

Student Mobility: The Forgotten Variable in Assessing School Performance

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During the decade of the 1980's, forty states enacted new testing programs. The vast majority of these programs focused on accountability which is most often defined as comparing schools or districts on standardized tests. In many cases, schools are stratified into groups based on some number of input variables and then compared. This approach assumes that grouping variables are relevant to the outcomes being reported and has serious limitations when there is consistent one-directional variance on the grouping characteristics within the group (Webster and Edwards, 1993), but that's another issue. The most common grouping characteristics used are ethnic makeup, some measure of economic status, and some measure of limited English proficiency (Guskey and Kifer, 1990). The authors are unaware of any system where a measure of student mobility is a major contributor (> 10%) to the stratification.

The State Academic Excellence Indicator System in Texas, originally patterned after California, is an example of these new accountability systems. Currently, the classification variables used are percent economically disadvantaged (40%), percent minority (40%), District wealth (10%), percent limited English proficient (5%), and student mobility (5%). While avoiding the temptation to discuss at length the methodological limitations of this system, the Committee that recommended these weights stated that mobility was weighted low because a satisfactory measure of mobility was not available on a Statewide basis (TSBOE, 1991).

Definitions

For purposes of this paper, mobility rate is defined as the number of annual transactions (transfers in, transfers out, withdrawals, and admission of new District students) divided by the average daily membership of the school. Stability rate, a related statistic, is defined as the number of students continuously enrolled between the end of the first and fifth six weeks divided by the average daily membership of the school.

Relationship Between Mobility and Achievement and Other Outcome Variables

A number of studies have attempted to support or refute the relationship between important outcome variables and mobility. Many of these studies offer apparently conflicting results. A clue to the reasons for these conflicting results can be gleaned from a study completed by the Cleveland Public Schools (CPS, 1989). In that study, stable students (defined as being enrolled for at least 178 days and not transferring from one school to another) exhibited the following characteristics when compared to less stable students: (1) higher family income; (2) higher attendance rate; (3) more likely to be tardy; (4) more likely to have lower suspension rates; (5) less likely to have withdrawn from or dropped out of school; (6) more likely to be promoted; (7) over twice as likely to have received one day of reading diagnosis and to be in more than one reading project; (8) more likely to have taken the standardized, citywide reading test at the secondary level, (9) likely to have higher scores on reading achievement and competency tests; and (10) likely to have higher scores on mathematics achievement tests. Thus, there are many contributing factors to poor achievement that are characteristic of highly mobile students. Because of this complex relationship, results of mobility studies vary from attributing direct impact on achievement (Boloz and Vanati, 1983; Benson and Weigel, 1981; Reynolds, 1990; Ingersoll, 1988) to finding some impact on achievement (Gilchrest, 1970), to finding greater impact on achievement among lower economic level students

(Ingersoll, 1988; Faunce and Murten, 1966), to finding no impact on achievement (Fernandez, 1987; Stuhr and Wright, 1968; Atlanta Public Schools, 1972).

This paper examines the relationship between academic achievement and mobility. It hypothesizes that the inconsistent support of the relationship in the literature may be attributable to three methodological issues: (1) the measures of mobility, (2) inadequate mathematical representations of the relationship, and (3) inappropriate analyses of the relationship when schools are used as units of analysis.

Method

Design and analysis. Three different approaches were used to examine the relationship between academic achievement and mobility and between academic achievement and stability. The first merely examined, by grade level, the differences in measured achievement between mobile and non-mobile students. Mobile students were defined as those students who changed schools at least once during the school year. The second approach examined simple correlations among mobility, stability, and various achievement measures. Finally, weighted least squares was used to examine the relationship between achievement and several predictors: mobility, ethnicity, economic status (as measured by free or reduced lunch), limited English proficiency, and the first-order interactions among these variables. The descriptive and correlational analyses were done separately for K-6, 7-8, and 9-12 grade levels.

The weighted least squares approach was used to analyze data from schools with kindergarten through sixth-grade students. (A weighted least squares approach was used because the schools, the units of analysis, differed with respect to their student enrollments.) After the criterion and predictor variables were standardized and weighted by the schools' enrollments, forward stepwise regressions with entry levels of 4.0 were used to identify significant predictors of mathematics achievement; reading achievement;

and, composite achievement. The three regressions were performed on the following model.

$$Y_{Nx1} = X_{Nx p} \beta_{px1} + \epsilon_{Nx1}$$

where

$$Y_{Nx1} = [y_i]$$

$[y_i]$ is a $N \times 1$ column vector where y_i represents the Spring 1993 reading, math, or composite mean NCE for school i ; N represents the number of schools;

$$X_{Nx p} = [x_{ip}]$$

x_{ip} represents the Spring 1993 value of predictor p for school i ; the predictors include mobility rate, stability rate, % low income, % minority, % limited English proficiency, and all first order interactions among these predictors;

$$\beta_{px1} = (X' V^{-1} X)^{-1} (X' V^{-1} Y)$$

matrix solution for $Y_{Nx1} = X_{Nx p} \beta_{px1} + \epsilon_{Nx1}$;

where

$$V_{NxN} = [1/n_i] I_{NxN}$$

$[1/n_i]$ is a $N \times 1$ column vector; n_i represents the student enrollment for school i ; I is a $N \times N$ identity matrix;

$$\epsilon_{Nx1} = [\epsilon_i]$$

$[\epsilon_i]$ is a $N \times 1$ column vector; ϵ_i represents the residual for school i ; and,

$$E(\epsilon) = \mathbf{0},$$

$$V(\epsilon) = V_{NxN} \sigma^2, \text{ and}$$

$$\epsilon \sim N(\mathbf{0}, V_{NxN} \sigma^2).$$

Instrumentation. Measures of student achievement were attained from the *Iowa Tests of Basic Skills (ITBS)*, grades 1-8, the *Tests of Achievement and Proficiency (TAP)*, grade 10, the *Texas Educational Assessment of Minimum Skills (TEAMS)*, grades 3, 5, 7, 9 and 11, and the *Survey Tests of Essential Elements/Learner Standards (STEELS)*, grades 7-12. The *ITBS* and *TAP* are nationally normed standardized achievement tests. Reading and mathematics subtests were analyzed. The *TEAMS* is a State mandated criterion-referenced test in reading, writing, and mathematics. The *STEELS* are 1243 criterion-referenced course final examinations in grades 7-12 in language arts, mathematics, social studies, and science. At grades 1-6, the *STEELS* are end of year tests.

Results

Table 1 presents the results, in mean grade equivalents, for stable versus mobile students at each grade level. Results are tabled for both the reading and mathematics subtests of the *ITBS* and *TAP*.

Table 1

Mean Grade Equivalent Scores for Stable and Mobile Students

Grade	Reading				Mathematics			
	n _{stable}	\bar{x} _{stable}	n _{mobile}	\bar{x} _{mobile}	n _{stable}	\bar{x} _{stable}	n _{mobile}	\bar{x} _{mobile}
1	7878	1.78*	1493	1.52	No data available			
2	9559	2.65*	1548	2.39	9300	3.16*	1462	2.95
3	9178	3.58*	1383	3.27	9089	3.76*	1354	3.50
4	9079	4.38*	1353	4.01	8944	4.70*	1343	4.33
5	8589	5.33*	1192	4.92	8538	5.93*	1179	5.48
6	7939	6.08*	1077	5.65	7853	6.76*	1060	6.21
7	7918	6.91*	1011	6.30	7731	7.52*	976	6.97
8	7238	7.78*	800	7.28	7083	8.20*	769	7.74
10	5412	10.03*	405	9.20	5449	10.57*	404	9.64

*p <.01

A weak to moderate relationship between achievement and stability is supported by the statistics in Table 1. That is, in reading and mathematics, stable students significantly outperformed the mobile students regardless of grade level. The data presented in Table 1 depict the best case for mobile students since many mobile students have no test data. In actuality, there were 43,560 mobile students during this time period. Data were available on only 10,262 of them. Part of the missing data was due to the District not testing at grades K, 9, 11, and 12. For comparison purposes, there were 111,737 stable students. Data were available on 72,790 of them. There were approximately 35,000 students in grades K, 9, 11, and 12.

Carrying this theme a little further, Tables 2, 3, and 4 present correlation matrices for grades 1-6, 7-8, and 10 with schools as units of analysis. If one were to examine these simple correlation coefficients, one would conclude that stability rate is significantly related to achievement at the elementary grades as measured by the *ITBS* and the Composite of *ITBS*, *TEAMS*, and *STEELS*. Mobility rate is also significantly related to achievement at the middle school grades as measured by the *ITBS*, *TEAMS*, *STEELS*, and the Composite. Stability rate is also significantly related to achievement as measured by *TEAMS* and the Composite. And at grade 10, mobility rate is significantly related to achievement as measured by *STEELS*.

Thus far, the results of this study clearly support at least a weak to moderate relationship between academic achievement and mobility. Not only do stable students score better than mobile students, but the overall high achievement levels of schools are significantly related to low mobility or high stability. So why is the relationship between academic achievement and mobility supported by some studies and refuted by others?

At least one response to this question seems plausible. It appears that the inconsistencies may be attributable to the measures of the concept of interest, i.e., continuous or discontinuous instructional treatment. Specifically, thus far our findings have shown different support for the relationship depending on whether stability was used

as a measure of continuous treatment or whether mobility was used as a measure of discontinuous treatment. However, until two other methodological issues are addressed, acceptance of this inference requires at a minimum two leaps in logic. First, if we know that the strength of the relationship depends not only on stability and mobility but also on ethnicity, economic status, and limited English proficiency status, then shouldn't we include these variables in our mathematical representations of the relationship? And second, if we know that schools differ significantly with respect to their student enrollments, then shouldn't we include this information in our analyses of the relationship when schools are the units of analysis?

These two methodological concerns were addressed in this study as follows. The criterion variables (mathematics achievement, reading achievement, composite achievement) and predictor variables (mobility, stability, % low income, % minority, % limited English proficiency) for K-6 schools were standardized and weighted based on the schools' enrollments. Then, the five predictors and the first-order interactions among them were allowed to compete in predicting the three criteria: mathematics achievement; reading achievement; and, composite achievement.

The results of these predictions are shown in Table 5. The weighted least squares approach supported a strong relationship between academic achievement and stability regardless of subject area. Furthermore, the interaction between stability and % minority was significantly related to reading achievement and composite achievement. And % minority was shown to be significantly related to mathematics achievement. The study's support for the relationship between academic achievement and % minority (or even its interaction) was expected. The literature has consistently supported this relationship.

The strength of the relationship between achievement and stability, however, was unexpected. The multiple Rs for stability's contribution in the three regressions were extremely large: .733 for composite achievement, .784 for mathematics achievement, and .851 for reading achievement. Without exception, none of the other predictors or their

first-order interactions entered into the equations first. Regardless of subject area, stability entered into the equations first. The remaining variables simply could not compete with stability's ability to predict achievement. This study shows that stability, a related measure of mobility, is a good candidate for consideration in the development of equitable accountability systems for assessing school performance, and that weighted least squares is a defensible technique in the implementation of equitable accountability systems for assessing school performance. In effect, mobility should no longer be the forgotten variable in assessing school performance; and, weighted least squares should no longer be the forgotten analysis when schools are used as units of analysis.

Table 2

Correlation Coefficients Between Mobility, Stability, and Achievement
 Grades 1-6, N=133

	STABILITY	MOBILITY	<i>ITBS</i>	<i>TEAMS</i>	<i>STEELS</i>	COMP-Z
A.D.M.	- 0.058	- 0.218	- 0.043	- 0.134	- 0.106	- 0.105
STABILITY		- 0.468 *	0.424 *	0.112	0.253	0.293 *
MOBILITY			- 0.201	- 0.025	- 0.133	- 0.114
<i>ITBS</i>				0.640 *	0.864 *	0.930 *
<i>TEAMS</i>					0.622 *	0.840 *
<i>STEELS</i>						0.923 *

Note. A.D.M. = average daily membership; COMP-Z = a standardized total achievement score measure that aggregates *ITBS*, *TEAMS*, and *STEELS* performance

*p<.01

Table 3

Correlation Coefficients Between Mobility, Stability, and Achievement
 Grades 7-8, N=23

	STABILITY	MOBILITY	<i>ITBS</i>	<i>TEAMS</i>	<i>STEELS</i>	COMP-Z
A.D.M.	- 0.515	0.196	- 0.333	- 0.510	- 0.478	- 0.500
STABILITY		- 0.440	0.123	0.521	0.365	0.436
MOBILITY			- 0.751 *	- 0.678 *	- 0.723 *	- 0.760 *
<i>ITBS</i>				0.823 *	0.812 *	0.903 *
<i>TEAMS</i>					0.865 *	0.965 *
<i>STEELS</i>						0.948 *

Note. A.D.M. = average daily membership; COMP-Z = a standardized total achievement score measure that aggregates *ITBS*, *TEAMS*, and *STEELS* performance

*p<.01

Table 4

Correlation Coefficients Between Mobility, Stability, and Achievement
Grade 10, N=26

	STABILITY	TAP	TEAMS	STEELS	COMP-Z
A.D.M.	- 0.158	- 0.169	- 0.242	- 0.158	- 0.195
STABILITY	-0.027	- 0.079	0.196	0.096	0.113
MOBILITY		- 0.355	- 0.338	- 0.443 *	- 0.390
ITBS			0.823 *	0.812 *	0.903 *
TEAMS				0.939 *	0.982 *
STEELS					0.978 *

Note. A.D.M. = average daily membership; COMP-Z = a standardized total achievement score measure that aggregates ITBS, TEAMS, and STEELS performance

*p<.01

Table 5

Stepwise Regression Summary of the Weighted Criteria Regressed on the
Five Weighted Predictors and Their 10 Weighted First-Order Interactions
Grades K-6, N=107

VARIABLE	Step in			Multiple R			F Entry level		
	M	R	C	M	R	C	M	R	C
Stability	1	1	1	.784	.851	.734	167.19*	275.37*	122.42*
% Minority	2	-		.854			44.45*		
%Stability x %Minority	-	2	2		.913	.835		69.19*	54.22*

Note. M, R, and C represent mathematics achievement, reading achievement, and composite achievement, respectively. The remaining predictor variables and their first-order interactions did not enter into the equation with an F-to-enter set at 4.0.

*p<.01

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