities.

Future research into rural mathematics education must consider, as it frames and pursues salient questions (e.g., about structural features, equity and adequacy, and collective purpose), the meanings of *rural lifeways.* Consideration of these meanings is tantamount to valuing them, since they are—as Raymond Williams (1973) insisted—so widely devalued. In a recent essay on the topic of doing research into mathematics and science education in rural contexts, one observer claimed,

> If you don't respect something, you shouldn't study it. Far from harboring a bias, a respectful stance *actively constitutes objectivity*. The deficit view is a hidden bias that's fatal to the object of study. (Howley, 2001, p. 19)

Respect does not mean approval, but unlike lack of respect, it harbors that possibility.

Quite narrow quantitative studies must also be informed by such meanings. But rather than seeking simple differences, future quantitative studies should consider variation, interactions, dilemmas, and contradictions, for these are the challenges that make practice and improvement difficult—and they make for interesting and valuable research. Such studies, however, are far less likely to unfold without an informative base of qualitative studies that articulate rural meanings in the context of mathematics knowledge at work—in and out of rural schools. As yet, hardly any such research exists, and, for that reason, it is no wonder the existing quantitative research base is so thin.

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