Inequality of Access to Educational Resources: A National Report Card for Eighth-Grade Math

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This article considers social and ethnic inequality in access to resources for mathematics learning in eighth grade: favorable school disciplinary climate, advanced course offerings, teacher subject-matter preparation, and emphasis on reasoning during classroom discourse. Data are from 41 states and territories participating in the 1992 Trial State Assessment (TSA) of the National Assessment of Educational Progress (NAEP). Socially advantaged students typically had greater access to these resources than did socially disadvantaged students. Access also depended on student ethnicity. However, the degree of social and ethnic inequality in access varied significantly across states. New methods for assessing and displaying state-to-state variation in social and ethnic inequality are illustrated. We argue that “report cards” displaying state differences in student proficiency are, by themselves, misleading; state differences in access to key educational resources provide an important supplement.

During the past decade, U.S. policymakers have increasingly expressed concern that the nation’s schools are failing to prepare students to meet the demands of the modern global economy. In particular, international assessments have revealed serious weaknesses in mathematics proficiency, crucial to new sectors of the economy (see, e.g., Beaton et al., 1996; Medrich & Griffith, 1992; NCES, 1995, pp. 230–231). Inextricably linked to U.S. performance overall are two interrelated features of formal education in the U.S.: its uniquely decentralized governance and persistent social and ethnic inequality.

Decentralization

The authority to construct and fund schools, to establish curricula, to assess learning, and to certify teachers resides primarily in the states and localities. Thus, understanding national levels of student performance requires attention to variability among states and localities in educational resources, processes, and outcomes. Moreover, attempts to improve the national picture must involve state and local initiatives. In this light, it is not surprising that, paralleling the growing interest in the U.S. standing on international assessments, governors and legislators have become increasingly interested in state-to-state comparisons in student proficiency.

Inequality

Social and ethnic inequality in educational achievement constitute a troublesome and enduring aspect of schooling in the U.S. (Berne & Picus, 1994; Mullis, Dossey, Owen, & Phillips, 1993). Large proficiency gaps between students of high and low socioeconomic status and between European-American students on one hand and African-American and/or Hispanic students on the other
have been verified in every major national study of secondary students beginning with Coleman and others (1966). Any attempt to understand or improve national levels of student proficiency must consider these substantial disparities.

Decentralization and inequality are, of course, linked. NAEP reveals significant state-to-state variation in a variety of mathematical domains. It also reveals substantial differences between states in student ethnic background and social status. These demographic differences are strongly implicated in the state-to-state variation in mean proficiency scores.

While most analyses of NAEP focus on student outcomes, this article focuses on student access to key resources for instruction. Specifically, we consider the social distribution of access to these resources. To what extent are these school- and classroom-level opportunities equitably distributed across social groups defined in terms of class and ethnicity? Does equity vary significantly from state to state? Is equity with respect to ethnicity correlated with equity with respect to social background? How is equity related to the general availability of some of the key educational opportunities?

One product of this work is a different kind of “report card” for states than is typically made available to policymakers. The typical report card provides unadjusted differences between states in academic proficiency. This typical report, though conveying some useful information, can easily mislead. It tends to provide an overly negative portrayal of education systems in states with comparatively disadvantaged demographics and an overly rosy picture of education in states with more advantaged students. Moreover, it provides little insight into ways in which policy changes might produce better outcomes.

The report card we sketch compares states on educational opportunities, resources, or processes that are theoretically and empirically linked to outcomes. It reveals the equity with which these are distributed as a function of student social background and ethnicity. It therefore points the discussion toward interventions that would increase the quality and equity of education provision.

Why Focus on Resources Rather Than Student Proficiency?

We do not dispute the value of monitoring state means in student proficiency. Such means give some indication of what students in each state know and can do. But such state means are difficult to interpret and, by themselves, are almost certainly misleading. To understand why requires a brief review of the longstanding debate over the sources of educational inequality and some attention to how that debate bears on state-to-state variation in proficiency.

Home Environmental Inequality

From one standpoint, the school is an essentially neutral learning environment passively allowing sharp inequality in home circumstances to translate into similar inequalities in learning outcomes. Families have long been known to vary substantially in their capacities to provide educational environments that foster school readiness and reading literacy (Fraser, 1959; Wolf, 1968). Such differences are linked to social status indicators, including income, parental occupation, and parental education (Coleman et al., 1966; Peaker, 1967). Parents of high social status are more likely than parents of low social status to have the resources and skills needed to support their children’s academic learning.

If this explanation were completely sufficient to understand observed achievement gaps, variation in student achievement between schools would simply reflect the varied home environments of students attending those schools. Policy interventions aimed at increasing equity might focus primarily on early interventions such as Head Start and on providing support for the families of the most disadvantaged children. Interventions at the classroom or school levels, though perhaps laudable for increasing mean achievement, hold less promise in reducing inequality.

School Environmental Inequality

From an entirely different standpoint, schools are a much more active force, subjecting essentially similar children to dramatically different learning experiences and thereby actively recreating in each new generation a wide intellectual inequality that conforms to the wide inequalities in earnings and occupational prestige. Clear expositions of this view appear in Ryan (1971) and Bowles and Gintis (1976; Kozol, 1991). Tracking (Oakes, 1985, 1990), differential teacher expectations (Rist, 1970; Rosenthal & Jacobson, 1968), varied school ethos or climate (Rutter, Maughan, Mortimore, Ouston, & Smith, 1979), course requirements (Lee & Bryk, 1989), teacher subject matter and pedagogical
knowledge (Finley, 1984; Rosenbaum, 1976), and level of cognitive stimulation in the classroom (Page, 1990; Rowan, Raudenbush, & Cheong, 1993) are aspects of the schooling system often viewed as fostering unequal opportunity and outcomes.

If inequality of schooling were the sole determinant of inequality of educational outcomes, inequality in school mean achievement would reflect school differences in policy and practice. Not surprisingly, those who have emphasized the school as a causal agent in creating educational inequality, while often endorsing compensatory educational policies, have called for sweeping structural reforms in the provision of schooling. These include the elimination of tracking, school finance reform that would equalize spending across rich and poor districts (Berne, 1994), and a recasting of teacher preparation to foster more favorable expectations and more cognitively stimulating instruction for currently disadvantaged students. If the “school effects” explanation were correct, such reforms would reduce or eliminate differences among schools in achievement.

The debate reviewed above leaves school differences in student mean outcomes open to vastly different interpretations. One observer might view an elevated school mean as simply reflecting an advantaged school composition; another would attribute this success to excellent school governance, organization, policy, and instructional practice. Those who study school effects seek to measure key aspects of both student composition and school process to assess the relative contributions of each and to isolate those contributors to achievement that reformers can modify (Fuller, 1987; Lee & Bryk, 1993). Causal inference in such studies is always perilous because student composition and school process are inevitably correlated. Thus, if either student composition or school process are not measured well and included in the analysis, estimates of both will be biased.

Given the difficulty in conducting sound studies of school effects, it is not surprising that schemes designed to hold schools accountable for their mean achievement levels have encountered intense criticism (Willms, 1992). School means that are not adjusted for student composition will typically convey an overly negative picture of school process in those schools with the most disadvantaged students. However, incorporating adjustments for composition typically leads to underestimates of the effectiveness of schools having favorable student composition (Raudenbush & Willms, 1995).

**Implications of the Debate for Interpreting State Variation in Outcomes**

All of the difficulties in interpreting school differences in mean outcomes are amplified when interest focuses on state mean differences. First, state means are simply aggregates of school means—the same means that have been found difficult to interpret in all but the most careful studies. Second, while all of the problems associated with interpreting either unadjusted or adjusted school means are present in adjusting state means, others are added. For example, the association between student composition and school processes will vary from state to state, as we show below, making the problem of finding meaningful adjustments for student composition even more perplexing. And differences in state means will at least partially reflect differences in state policy. Such policy differences may also be correlated with school composition and school process, creating extra uncertainty about the sources of state variation.

Thus, while making good estimates of state mean proficiency appears essential to any picture of the condition of the nation’s education system, state differences in mean proficiency are, by themselves, intrinsically ambiguous at best and misleading at worst because of the inevitable temptation to make groundless causal inferences. We therefore propose a supplement to the typical reporting of results from NAEP.

Our supplement to standard reporting focuses on resources that have been theoretically and empirically linked to student learning. Rather than dwelling on student demography as a source of inequality in achievement, we assess the extent to which states are providing key educational resources to children of varied social and ethnic backgrounds. Assuming that such resources are truly important for learning, information on access to these resources points directly to needed policy debates on the desirability and feasibility of increasing such access, especially to students currently most lacking in access.

**Which Resources Shall Become the Focus of Reporting?**

Ideally, an extensive body of high-quality educational research would identify resources unarguably causally linked to student outcomes.
Next, it would be possible for NAEP to collect high-quality data on valid indicators of these resources. It would then be possible to supplement current data on the social and ethnic distribution of educational achievement with data on the social and ethnic distribution of key resources for learning in each state.

This ideal is not currently achievable. While many studies are providing important evidence on school resources and processes linked to student outcomes (Lee & Bryk, 1993), NAEP currently collects data on a rather limited set of indicators of these resources and processes.

Rather than wait for the ideal to be achieved, however, we have decided to move ahead with currently available data. To be included in our assessment, a resource indicator had to meet three conditions: (a) It had to be associated with student achievement based on past theory and research, (b) it had to be collected in the 1992 Trial State Assessment of NAEP, and (c) the indicator as operationalized in NAEP had to be consistently related to student math proficiency as assessed in NAEP, with the best available controls for student background and school composition. We settled on four indicators: school disciplinary climate, access to high school algebra, teacher preparation (as indicated by the presence of an undergraduate degree in mathematics), and teacher emphasis on reasoning in the classroom.

Preliminary Study

Raudenbush, Fotiu, and Cheong (in press) studied associations among our four school resource indicators and student outcomes within each of the 41 states participating in the TSA. They estimated a hierarchical linear model within each state, viewing students as nested within schools. The analysis controlled for student demographic variables including ethnicity; national origin; family structure; parental education; home environmental variables such as time watching television; mobility (whether a student changed schools during the past two years); and the availability of books, newspapers, and magazines in the home. They controlled type of course taken (algebra, pre-algebra, or other) as a rough proxy for prior mathematics ability. School-level controls included social and ethnic composition, location (urban vs. rural vs. suburban), instructional dollars per pupil, and computing resources. The adjusted coefficients for each of the four resource indicators were then compared across states using Bayes and empirical Bayes methods described in detail in Raudenbush et al. (in press). Given the cross-sectional nature of the data, problems of causal inference are daunting. Nevertheless, the findings gave support to the contention that the four indicators we chose relate as expected to outcomes and therefore constitute reasonable indicators of resources relevant to teaching and learning.

The demographic, family-environment, and school-level characteristics consistently related to math proficiency as expected across the 41 states. Controlling these covariates, key findings were as follows:

- Disciplinary climate (described in detail below) was consistently positively related to math proficiency. There was essentially no variation in the effect of this predictor across states, and the pooled, within-state coefficient was highly and positively significant statistically.
- The coefficient associated with a school offering algebra for high school credit was, on average, statistically significant and negative. To interpret this negative effect, we must recognize that student course taking was also in the model. Thus, the effect represented the expected difference in math proficiency between a student not taking algebra in a school that offered algebra and a student in a school that did not offer algebra. One implication of the predominantly negative effect across the states is that there were at least some students in schools not offering algebra who would have benefited from enrollment in an algebra course had they attended schools that offered algebra. In addition, as taking algebra was, in general, the most powerful single predictor of proficiency, one must conclude that attending a school that offers algebra eliminates a barrier to heightened math proficiency.
- Teacher preparation, as indicated by having majored in math as an undergraduate, was consistently positively and highly significantly related to math proficiency.
- Teacher reported emphasis on reasoning, also consistently positively and significantly related to proficiency, was the single strongest predictor of math proficiency among the four indicators.

An important finding was that residual between-state variation in outcomes was negligible once the covariates and resource indicators were controlled. This suggests that a plausible statistical model that controls even roughly measured student demographics, school composition, and resources for
learning is sufficient to account for nearly all of between-state variation in proficiency. This finding accentuates the importance of understanding access to resources for learning to better understand state differences rather than searching for more predictors of proficiency.

The analysis just reported, based as it is on cross-sectional data, has potential for both positive and negative bias. Prior student ability is only roughly approximated by course assignment and by other student-level variables. Failure to adequately adjust for prior ability may have biased the findings. On the other hand, some of the "predictors" controlled in the analysis may have been endogenous to the outcome or to each other. For example, including an emphasis on reasoning in the analysis may have led to an underestimate of the contribution of teacher preparation because better-prepared teachers were found more likely than other teachers to emphasize reasoning. Similarly, a favorable school disciplinary climate, while likely enhancing teaching and learning, is also likely to respond favorably to effective student teaching and learning.

Despite the elusive nature of causal inference in this kind of study, we see the evidence as encouraging for our purposes. Our choice of resource indicators was based on prior theory and research, not on NAEP data. However, the results of the NAEP analysis encourage us to believe that the indicators of these resources as operationalized in NAEP are reasonable: They consistently behave as expected, given available theory.

In the pages that follow, we describe the sample and measures, describe the analytic approach, report on the social distribution of these four indicators across 41 states, and consider implications for policy and future reporting.

Sample and Measures

Sample

The analyses are based on data from 99,980 eighth graders attending 3,537 schools located in 41 states and territories participating in the 1992 Trial State Assessment in mathematics. Thus, the average state sample included 2,438 students and 86 schools.

Students within each state were selected by means of a two-stage cluster sample with stratification at the first stage. Specifically, schools were first stratified on the basis of urbanicity, minority concentration, size, and area income and then (a) schools were selected at random within strata with a probability proportional to student grade level enrollment, and (b) students were systematically selected from a list of students given a random starting point within schools.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td>African American</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Hispanic American</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Asian American</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Native American</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>European American</td>
<td>0.64</td>
</tr>
<tr>
<td>Parent education</td>
<td>Less than high school</td>
<td>0.36</td>
</tr>
<tr>
<td></td>
<td>High school grad (but no bachelor's)</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>Bachelor's degree</td>
<td>0.26</td>
</tr>
<tr>
<td>Teacher education</td>
<td>No math major</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>Math major</td>
<td>0.43</td>
</tr>
<tr>
<td>School offers algebra</td>
<td>No</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>0.75</td>
</tr>
<tr>
<td>Emphasis on reasoning</td>
<td>No (less than moderate)</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>Yes (moderate or heavy)</td>
<td>0.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>School disciplinary climate</td>
<td>0.00</td>
<td>0.63</td>
</tr>
</tbody>
</table>
Measures

Table 1 lists the variables used and their descriptive statistics. The variables include indicators of student ethnicity and social background and of the four resource indicators of interest.

Student ethnicity and social background. Student ethnicity was categorized as Hispanic, non-Hispanic Black (African American), Asian American, Native American, and European American. Parent education levels included less than a high school degree, high school degree (but not bachelor's), and bachelor's degree. If both parents' data were available, parent education was taken as that of the more highly educated parent. As Table 1 shows, African Americans made up 15% of the sample, Hispanics 14%, Asians 3%, and Native Americans 2%. In the sample, 38% of either the moms or dads of the students held only a high school diploma, and 26% graduated from college.

Resource indicators. Teachers' subject-matter preparation was indicated by a binary variable (the teacher did or did not major in math as an undergraduate); 43% of the students had teachers who did major in math. Teacher-reported emphasis on reasoning in the classroom was also binary (an indicator for moderate-to-high emphasis vs. less-than-moderate emphasis). For short, we shall say that the teacher either did or did not emphasize reasoning during mathematics instruction; 46% of all students had teachers who did emphasize reasoning. Availability of algebra was a binary variable (the school either did or did not offer algebra to eighth graders for high school credit); 75% of the students attended a school that did offer algebra for high school credit. School disciplinary climate was a scale created from principal questionnaire items indicating the extent to which each of the following was a problem in the school: tardiness, absenteeism, cutting classes, physical conflicts, drug and alcohol use, teacher absenteeism, race or cultural conflict. Each item was first standardized, and the scale was constructed as the average of the nine standardized scores. Average Cronbach's alpha for the 41 states was 0.79.

Analytic Approach

In modeling the relationship between student demographic background and educational resources, our analysis strategy depends on whether the educational resource in question was measured continuously or dichotomously. School climate was measured continuously. Dichotomous resources included school course offering (1 = school offers high school algebra, 0 = school does not offer high school algebra), teacher education (1 = teacher majored in math, 0 = teacher did not major in math), and emphasis on reasoning in the classroom (1 = high or moderate, 0 = other).

Model for the Continuous Outcome
(Disciplinary Climate)

The method of estimation for the model studying school climate involves a two-level hierarchical linear model (Bryk & Raudenbush, 1992) with students nested within states. Robust standard errors were computed using the generalized estimating equation approach of Zeger, Liang, and Albert (1988). These standard errors are relatively insensitive to misspecification of the variances and covariances at the two levels and to the distributional assumptions at each level. State-specific effects were estimated via empirical Bayes (Morris, 1983; Raudenbush, 1988).

Specifically, we estimated a within-state model in which ethnicity, parent education, and the ethnicity-by-parent interaction predicted school climate. Ethnicity was represented by four dummy variables and parent education by two dummy variables. Allowing for the ethnicity-by-parent interaction effect enabled us to model access to resources for each subgroup (e.g., African Americans of low, middle, or high parent education). We allowed coefficients for the parent education dummies and for African-American and Hispanic-American ethnicity to vary randomly over states, thus allowing state-by-state comparisons. Sample sizes of Asian Americans and Native Americans were, unfortunately, too small to allow such a fine-grained analysis.

Models for the Dichotomous Resource Indicators

The same explanatory model for the school climate was specified for each dichotomous outcome. In this case, however, we used a two-level logistic regression model, estimated by penalized quasi-likelihood (Breslow & Clayton, 1993), with robust standard errors. Such a model is equivalent to a 2 x 3 x 5 x 41 contingency table with 2 levels of the outcome, 3 levels of parent education, 5 levels of ethnicity, and 41 levels representing states.

Results

We now consider the degree of ethnic and social equality in access to the four resources of interest.
Specifically, we ask the following questions for each resource indicator:

- Averaging within the 41 states participating in the TSA, to what extent do student social background, as indicated by parental education and student ethnicity, predict access to the resources?
- Does the degree of inequality in access vary by state? And if so, how do the 41 states compare?

**Results Averaged Across States**

*School disciplinary climate.* Figure 1 gives the graph of the fitted model in which ethnicity and parental education predict access to favorable disciplinary climate. The figure shows that higher levels of parent education are clearly linked to more favorable disciplinary climate. The near parallelism of the five lines (with the exception of the line for Native Americans, which is based on a comparatively small sample) reflects the absence of any statistical evidence of a two-way interaction involving parental education and ethnicity. There is a substantial significant vertical displacement between ethnic groups. Pairwise comparisons using a Bonferroni adjustment to control the family-wise Type I error rate at the 5% level indicated four separate clusters of means (in descending order of magnitude): (a) European Americans, (b) Asians and Native Americans, (c) Hispanics, and (d) African Americans. Given that the school climate outcome had a mean of 0 and a standard deviation of 0.63, the differences manifest in Figure 1 are nontrivial in magnitude: About 0.20 standard deviation units separate those with parents having a bachelor’s from those whose parents without a high school diploma; nearly half a standard deviation separates European Americans and African Americans. Because there was no evidence of interaction effects, we re-estimated the model excluding the interaction terms. The regression coefficients and standard errors for the trimmed model appear in Table 2.

*Access to high school algebra.* Figure 2 plots the predicted probability of attending a school that offers high school algebra for eighth graders as a function of parent education for each of the five major ethnic groups under study. We see that parent education is positively associated with the probability of attending such a school. As in the case of climate, the near parallelism of the five lines reflects the absence of any statistical evidence of a two-way interaction involving parental education and ethnicity. Again, we find a significant vertical displacement between ethnic groups. Pairwise comparisons using a Bonferroni adjustment to control the family-wise Type I error rate at the 5% level indicated three separate clusters of ethnic group probabilities (in descending order of magnitude): (a) Asians; (b) European Americans, African Americans, and Hispanics; and (c) Native Americans. The differences manifest in Figure 2 are comparatively

![Figure 1](image1.png)

*FIGURE 1. Predicted school disciplinary climate as a function of parent education and ethnicity.*
TABLE 2
Results for Models of Social Distribution of Educational Resources

<table>
<thead>
<tr>
<th>α</th>
<th>Resource indicator</th>
<th>School climate</th>
<th>Offering of algebra</th>
<th>Teacher with math major</th>
<th>Emphasis on reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(\hat{\alpha} \text{ (r.s.e.)} )</td>
<td>(\hat{\alpha} \text{ (r.s.e.)} )</td>
<td>(\hat{\alpha} \text{ (r.s.e.)} )</td>
<td>(\hat{\alpha} \text{ (r.s.e.)} )</td>
</tr>
<tr>
<td>Intercept</td>
<td></td>
<td>-0.000 (0.025)</td>
<td>1.191 (0.154)</td>
<td>-0.265 (0.065)</td>
<td>-0.199 (0.042)</td>
</tr>
<tr>
<td>Main effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American (AF)</td>
<td>-0.297 (0.034)</td>
<td>-0.183 (0.108)</td>
<td>-0.019 (0.086)</td>
<td>0.027 (0.068)</td>
<td></td>
</tr>
<tr>
<td>Hispanic American (HA)</td>
<td>-0.162 (0.031)</td>
<td>-0.171 (0.069)</td>
<td>-0.110 (0.060)</td>
<td>0.015 (0.035)</td>
<td></td>
</tr>
<tr>
<td>Asian American (AA)</td>
<td>-0.084 (0.023)</td>
<td>0.193 (0.060)</td>
<td>0.058 (0.100)</td>
<td>0.243 (0.243)</td>
<td></td>
</tr>
<tr>
<td>Native American (NA)</td>
<td>-0.084 (0.029)</td>
<td>-0.287 (0.102)</td>
<td>0.202 (0.121)</td>
<td>-0.066 (0.104)</td>
<td></td>
</tr>
<tr>
<td>High school (HS)</td>
<td>0.058 (0.008)</td>
<td>0.102 (0.024)</td>
<td>0.136 (0.032)</td>
<td>0.257 (0.030)</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree (BA)</td>
<td>0.122 (0.013)</td>
<td>0.244 (0.034)</td>
<td>0.251 (0.037)</td>
<td>0.534 (0.037)</td>
<td></td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AF × HS</td>
<td></td>
<td>-0.098 (0.078)</td>
<td>-0.136 (0.055)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AF × BA</td>
<td></td>
<td>-0.165 (0.122)</td>
<td>-0.318 (0.067)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI × HS</td>
<td></td>
<td>-0.079 (0.057)</td>
<td>-0.232 (0.074)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI × BA</td>
<td></td>
<td>0.007 (0.084)</td>
<td>-0.336 (0.091)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS × HS</td>
<td></td>
<td>0.188 (0.082)</td>
<td>0.223 (0.158)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS × BA</td>
<td></td>
<td>0.176 (0.126)</td>
<td>0.166 (0.181)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA × HS</td>
<td></td>
<td>-0.467 (0.167)</td>
<td>-0.171 (0.154)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA × BA</td>
<td></td>
<td>-0.371 (0.241)</td>
<td>-0.273 (0.204)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Robust standard error.

modest in magnitude.

We dropped the interaction terms, and Table 2 gives the pooled regression coefficient estimates and their robust standard errors based on the trimmed model. The regression coefficients for the predictors give the associated partial effects in terms of log odds. Besides computing predicted probabilities based on the regression coefficients, one could compute odds ratios as well. For instance, the odds ratios of offering algebra for a school attended by a

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FIGURE 2. Predicted probability of assignment to a school that offers algebra as a function of parent education and ethnicity.
student whose parent had less than high school education versus a school attended by a student whose parent had college education is \( \exp(\tilde{\alpha}_{BA}) = \exp(-0.244) = 0.784. \)

We now turn to two classroom-level resources for learning: teacher subject-matter preparation as indicated by having majored in mathematics and a cognitively stimulating environment as indicated by an instructional emphasis on mathematical reasoning. In both cases, we find that social background (as indicated by parent education) and ethnicity are linked to access to the resource. However, the findings are more complex than those reported above in that, in the case of these two classroom-level resources, a two-way interaction is manifest.

Teacher preparation. Figure 3 plots the predicted probability of encountering a math teacher who majored in math as a function of social background and ethnicity. The figure shows that higher levels of parent education are linked to a higher probability of encountering such a teacher. However, the magnitude of this relationship depends on ethnicity. The link between social background and teacher preparation is strongest for Asians and European Americans and weakest for Hispanics and Native Americans. Equivalently, we can say that ethnic gaps in access to the resource are manifest, but are more pronounced at higher than at lower levels of parent education.

**Emphasis on reasoning.** Figure 4 plots the predicted probability of encountering a math teacher who emphasizes mathematical reasoning during instruction. Again, there is a positive relationship between parent education and this probability, but again, the magnitude of this association depends on ethnicity. The link between parent education and access to reasoning is strongest for Asians and European Americans and weakest for the other three groups. Equivalently, just as in the case of teacher preparation, we can say that ethnic gaps in access to the resource are manifest, but are more pronounced at higher than at lower levels of parent education.

**Summary.** In sum, we find evidence of ethnic and social inequality in access for all four resource indicators when averaging across the 41 states. Main effects of both ethnicity and social background generally parallel previous findings in predicting student achievement. Thus, just as high parental education predicts favorable outcomes, it also predicts access to schools with favorable climates, schools that offer algebra, teachers with training in mathematics, and classrooms that emphasize reasoning. Similarly, ethnic groups disadvantaged in outcomes (African Americans, Hispanic Americans, and Native Americans) also encounter less access to these resources for learning.
State Variation in Access to Resources

The pooled, within-state findings regarding social and ethnic inequality in access to a favorable school climate provide an on-average picture of inequality in access to resources over 41 states. However, these on-average results poorly represent the picture that we find in many states. In fact, the data reveal substantial evidence of state variation.

The case of school disciplinary climate illustrates the substantial variation across states. Figure 5 plots 95% bivariate confidence ellipses for the 41 states where the vertical axis is social inequality (as indicated by mean gaps in school climate between students having parental education of a bachelor’s and less than high school) and the horizontal axis is ethnic inequality (as indicated by mean differences between African Americans and European Americans). Four features of the scatter plot of ellipses are noteworthy:

- First, there is a rather strong negative relationship between parent education “gaps” and ethnicity “gaps.” That is, states with a high degree of social inequality tend also to exhibit a high degree of ethnic inequality. New York is a case in point; lying in the upper left quadrant, New York has a “parent education gap” of about 0.30 points (half a standard deviation) and an “ethnicity gap” of around 0.60 (a full standard deviation).
- Some degree of inequality is present in nearly all states. This inference is based on noticing that nearly the entire scatter of ellipses lies above zero on the vertical axis (indicating positive parental education effects within states) and below zero on the horizontal axis (indicating that African-American ethnicity is associated with lower levels of disciplinary climate).
- However, the magnitude of inequality varies quite substantially across states. There is a cluster of states near the origin (the point indicating equality of both parent education and ethnicity). There are also states far from the origin (e.g., New York, New Jersey, California, Massachusetts), implying substantial inequality in access to favorable disciplinary climate in these states.
- There is considerable overlap among the ellipses, making it hard to distinguish many pairs of states and, in fact, making pairwise comparisons confusing. However, the ellipses of any pair of states can be shaded (as is Michigan’s ellipse in Figure 5) to facilitate a desired pairwise comparison. Using computer graphics, it is easy to highlight any subset of states to generate clearer comparisons.

The value of the ellipses is that they automatically communicate the degree of uncertainty about rankings among states. Consider, for example, Michigan and Ohio. Ohio is characterized by significantly greater ethnic inequality than Michigan is; that is, the gap between European Americans
and African Americans in the disciplinary climates they encounter is statistically greater in Ohio than in Michigan, as indicated by the fact that the two ellipses do not overlap on the horizontal axis. However, the two states do not differ in social inequality, as indicated by the fact that their ellipses do overlap on the vertical axis.

**Excellence versus equality.** It is also possible to plot "excellence" (high levels of a resource) against "equality," as depicted in Figure 6. The figure shows, for example, that New Jersey, though displaying a comparatively high degree of ethnic inequality, has one of the highest average levels of disciplinary climate. Equality is not a good thing if environments are equally bad; South Carolina and Mississippi exhibit low levels of inequality but also low average levels of disciplinary climate.

For the other resources, the pooled results also
poorly represent the degree of inequality in some states. Again, the data reveal substantial evidence of state variation. It is possible and generally useful to describe state-to-state variation in access to these resources as we did in the case of school climate (Figures 4 & 5). However, a detailed discussion of differences among the 41 states on all resources goes beyond the scope of this article.

Conclusions

The Trial State Assessment of NAEP reports mean student proficiency in a given subject for each of the participating states, broken down by ethnicity and parent education (cf., Mullis et al., 1993). Although reports of state means are essential as part of an assessment of the condition of education in the U.S., we have argued in this article that such
state means, by themselves, are difficult to interpret and even misleading. The means reflect an unknown mix of contributions from student demographics, school organization and process, and state policy. To supplement the reporting of means, we have proposed a reporting of the access that states provide to key resources for learning. Knowing the extent to which states provide these resources to students of varied social background and ethnicity points toward sharply defined policy debates concerning ways to improve education. The results of our analysis are both substantive and methodological.

Substantive Findings

Our results indicate substantial inequality in access to resources, on average, over the 41 participating states. Social background, as indicated by levels of parental education, is significantly related to access to a school with a favorable disciplinary climate and a school that offers high school algebra for eighth graders. Social background also predicts the probability that an eighth grader will encounter a teacher who majored in mathematics and a teacher who emphasizes reasoning during mathematics instruction. These effects of social background are adjusted for ethnicity.

The results for ethnicity parallel those for social background, although they vary to some degree by the resource of interest. For example, with respect to school disciplinary climate, European Americans encounter, on average, the most favorable disciplinary climates; Asians and Native Americans are next, followed by Hispanic Americans, and finally by African Americans. The probability of attending a school that offers algebra is distributed a little differently: Asian Americans experience the highest probability of attending such a school; European Americans, African Americans, and Hispanic Americans are next most likely to attend such a school; and Native Americans have the lowest probability of attending such a school. These effects of ethnicity are adjusted for social background. The results for teacher preparation and emphasis on reasoning are more complex: Ethnic gaps in access are greatest at highest levels of parental education, with Asian Americans and European Americans having greater access than other groups to each resource.

In sum, we have found substantial evidence of inequality in access to these resources as a function of social background and ethnicity. However, there is also substantial variation across states in the extent of inequality. While some degree of both forms of inequality appears to exist in nearly all states, inequality is much more pronounced in some states than in others. Moreover, the overall level of availability of each resource also varies from state to state. While a fine-grained analysis of state differences on all four resources would be of interest, such a study goes beyond the scope of this article. However, we have suggested ways in which state differences might be examined.

The policy implications of these findings vary as a function of the resource in question. Whether a school offers algebra to eighth graders is amenable to direct influence by state and district policy. The key impediment to offering algebra in a given setting is cost. It is generally more costly for smaller schools than for larger schools to diversify their curricula. Similarly, hiring teachers with serious college-level preparation in mathematics is under the direct control of policy, with cost again being a key impediment.

Constructing a favorable disciplinary climate, in contrast, is only partially under the control of policymakers. Effective adult leadership in a school setting is arguably the primary ingredient in creating such a climate, although the active participation of students and parents is also required for success. Skill, knowledge, and commitment are required, and there is considerable uncertainty in how to foster the needed efforts. Similarly, a decision to emphasize reasoning is in the hands of the teacher, depending on the teacher's knowledge, skills, and evaluation of student needs. Interventions to encourage instruction that emphasizes reasoning are currently widespread, but the outcomes of such interventions are inevitably uncertain.

In sum, how information from a report such as ours ought to influence the policy debate will vary as a function of the kind of resource in question. Options for increasing access to certain resources must be evaluated in terms of cost and feasibility. Our primary point, however, is that systematically collected data on access to key resources, as a supplement to reports of mean proficiency, ought to constitute an important input into policy debates regarding educational reform.

Methodological Implications

The educational resources considered here clearly constitute a small subset of those that ought to be studied. We have reasoned that the resources
of key interest are those suggested by prior theory and research and operationalized in NAEP. There should also be some evidence that the NAEP indicator of the resource relates as expected to key educational outcomes. The logic of this argument is to extend NAEP to include a wider range of possible resources than are now included and to take some pains to ensure that the resource indicators achieve a modicum of construct validity.

A promising avenue for future research is to develop more sophisticated models to explain variation in access to key resources. School district wealth, urban versus suburban versus rural location, school size, student expenditures, and school social composition may shape the probability that resources will become available to a student and may shed light on impediments to increasing access and new targets for intervention by policy. Our broad recommendation is that, as we assess student progress in subject-matter proficiency, we also assess the extent to which the education system provides resources that support such student progress.

Notes

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1For brevity, we shall refer to the participating jurisdictions as “states.”

2Student advantage is typically positively correlated with effective school process. Analyses that control student demographics without incorporating good measures of school process will overestimate the importance of student background, thus leading to overly severe adjustments for student background and thereby underestimating the effectiveness of schools serving advantaged students. Rarely do school accountability studies measure key aspects of school process.

3The mean differences associated with social inequality are adjusted for ethnicity, and the mean differences associated with ethnicity are adjusted for parent education. The 95% confidence ellipses are based on the empirical Bayes posterior distribution (Morris, 1983) of the parent education and ethnicity coefficients for each state.

References


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