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ABSTRACT

This study examined the issue of whether any differences exist in school achievement among rural, suburban, and urban school students in four major areas of school learning: reading, mathematics, science, and social studies. Data from the National Education Longitudinal Study of 1988 (NELS: 88), which followed a nationally representative sample of 24,500 students from the 8th to the 12th grade, were used. Performance comparisons among rural, suburban, and urban students were made for the nationally representative samples of 8th, 10th, and 12th graders in four areas of school learning: reading, math, science, and social studies. Performance comparisons were made after adjusting for the potential influence of socioeconomic status. Performance comparison analyses were conducted separately for the four major ethnic groups (Whites, Blacks, Hispanics, and Asian Americans and Pacific Islanders) and separately for public and private school students. In addition, performance comparisons of rural, suburban, and urban students were made separately for the four geographic regions of the United States: the Northeast, Midwest, South, and West. Classifications of rural, suburban, and urban schools, and of geographic regions, were based on the 1980 Census classification of the schools from which the students were sampled. The results showed that students from rural schools performed as well as, if not better than, their peers in metropolitan schools in math, science, reading, and social studies. Contains 70 references and 7 data tables. (TD)

Academic Achievement of Rural School Students:

A Multi-Year Comparison with Their Peers in Suburban and Urban Schools

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ABSTRACT

This study examined the issue of whether any differences exist in some major areas of school learning among rural/suburban/urban school students. Data from the National Education Longitudinal Study of 1988 (NELS:88) were used in the study. Performance comparisons among rural, suburban, and urban school students were made for the nationally representative samples of the 8th, 10th, and 12th graders in reading, math, science, and social studies. Several potential confounding variables (SES, ethnicity, public/private schools) were considered in the analyses. The classification of rural/suburban/urban schools was strictly based on the classification of US 1980 census for the schools from which the students were sampled.

The results showed that the rural school students performed as well as, if not better than, their peers in metropolitan schools. The results from this study agreed with the findings of some previous studies which found no rural/suburban/urban differences. The findings of this study, however, were based on data collected on a much larger scale than almost all previous studies. Furthermore, the representativeness of the samples used in the study gave the findings more credibility. The separate analyses for different ethnic groups, and those for the public and private school students, also helped to avoid some potential confounding. These features helped to strengthen the internal as well as the external validity of the findings of the study. Several limitations of the study were also discussed.

For quite some time, there has been a general perception that students from schools of small and rural communities may receive an education that is inferior to that received by students from schools of larger urban and suburban communities, and consequently, rural-urban differences may exist in terms of the students' academic performance. Furthermore, there has been discussion that, not only do rural-urban differences exist with regard to academic performance, but also with regard to many other socially desirable outcomes, such as social concerns, aptitude, intelligence, aspiration, etc. (DeYoung & Lawrence, 1995). This issue of whether real differences in educational outcomes exist between rural school students and their peers in suburban and urban schools has been a topic of debate for many researchers, especially for the educational professionals in rural areas. The very existence of this journal (Journal of Research in Rural Education) attests to the fact that there are issues related to rural education which may have broad social ramifications; academic achievement of rural school students is probably one of these issues.

The concern about potential rural-urban differences in educational outcomes is not limited to this country; but rather, it appears to be a global issue. For example, research studies comparing students from rural and "metropolitan" (urban and suburban) areas on a variety of social, psychological, and educational outcome variables have been conducted in many countries, such as in South Africa (Liddell, 1994; Mwamwenda, 1992), in Nigeria (Akande, 1990), in Australia (Northern Territory Department of Education, Darwin, Australia, 1992), in India (Singh & Varma, 1995), and in Peru (Stevenson, Chen, & Booth, 1990), to name just a few. Because societal conditions with regard to rural-urban differences (e.g., rural-urban differences in cultural, economic, and political conditions) can differ drastically from one country to another, findings from a study conducted in one country may not be generalizable to another. For this reason, in

the present study, we limited our review of the literature and discussion to studies conducted in the United States only.

Not surprisingly, like many other issues in education, the research comparing rural school students with their suburban and urban counterparts in educational outcomes in general, and in academic achievement in particular, has yielded inconsistent findings. While some studies failed to find any statistically significant differences between the rural school students and those in metropolitan areas in academic achievement (Alspaugh, 1992; Snyder & West, 1992. For review, see Edington & Koehler, 1987; Haller, Monk, & Tien, 1992), other studies found that students in metropolitan areas had better performance than their rural counterparts in such academic areas as mathematics, reading, and science, as well as performance on some widely used standardized tests such as the ACT (Coe, Howley, & Hughes, 1989a, b; Edington & Koehler, 1987; Greenberg & Teixeira, 1995; Lindberg Nelson, & Nelson, 1985). Still, in some other studies, students from rural schools were found to have performed better than those from metropolitan areas in academic areas such as reading and mathematics (Alspaugh, 1992; Alspaugh & Harting, 1995; Haller et al., 1992).

Research Related to Different Academic Subjects

Research studies have compared rural school students with those from metropolitan schools on several major areas of academic achievement, including reading, mathematics, science, and social studies. In the area of reading, rural students have been shown to have comparable performance with that of their urban counterparts (Ratekin, 1971), especially for younger students (Liu & Brinlee, 1983). For mathematics, some studies found no differences in math achievement scores (Alspaugh, 1992) or the higher-order thinking skills required for mathematics achievement (Haller et al., 1993). Others, however, found differences in math achievement among school

districts of different size (Wilson, 1985). Lindberg et al. (1985) found that students from small rural schools performed at levels lower than those attending larger schools, and some researchers concluded that such differences may not be due to differences in technological resources (Templeton & Paden, 1991).

Probably because science is an interdisciplinary subject domain involving, among other things, skills of math and reading (Massachusetts State Department of Education, 1987), there is relatively little research on the outcome variable of science achievement, particularly at and below middle school. As discussed by Haller et al, (1992), different aspects of science as a school subject area lie on a continuum in terms quantitative knowledge required. For example. although physics and chemistry may require more mathematics knowledge, the biological sciences (e.g., botany, zoology) are taught primarily through the use of verbal descriptors (i.e., qualitative approach). Another characteristic of science as a school subject is that science is usually considered as a "hands-on" subject domain which requires specialized equipment and supplies -- resources that are more likely to be lacking in rural schools (Coe et al., 1989a, b; Edington, 1979; DeYoung & Lawrence, 1995). It is therefore intuitively appealing that rural students would be at a disadvantage compared to their suburban and urban counterparts. Haller et al. (1992), however, found that neither ruralness nor school size had any effect on mathematics and science achievement, nor on the higher-order cognitive skills required for these subject domains.

Like science, there have been relatively few studies comparing rural students with their suburban and urban counterparts in the area of social studies. Easton and Ellerbruch (1985) examined over 900 13-year olds and observed that students from the extreme rural communities performed slightly lower than the national levels, whereas those from the "disadvantaged-urban" communities scored much further below the national levels. This latter group had a relatively

higher proportion on welfare and higher rate of unemployment. Consistently, those students in the "advantaged-urban" communities, whose parents mostly held professional or managerial positions, scored significantly higher than the national performance levels.

Major Relevant Factors for the Potential Rural-Urban Differences

There are a few factors which have been widely considered as potential contributors to the potential rural-suburban-urban differences in students' educational outcomes: availability of resources, rural-suburban-urban differences in socioeconomic status (SES), and parental expectation and community influence.

Availability of resources. Difference between the rural and urban schools in terms of the availability of resources, e.g., books, computers, art and science supplies, course offerings, and adequately heated or cooled buildings, has been considered by many researchers as one potential contributor to some observed or perceived rural-urban differences in educational outcomes (e.g., DeYoung & Lawrence, 1995; Edington, 1979; Haller et al., 1992; Jones & Southern, 1992; Marion, 1979; McLean & Ross, 1994; Owens & Waxman, 1995, 1996; Thompson, 1990). The availability of fewer resources in many rural schools than those in metropolitan areas (Coe et al., 1989a, b) are often related to more limited curricula for these rural schools (DeYoung & Lawrence, 1995; Hall & Barker, 1995; Haller et al., 1992). Some research findings indicated that the availability of resources did make a difference in students' educational outcomes. For example, Kleinfeld, McDiarmid, and Hagstrom (1985) showed that comparable school achievement was accomplished in Alaska after the oil money made almost all schools technologically modern, regardless of school locality. Such findings lend credence to the argument that the location is unimportant (Liu & Brinlee, 1983) compared to the availability of learning resources.

Socio-economic status (SES). There is some indication that in rural-urban difference studies with regard to educational outcomes, SES may have been playing a role. Socio-economic status has been shown to be positively related to students' school achievement (e.g., Kimble , Cramer, & House, 1976; McIntire & Marion, 1989), and it is perceived that there is a difference between rural students and their metropolitan counterparts in this aspect, with rural students usually having lower SES. Rural and urban students appeared to differ, however, in terms of the impact SES seems to have on their school achievement. Alspaugh (1992) observed that a large proportion of the between-school variance in school achievement among urban schools is associated with the students' SES, while a smaller proportion of the between-school variance in school achievement among rural schools was associated with the students' SES (Alspaugh & Harting, 1995).

Parental expectation and community influence. Community and parental involvement have generally been considered as being positively related to student school achievement and subsequent career choices (Alspaugh & Harting, 1995; Ramos & Sanchez, 1995). As viewed by some researchers, rural students may be at some disadvantage compared with their metropolitan counterparts in these aspects, because small, isolated, and low-SES rural communities often have less community involvement in education (e.g., DeYoung & Lawrence, 1995). But this view is not generally shared by all researchers, some of whom believe that smaller schools have a strong community relationship (Alspaugh & Harting, 1995; O'Connell & Hagans, 1985), which translates into comparable, if not stronger, community support for school education than communities in metropolitan areas (Jones & Southern, 1992; Lloyd, Lloyd, Prain, & Smith, 1994). For example, rural students have been shown to have stronger feelings of belonging, and greater self-concept and self-responsibility, especially in academics (e.g., Morrow, 1989), all of which are positive

factors for enhanced scholastic achievement (Gaspard & Burnett, 1991).

Some researchers believe that parents in the small rural communities often have lower expectations about their children's educational attainment, and subsequently, the students often have lower educational and career aspirations (DeYoung & Lawrence, 1995; Furlong & Cartmel, 1995; Motsinger, 1990; Patterson, 1994; Tompkins & Deloney, 1994; Trice, 1991; Zimbelman, 1987). On the other hand, many of their metropolitan counterparts often adopt the "the sky's the limit" perspective (e.g., Pollard & O'Hare, 1990). Other researchers, however, have found that rural and urban students actually possess comparable career aspirations (Jyung & Miller, 1990; McCraken & Barcinas, 1991), achievement motivation (Willoughby, Arnold, & Calkins, 1981); but rural students often have lower income expectations (McCracken & Barcinas, 1991).

Some Common Weaknesses in Previous Research

A close look at the research literature in this area reveals that there are a few factors which may have contributed to the inconsistent findings about whether there are any real differences in academic achievement between students from rural schools and those from metropolitan areas. The major factors are (1) sampling; (2) inconsistent definition of "rural", "suburban", and "urban" in different studies; (3) failure to take SES into consideration in analyses; (4) failure to consider "ethnicity" as a variable in many studies; and (5) failure to consider the distinction of public/private schools.

Issues related to sampling. One problem which plagues many previous studies is that many studies relied on local or convenience samples (e.g., Edington, 1981; Gaspard & Burnett, 1991; Tack, 1995). As is well known, the use of convenience samples does not lend itself well to the external validity of the research findings (Gall, Borg, & Gall, 1996). In other words, the generalizability of the results from these studies is quite uncertain, and the extent to which the

findings could be generalized to the general student populations is largely unknown. Because of the questionable external validity, it may not be surprising that inconsistency of research findings abounds across studies.

Inconsistent definitions of "rural", "suburban", and "urban" in different studies. This problem appears to be as serious as, if not more than, the problem of sampling discussed above. In many studies, the terms "rural", "suburban", and "urban" were either not clearly defined, or inconsistently defined across different studies. When such terms were defined, it appears that different criteria were involved in the definition, such as school size (e.g., Haller et al., 1992; Kearney, 1994; Melnick et al., 1987), or the size of an area served by a school (e.g., Liu & Brinlee, 1983). Without a clear and consistent definition of these terms, consistency of findings across studies is unlikely to occur.

SES as a confounding variable. It is widely documented that SES is positively correlated with students' academic achievement. Although some researchers considered SES as a potential confounding variable in their investigation about rural-suburban-urban differences in school achievement (e.g., Alspaugh, 1992; Corley, Goodjoin, & York, 1991), many other researchers did not attempt to control for this variable in their studies (e.g., Hall, Kelly, & Van Buren, 1995; Ratekin, 1971). It is likely that the inconsistent treatment of SES in different studies may have caused some inconsistency in the findings.

Ethnicity as a potential confounding variable. Previous studies in this area rarely considered ethnicity of students as a variable while investigating the rural/urban students' academic achievement (e.g., Hall, et al., 1995; McCracken & Barcinas, 1991). Ethnicity of students, however, can be a potential confounding variable in this area of research for two reasons: (1) it is well documented and widely recognized that, for whatever reasons, there are

some persistent and considerable academic performance differences among certain ethnic groups of students in this nation (Fan, Willson, & Kapes, 1996; Reynolods & Brown, 1984); (2) the population distribution patterns in rural/suburban/urban areas are quite different for different ethnic groups. For example, in the national database of the National Education Longitudinal Study of 1988 (NELS:88) collected by the National Center for Education Statistics (NCES), among African-American students, approximately 22%, 28%, and 50% were in rural, suburban, and urban areas respectively, while among Caucasian students, the corresponding percentages were about 35%, 47%, and 18%, respectively. If ignored, such unequal ethnic group population distributions in rural/suburban/urban areas, coupled with the consistent ethnic group differences in academic achievement, could make the water of rural/suburban/urban students' achievement comparison very muddy.

Public/private school as a potential confounding variable. Like ethnicity, the distinction between public and private schools rarely attracted the attention of researchers in this area. Admittedly, most studies probably did not involve private school students, but many studies fell short of providing specific information about this (e.g., Lucas, 1996; McIntire & Marion, 1989). Similar to the variable ethnicity, if a study used samples from both public and private school students, failure to pay attention to the distinction between public/private schools could confound empirical findings about rural/suburban/urban differences for at least two reasons: (1) it has been well documented and widely recognized that there tends to be a persistent difference in academic achievement between the private and public school students, although researchers may not agree about the reasons for the observed difference; (2) the relative distributions of public and private schools in rural/suburban/urban areas are quite different. For example, in NELS:88 database which we used in this study, for the 8th graders in 1988, the percentages of students in

public/private schools in the rural areas were about 97% vs. 3%, while the corresponding percentages in urban areas were approximately 77% vs. 23%. Like ethnicity, such unequal relative distributions of students in public/private schools in rural/suburban/urban areas, coupled with the widely observed difference in academic achievement between the public and private school students, could confound the research results about rural/suburban/urban students' academic achievement.

THE PRESENT STUDY

The present study used the National Education Longitudinal Study of 1988 (NELS:88) to investigate the issue of potential differences in school achievement among rural, suburban, and urban school students. The major objective of this study was to compare the academic achievement of the rural, suburban, and urban school students in four major areas of school learning: (a) reading, (b) mathematics, (c) science, and (d) social studies. This major objective was achieved through the comparison of rural-suburban-urban school students' performance in the four academic areas after controlling for the effect of SES. More specifically, the major objective was achieved through a series of analyses as the follows:

1. Through separate performance comparison analyses for the four major ethnic groups: Asian/Pacific Islanders, Hispanic, Caucasian, and African-American;
2. through separate performance comparison analyses for the public and the private school students;
3. through multiple-year comparison analyses as students progressed from the 8th grade to the 10th and the 12th grade; and
4. through separate performance comparison analyses for the four major geographical regions of the United States (Northeast, Midwest, South, and West).

The present study was designed to overcome the five common shortcomings discussed in the previous sections. First, the issue of non-representative sampling which plagued many previous studies in this area was addressed through the use of the NELS:88 database. In the following Data Source section under Method, the representativeness of the samples used in this study are more fully discussed. The sample representativeness would contribute substantially to the external validity of the study findings.

Second, the problem of non-standard definition of "rural", "suburban", and "urban" was avoided. As discussed above, inconsistent or unclear definition of school locality (i.e., rural, suburban, and urban) might have contributed to the inconsistent findings across different studies. In the NELS:88 database, however, the locality of a sampled school was clearly defined. A school was classified as either rural, suburban, or urban based on the Metropolitan Statistical Area (MSA) concept from the Federal Information Processing Standards as used by the U.S. Census Bureau. The locality classification of a school reflected the school's metropolitan status at the time of 1980 decennial census (NCES, 1994). This standard definition of the locality of a sampled school in the NELS:88 data offers a clear advantage over many previous studies in which such definition was either non-standard, or was not clearly provided.

Third, the potential confounding variable SES received full attention in this study, and its possible effect was statistically controlled in the analyses. The later Analysis section fully describes the analytic procedures for controlling SES. In NELS:88, SES was a composite score based on five variables: father's education level, mother's education level, father's occupation, mother's occupation, and family income. The NCES (1994) provides details about the measurement and construction of this composite variable.

Fourth, as argued previously, ethnicity of the students has the potential to confound the

research findings in this area. Many previous studies either failed to consider this variable, or could not address the issue because inadequate sample size would not permit separate analyses for different ethnic groups. Fortunately, the large database used in this study afforded us the opportunity to investigate the issues separately for the major ethnic group students in the United States. We believe that this approach is necessary under the current societal conditions with regard to ethnic group differences in academic achievement.

Fifth, unlike almost all its predecessors, this study conducted separate analyses for students from public and private schools while investigating the potential differences in school achievement among rural, suburban, and urban school students. As discussed above, it is necessary to address the distinction of public and private schools unless sampled students were only from one type of schools; otherwise, the findings with regard to rural/suburban/urban students' achievement could easily be confounded by the distinction between public/private schools. The large database used allowed us to incorporate this feature in our study design.

Among the five areas of strength discussed above, the first strengthened the external validity of the study, while the other four contributed to the internal validity of the study. In addition to these five areas, two other features of the study further strengthened the study: multi-year performance comparisons for students at the 8th, 10th, and 12th grade, and performance comparison analyses in four major geographical regions of the United States. The multi-year performance comparison analysis helped to examine any potential trend from the 8th to the 12th grade, while the separate analyses for geographical regions provided a mechanism for detecting potential regional differences.

Method

Data Source

The data source for this study was the longitudinal database of the National Education Longitudinal Study of 1988 (NELS:88). The data collection was designed and conducted by the National Center for Education Statistics (NCES), U.S. Department of Education (NCES, 1994). As a large-scale longitudinal database, NELS:88 followed a nationally representative sample of approximately 24,500 students who were in the 8th grade in 1988. Currently, four waves of data are available: data from the base year of 1988 (8th grade), the first follow-up of 1990 (10th grade), the second follow-up of 1992 (12th grade), and the third follow-up of 1994 (two years after high school graduation). The present study used data from the first three waves of data collection (8th- to 12th-grade levels).

Three types of questionnaires (student, parent, and teacher) were administered to each student, one parent of the student, and two of his/her teachers. Achievement tests in reading, mathematics, science, and social studies were administered. Data on a variety of academic, demographic, social, environmental, psychological, and familial variables were collected. This rich longitudinal database offers excellent opportunities for investigating rural/suburban/urban students' differences in academic achievement as students progress from the 8th to 12th grade. The NELS:88 data provides standardized test scores for each of the four areas (reading, math, science, and social studies) on the T-score scale for each wave of data collection (8th, 10th, and 12th grade) (NCES, 1994). These standardized test scores were used as the outcome variables on which rural/suburban/urban students were compared. For technical details concerning these tests, please see NCES (1994) and Rock and Pollack (1991).

Two critical features in the NELS:88 data collection pose some special difficulties for data

analysis of NELS:88: (1) the effect of purposeful oversampling of some ethnic/linguistic minority groups; and (2) the effect of multi-stage cluster sampling design. Before analysis plan could be discussed, these two issues must be addressed.

Oversampling. NELS:88 intentionally oversampled some ethnic/linguistic minority groups so that stable estimates could be obtained for these populations. Such purposeful oversampling creates some problems for data analyses, because the sample would no longer be representative of the general population if the oversampling was ignored in data analysis. Fortunately, researchers in NCES already created weights in NELS:88 data to reflect the fact that each individual sample member in NELS:88 represents a differential proportion of the national student population. Failure to use the appropriate weights would result in biased population parameter estimates (NCES, 1994). In data analyses for this proposed project, the weights were identified and applied according to NCES guidelines (NCES, 1994). In this study, SAS (Statistical Analysis System) was used for data analyses, and all the SAS statistical procedures used in this study permit assigning weights to sample members. As a result, the issue of oversampling for some groups was adequately addressed.

Cluster sampling and design effect. A more difficult sampling issue about NELS:88 data is the effect of multi-stage cluster sampling on the standard errors of sample statistics. In NELS:88 data collection, schools formed the natural sampling units, and students were then sampled within schools. Cluster sampling offers many practical advantages (Scheaffer, Mendenhall, & Ott, 1990), but it also poses many challenges for subsequent data analyses. All general statistical programs (e.g., SAS, SPSS, SYSTAT) assume that the data are collected from a simple random sampling design. The cluster sampling design of NELS:88 violates this assumption and tend to increase the sampling variance of a statistic (Kish, 1965; Kott, 1991; Lee,

Forthofer, & Lorimor, 1989; NCES, 1994). The effect of such increased variance is measured by a quantity called design effect, or deff (Kish, 1965): the ratio of the actual variance estimate of a cluster sample to the variance estimated based on the assumption of simple random sampling on the same data. If this issue, or deff, is ignored in analyses, erroneous decisions in inferential significance testing will result (typically substantially inflating Type I error rate), because a smaller standard error (based on the assumption of simple random sampling) is used in analyses when a larger standard error (from the true cluster sampling) is called for.

To provide a general guidance for dealing with this issue, NELS:88 manual provides the estimated values of deff for many simple estimators. These estimated deffs, though not exhaustive, do provide a sound basis for estimating some other deffs not provided in the manual. As discussed in the manual of NELS:88, ". . . more complex estimators show smaller design effect than simple estimators. Thus correlation and regression coefficients tend to have smaller design effects than subgroup comparisons, and subgroup comparisons have smaller design effects than means. This implies that it will be conservative to use the mean square root design effects presented here in calculating approximate standard errors for complex statistics, such as multiple regression coefficients" (NCES, 1994, p. 91). In this study, this conservative approach was adopted to address this issue. In other words, the most comparable mean deff provided in the NELS:88 manual was used to make adjustment for the standard errors of estimators in the analyses. Although this approach might make most statistical tests more conservative, the relatively large sample sizes involved in many analyses compensated for this conservativeness to a certain degree, because a large sample size will increase the statistical power of the statistical testing.

Analyses

Because there were four outcome variables as indicators of achievement in school learning (reading, math, science, and social studies), and there were three groups (rural, suburban, and school students), a multivariate analysis of variance (MANOVA) was called for as the basic analytic technique. The three waves of data (1988 for 8th graders, 1990 for 10th graders, and 1992 for 12th graders) were treated separately as three nationally representative samples for the 8th, 10th, and 12th graders. This was accomplished by assigning the appropriate cross-sectional weights (these weights are contained in the NELS:88 database) to each sample member for the three waves according to the NCES guidelines (NCES, 1994).

To take into account the effect of socio-economic status (SES) on the students' performance in the four areas of school learning, SES was used as the covariate in the analysis so that its contribution could be controlled while comparing the performance among rural, suburban, and urban school students. In other words, multivariate analysis of covariance (MANCOVA) was used as the analytic technique.

In addition to controlling for the potential confounding of SES, separate analyses were conducted for students from public schools and those from private schools, to avoid the potential confounding of the school type (public/private). In the same vein, separate analyses were conducted for students of different ethnic groups to avoid the potential confounding of ethnicity for the rural/suburban/urban differences. To explore if there were any regional differences with regard to urban/suburban/urban differences in school achievement, separate analyses were also conducted for the four geographical regions when sample size was adequate.

Because the sample size was large for some analyses in this study, small and practically unimportant differences could be declared statistically significant due to the statistical power

contributed by the large sample size. For this reason, multivariate effect size measures were calculated as the supplement to the statistical significance testing. The practice of using effect size measures to supplement statistical significance testing results for interpreting research findings has increasingly been advocated in recent years as a sound educational research practice (e.g., Shaver, 1993; Thompson, 1996). In this study, the multivariate effect size measures were calculated in the form of Wilk's Λ, a measure conceptually related to the widely known R^2 in analysis of variance (ANOVA) or regression analysis (Pedhazur, 1982)[1].

Inevitably, in a large database like NELS:88, a considerable number of subjects would have missing data on some variables used in this study. In our analyses, we did not attempt to account for missing data. Instead, only sample members who had complete data for the variables involved in the analyses were used. For this reason, the usable sample sizes were smaller than those in NELS:88. The sample size reduction due to this reason was minor for the 8th graders (base year of 1988 data collection in NELS:88), but was more pronounced for later two waves of NELS:88 data collection (1990 for the 10th graders, and 1992 for the 12th graders), mainly due to the fact that fewer students took the achievement tests in later grades for a variety of reasons: early graduation, dropping out of school, non-response on cognitive tests, etc. (Owings, J., National Center for Education Statistics. Personal communication,, Sept. 12, 1996).

Results and Discussions

To facilitate the presentation of the results and the related discussion, we made separate presentation for the public school students, the private school students, and for the four major geographical regions.

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[1] As Pedhazur (1982, p.708) shows, $R^2 \approx$ 1-Wilk's Λ.

Rural/Suburban/Urban Comparison for Public School Students

Table 1 to 3 present the performance comparison among the rural/suburban/urban students in the four areas of school learning in the public schools, and for the 8th, 10th, and 12th graders respectively. More specifically, each table contains rural/suburban/urban performance comparison for each of the four major ethnic groups. For each ethnic group, three important pieces of information are provided: (1) the MANCOVA results (both statistical significance testing result and approximate effect size measure) for the three groups (rural/suburban/urban) on the four variables; (2) the analysis of covariance (ANCOVA) results for the three groups for each of the four outcome variable; and (3) the means for the three groups on each of the four outcome variables, and the means were both weighted and adjusted for SES).

Insert Table 1, Table 2, and Table 3 about here

A close look at Table 1 reveals several phenomena. First, different ethnic groups tend to exhibit different population distribution patterns in rural/suburban/urban areas. While the majority of Caucasian students resided in suburban or rural areas, the majority of African-American and Hispanic students were from urban areas. Second, although the MANCOVA tests are statistically significant for all the four ethnic groups for the 8th graders, indicating that there are statistically significant differences among the rural/suburban/urban students when the four outcome variables were considered jointly, the multivariate effect size measures are all extremely small.

Third, the ANCOVA results were statistically significant for some outcome variables of some ethnic groups, but the effect size measures (eta-squares, η^2) are all too small to indicate any practically meaningful rural/suburban/urban differences on the four outcome measures. Fourth,

while the rural/suburban/urban differences are quite small, the differences among ethnic groups are somewhat pronounced, with Caucasian and Asian groups performing better than the African-American and Hispanic groups, regardless of the locality of the schools. Because we conducted separate analyses for different ethnic groups for the purpose of avoiding the potential confounding of ethnicity on rural/suburban/urban differences, the issue of ethnic group differences was not our research objective. So, other than this general observation regarding the ethnic group differences, we did not make any efforts to pursue it any further.

Other than the MANCOVA and ANCOVA results, and the respective multivariate and univariate effect size measures discussed above, the adjusted means of the four outcome variables are very comparable for the rural, suburban, and urban groups. There does not appear to be any consistent indication that rural students performed worse than their metropolitan counterparts, or vice versa, indicating that the rural/suburban/urban differences are almost non-existent for this group of nationally representative sample of 8th graders.

Table 2 and Table 3 convey similar information: the MANCOVA tests are all statistically significant, but the multivariate effect size measures are extremely small. Unlike Table 1, however, the univariate ANCOVA tests on the individual outcome variables for rural/suburban/urban student groups rarely reached statistical significance. In fact, for the 12th graders measured in 1992 (Table 3), none of the ANCOVA tests for rural/suburban/urban differences are statistically significant, despite the huge sample sizes for some ethnic groups (e.g., for Caucasian group). The fact that the multivariate tests are statistically significant while the univariate tests are not is a well-known statistical phenomenon: multivariate tests are usually more powerful than univariate tests (e.g., Stevens, 1993). In this sense, multivariate significance and univariate non-significance do not indicate any contradiction in the results.

Rural/Suburban/Urban Comparison for Private School Students

Table 4 presents the performance comparisons on the four outcome variables for the rural/suburban/urban students in private schools. For the three minority ethnic groups (Asian/Pacific, Hispanic, and African-American), because there were only a few, or even no, usable sample members from rural private schools for the three grades, comparisons between rural and metropolitan private school students for these three groups were almost impossible. For this reason, for private school students, only the rural/suburban/urban comparison for the Caucasian students is presented, because only this group had adequate sample sizes in all the cells.

Insert Table 4 about here

A comparison of Table 4 with the previous Tables 1 to 3 shows that, for Caucasian group, the students from private schools performed better than those from the public schools, regardless of the school locality and grade. As a matter of fact, this is also true for the other three ethnic groups not presented in the table. Because our interest is not about the comparison between private vs. public school students, and we conducted separate analyses for public and private school students only to avoid the potential confounding effect of this variable on the comparison among rural/suburban/urban students, we made no further efforts in this direction.

The information from Table 4 about private schools is consistent with that from the previous three tables about public schools: although the MANCOVA tests are statistically significant, all the multivariate effect size measures are extremely small. Furthermore, none of the univariate ANCOVA tests are statistically significant despite the large sample sizes. The univariate effect size measures for rural/suburban/urban group differences are almost all close to

zeros. Again, the analysis results here indicate no rural/suburban/urban differences in school achievement for private school students.

Rural/Suburban/Urban Comparison in Different Geographical Regions

As described previously, we were interested in looking at the potential rural/suburban/urban differences separately for the four geographical regions of this nation: Northeast, Midwest, South, and West, for the purpose of examining if any regional differences exist with regard to the issues about the potential rural/suburban/urban differences in educational outcomes. This further breakdown of the data into four regions, in addition to the previous breakdown of the data into public/private school students and that into different ethnic groups, caused such reduction of sample size in some cells, especially for the category of rural students, that reliable and stable comparisons among rural/suburban/urban students became questionable. Mainly for this reason, as well as for the consideration of space, we presented only the rural/suburban/urban comparisons for the Caucasian students (the group with adequate sample sizes under all conditions) in the public schools in the four different geographical regions of the nation. (The tables for other ethnic groups, however, are available from the first author upon request.) Table 5 to Table 7 present the rural/suburban/urban comparisons in the four geographical regions for the 8th, 10th, and 12th graders respectively.

Insert Table 5, Table 6, and Table 7 about here

Close examination of Table 5 shows that for the Caucasian students in the public schools, rural/suburban/urban differences in the four areas of school achievement does not seem to exist in the geographical regions of South, West and Northeast. In these three regions, although the

MANCOVA tests are statistically significant, almost all univariate ANCOVA tests fail to reach statistical significance, despite the large sample sizes. Also, the univariate effect size measures (η^2) are close to zeros. In the Midwest region, however, the data appears to favor the students from the rural public schools in all the four areas of school learning, with all the univariate ANCOVA tests statistically significant at the .01 level. The effect size measures, although still quite small, are conspicuously larger than those for the other three regions.

The slight advantage in favor the 8th grade students from the rural schools in the Midwest region (Table 5) seems to be less obvious and less consistent for the 10th graders in Table 6. In Table 6, other than for the Midwest region, practically no rural/suburban/urban differences appear to exist; all the univariate ANCOVA tests are statistically nonsignificant, and the univariate effect size measures are all quite small or close to zeros. The results in Table 7 are less clear for interpretation. In some cases, the 12th graders in rural schools appear to have a slight edge (e.g., Midwest, for Math and Science); but in some other cases, the data appear to favor the urban 12th graders (e.g., South, for Reading and Math). Despite some of these cases, the general conclusion based on the data in Table 7 is that there is no consistent evidence which points to noticeable rural/suburban/urban differences in academic learning.

The analysis results by geographical regions agree with what has been presented in Tables 1 to 4: when the data are analyzed separately for ethnic groups, separately for public and private school students, and separately for the geographical regions, and when school achievement is adjusted for SES, very little evidence has been found that indicates any observable and consistent rural/suburban/urban differences in the four areas of school learning. In cases where such differences are observed, there is a lack of consistency with regard to which group of students (rural, suburban, or urban) the differences favor.

Summary and Conclusions

This study conducted analyses to examine the issue of whether any rural/suburban/urban differences exist in students academic achievement. The study relied on data from the National Education Longitudinal Study of 1988 (NELS:88), a multi-year database from a large and nationally representative sample of students as they progressed from the 8th to 12th grade. Performance comparisons among rural, suburban, and urban students were made for the nationally representative samples of the 8th, 10th, and 12th graders in four areas of school learning: reading, math, science, and social studies. The performance comparisons were made after adjusting for the potential influence of socio-economic status. Performance comparison analyses were conducted separately for the four major ethnic groups, and separately for the public and private school students. In addition, performance comparisons of rural/suburban/urban students were made separately for the four geographical regions of the United States: the Northeast, the Midwest, the South, and the West. The classification of rural/suburban/urban schools, and that of geographical regions, were all strictly based on the classification of US 1980 census for the schools from which the students were sampled for the NELS:88 data.

The findings of this study can be succinctly summarized as follows: the students from rural schools performed as well as their peers in metropolitan areas in the four areas of school learning: reading, math, science, and social studies. The results from this study agree with the findings of some previous studies which found no rural/suburban/urban differences (e.g., Haller et al., 1992; Snyder & West, 1992). The findings of this study, however, were based on data collected on a much larger scale than almost all previous studies. Furthermore, the samples used in this study were generally considered as being nationally representative, which increases the credibility of the findings. The analyses for separate ethnic groups and those for the public and private school

students also avoided some potential confounding, as reasoned in the previous sections. These features help to strengthen the internal validity as well as the external validity of the findings of the study.

Despite the strengths of this study as discussed previously, this study also has its share of limitations. First, although the definition and classification of school locality (rural, suburban, and urban) are clear and consistent based on the criterion used in U.S. census, the data did not allow us to examine those rural schools from those "extreme rural communities", as did some previous studies had done (e.g., Easton & Ellerbruch, 1985). It is possible that students from these "extreme rural communities" may have some deficiencies in their school learning which are not revealed in this study. In the same vein, the data did not allow us to examine those students from the "disadvantaged-urban" schools, usually inner city schools, at the other side of the spectrum (Easton & Ellerbruch, 1985). Second, although the data for the 8th graders were quite complete for the variables used in this study, there was considerable amount of missing data, especially on the four cognitive tests (reading, math, science, and social studies), due to a variety of reasons. The missing data may have made the data for the 10th and 12th graders less representative of the general student population. Although the extent to which the problem of missing data may have distorted the results is unknown, in our opinion, such distortion, if any, should be small, because the findings based on different groups are highly consistent.

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Table 1 8th Grade Rural/Suburban/Urban Students Performance Comparison - Public Schools

Ethnicity	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Asian/ Pacific	Rural	140	51.36[a]	51.66	52.42	50.95	Wilk's Λ=.96*
	Suburban	604	50.73	53.83	51.35	51.65	$R^2 \approx .04$
	Urban	430	49.37	52.98	49.76	49.67	
	ANCOVA Results		F= 3.58	3.11	5.03*	4.43	
			η^2= .005	.004	.007	.006	
Hispanic	Rural	484	44.50	45.15	45.59	44.67	Wilk's Λ=.98*
	Suburban	942	46.41	46.08	46.65	46.05	$R^2 \approx .02$
	Urban	1143	45.05	44.71	44.66	44.55	
	ANCOVA Results		F=12.51*	8.08*	15.27*	8.27*	
			η^2= .005	.004	.007	.006	
Caucasian	Rural	4757	51.56	51.72	52.40	51.60	Wilk's Λ=.99*
	Suburban	5336	51.00	51.22	51.08	50.90	$R^2 \approx .01$
	Urban	1731	50.63	50.63	50.83	50.59	
	ANCOVA Results		F= 7.30*	9.06*	30.18*	10.40*	
			η^2= .001	.001	.005	.002	
African- American	Rural	593	44.73	43.94	44.77	44.85	Wilk's Λ=.97*
	Suburban	580	44.09	44.06	44.00	45.03	$R^2 \approx .03$
	Urban	1208	44.04	43.11	42.57	44.15	
	ANCOVA Results		F= 1.61	4.97*	20.64*	3.12	
			η^2= .001	.004	.016	.002	

* Statistically Significant at .01 level.

a For space consideration, standard deviations are not presented. Even though the scores are on T-score scale (mean of 50, and standard deviation of 10), the standard deviations for the ethnic groups tend to differ, with the three minority groups having somewhat smaller standard deviations (7 to 9), and the majority group (Caucasian) having somewhat larger standard deviation (10 to 11). This phenomenon appears to be consistent across the three grades.

Table 2 10th Grade Rural/Suburban/Urban Students Performance Comparison - Public Schools

Ethnicity	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Asian/ Pacific	Rural	114	52.04	53.36	53.98	52.01	Wilk's Λ=.95*
	Suburban	424	51.32	54.96	53.00	52.19	$R^2 \approx .05$
	Urban	313	50.38	54.01	50.27	50.12	
	ANCOVA Results		F= 1.59	1.64	9.55*	4.35	
			η^2= .003	.003	.019	.009	
Hispanic	Rural	392	46.08	46.12	46.06	46.04	Wilk's Λ=.98*
	Suburban	536	46.63	46.77	46.07	46.52	$R^2 \approx .02$
	Urban	738	46.97	45.76	45.45	46.60	
	ANCOVA Results		F= 1.43	2.43	1.32	.62	
			η^2= .001	.003	.001	.001	
Caucasian	Rural	3962	51.83	52.21	52.65	51.79	Wilk's Λ=.99*
	Suburban	4257	51.52	51.80	51.85	51.60	$R^2 \approx .01$
	Urban	1368	52.24	52.21	52.10	51.99	
	ANCOVA Results		F= 3.46	2.43	7.46*	1.10	
			η^2= .001	.000	.001	.000	
African-American	Rural	455	45.04	44.60	43.80	46.06	Wilk's Λ=.97*
	Suburban	381	45.02	44.89	43.87	46.48	$R^2 \approx .03$
	Urban	504	45.66	44.13	42.64	45.15	
	ANCOVA Results		F= .88	1.17	4.50	3.66	
			η^2= .001	.002	.006	.005	

* Statistically Significant at .01 level.

Table 3 12th Grade Rural/Suburban/Urban Students Performance Comparison - Public Schools

Ethnicity	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Asian/ Pacific	Rural	102	51.12	52.65	51.27	51.55	Wilk's Λ=.97*
	Suburban	391	51.46	55.03	51.99	52.64	$R^2 \approx .03$
	Urban	257	51.06	53.87	50.85	50.40	
	ANCOVA Results		F= .16	3.35	1.29	4.54	
			η^2= .000	.007	.002	.010	
Hispanic	Rural	317	46.40	46.15	46.34	45.97	Wilk's Λ=.98*
	Suburban	451	46.81	46.74	46.11	46.80	$R^2 \approx .02$
	Urban	560	47.81	47.83	46.37	47.80	
	ANCOVA Results		F= 2.90	4.43	.12	4.37	
			η^2= .004	.005	.000	.006	
Caucasian	Rural	3259	51.83	52.53	52.78	52.08	Wilk's Λ=.99*
	Suburban	3227	51.95	52.34	52.66	52.09	$R^2 \approx .01$
	Urban	1078	52.73	52.50	52.26	52.47	
	ANCOVA Results		F= 4.18	.42	1.40	.85	
			η^2= .001	.000	.000	.000	
African-American	Rural	373	44.84	44.95	43.87	46.01	Wilk's Λ=.97*
	Suburban	287	44.87	44.61	42.86	45.90	$R^2 \approx .03$
	Urban	385	45.75	44.37	42.74	45.17	
	ANCOVA Results		F= 1.37	.45	1.94	1.10	
			η^2= .002	.001	.003	.002	

* Statistically Significant at .01 level.

Table 4 8th, 10th, and 12th Grade Caucasian Rural/Suburban/Urban Students Performance Comparison - Private Schools

Grade	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
8th Grade	Rural	321	55.26	55.53	54.21	55.30	Wilk's Λ=.99*
	Suburban	1606	55.69	54.72	54.51	55.85	$R^2 \approx .01$
	Urban	1903	55.89	55.28	54.26	55.50	
	ANCOVA Results		F= .78	2.32	.38	1.00	
			η^2= .000	.001	.000	.000	
10th Grade	Rural	87	57.22	55.85	54.28	54.45	Wilk's Λ=.98*
	Suburban	560	56.93	56.99	56.67	56.51	$R^2 \approx .02$
	Urban	1177	56.96	56.84	55.85	56.34	
	ANCOVA Results		F= .06	1.02	4.14	3.03	
			η^2= .000	.000	.004	.003	
12th Grade	Rural	82	56.17	56.86	55.62	55.77	Wilk's Λ=.98*
	Suburban	418	55.48	57.42	56.37	55.68	$R^2 \approx .02$
	Urban	955	56.63	57.09	55.81	56.77	
	ANCOVA Results		F= 2.65	.37	.69	2.44	
			η^2= .003	.000	.001	.003	

* Statistically significant at .01 level.

Table 5 8th Grade Rural/Suburban/Urban Performance Comparison - Public School Caucasian Students in Four Geographical Regions

Geographic Region	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Northeast	Rural	673	52.68	52.61	53.90	53.30	Wilk's Λ=.98*
	Suburban	1250	52.01	52.72	52.18	52.27	$R^2 \approx .02$
	Urban	216	51.77	51.15	52.49	52.94	
	ANCOVA Results		F= 1.30	2.66	6.59*	2.61	
			η^2= .001	.002	.005	.002	
Mid-West	Rural	1639	52.14	53.24	53.27	52.26	Wilk's Λ=.97*
	Suburban	1651	50.34	50.81	50.65	50.41	$R^2 \approx .03$
	Urban	423	49.96	51.39	50.44	50.55	
	ANCOVA Results		F=18.81*	31.37*	37.22*	18.65*	
			η^2= .009	.014	.017	.009	
South	Rural	1864	50.38	49.83	50.91	50.14	Wilk's Λ=.99
	Suburban	1325	50.63	49.91	50.51	50.10	$R^2 \approx .01$
	Urban	732	49.97	49.54	50.11	49.92	
	ANCOVA Results		F= 1.17	.41	2.05	.14	
			η^2= .001	.000	.001	.000	
West	Rural	581	51.48	51.42	52.11	51.51	Wilk's Λ=.99*
	Suburban	1110	51.57	52.09	51.46	51.31	$R^2 \approx .01$
	Urban	342	51.75	51.75	51.31	50.33	
	ANCOVA Results		F= .09	.93	1.05	1.93	
			η^2= .000	.001	.001	.002	

* Statistically Significant at .01 level.

Table 6 10th Grade Rural/Suburban/Urban Performance Comparison - Public School Caucasian Students in Four Geographical Regions

Geographic Region	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Northeast	Rural	596	53.19	53.45	54.20	54.12	Wilk's Λ=.98*
	Suburban	1062	52.73	53.73	53.56	54.02	$R^2 \approx .02$
	Urban	165	54.58	53.93	53.05	53.82	
	ANCOVA Results		F= 3.53	.28	1.39	.08	
			η^2= .003	.000	.001	.000	
Mid-West	Rural	1500	51.91	53.24	53.36	52.22	Wilk's Λ=.97*
	Suburban	1448	50.67	51.29	51.51	50.84	$R^2 \approx .03$
	Urban	378	51.58	52.38	51.52	53.31	
	ANCOVA Results		F= 6.92*	18.14*	16.71*	15.09*	
			η^2= .004	.009	.009	.008	
South	Rural	1418	50.76	50.34	50.78	50.27	Wilk's Λ=.99
	Suburban	1031	50.97	50.23	50.57	50.36	$R^2 \approx .01$
	Urban	540	51.43	51.24	50.98	51.14	
	ANCOVA Results		F= .93	2.46	.42	1.69	
			η^2= .001	.001	.000	.001	
West	Rural	448	52.51	52.34	53.39	51.42	Wilk's Λ=.98*
	Suburban	716	52.59	52.76	52.41	51.76	$R^2 \approx .02$
	Urban	285	53.16	53.01	54.16	51.29	
	ANCOVA Results		F= .55	.49	4.32	.36	
			η^2= .001	.001	.001	.000	

* Statistically Significant at .01 level.

Table 7 12th Grade Rural/Suburban/Urban Performance Comparison - Public School Caucasian Students in Four Geographical Regions

Geographic Region	Locality	N	Means (Adjusted for SES) Read	Math	Science	Social S.	MANCOVA Results
Northeast	Rural	515	53.15	54.53	55.21	53.38	Wilk's Λ=.98*
	Suburban	845	52.53	53.76	53.19	52.60	$R^2 \approx .02$
	Urban	136	53.71	54.40	53.33	53.56	
	ANCOVA		F= 1.62	1.12	8.54*	1.67	
	Results		η^2= .002	.001	.010	.002	
Mid-West	Rural	1254	51.80	53.40	53.18	52.72	Wilk's Λ=.98*
	Suburban	1092	51.29	51.64	52.22	51.92	$R^2 \approx .02$
	Urban	307	52.12	51.67	51.67	52.82	
	ANCOVA		F= 1.43	13.16*	4.91*	2.63	
	Results		η^2= .001	.009	.003	.002	
South	Rural	1154	50.75	50.67	50.92	50.31	Wilk's Λ=.99*
	Suburban	755	51.25	51.29	51.89	51.25	$R^2 \approx .01$
	Urban	415	52.62	52.33	51.80	51.60	
	ANCOVA		F= 5.77*	5.35*	3.06	3.89	
	Results		η^2= .005	.004	.002	.003	
West	Rural	336	52.96	51.95	53.15	53.11	Wilk's Λ=.99
	Suburban	535	53.76	53.45	54.21	53.30	$R^2 \approx .01$
	Urban	220	53.38	52.94	53.40	53.17	
	ANCOVA		F= .83	2.85	1.62	.05	
	Results		η^2= .001	.004	.003	.000	

* Statistically Significant at .01 level.

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