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AUTHOR Yap, Kim Onn
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ABSTRACT

Data obtained for 89 Title I reading projects were analyzed by multiple regression and discriminant function techniques to assess the relationships between project students' achievement and project characteristics. The results suggested that project characteristics specified in the Title I Evaluation and Reporting System (TIERS) data forms are potentially useful as predictors of achievement gain. Two of the more potent factors were shown to be per pupil cost and pretest achievement status. Taken together they explained more than 25 percent of the variance in achievement gain. (Author/HK)

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Northwest Regional Educational Laboratory

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Data obtained for 89 Title I reading projects were analyzed by multiple regression and discriminant function techniques to assess the relationships between project students' achievement and project characteristics. The results suggest that project characteristics specified in the title I Evaluation and Reporting System data reporting forms are potentially useful as predictors of achievement gain. Two of the more potent factors are shown to be per pupil cost and pretest achievement status. Taken together they explain more than one-fourth of the variance in achievement gain.

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INTRODUCTION

The utility of the Title I Evaluation and reporting system (TIERS) as a vehicle for evaluation use and policy making has been questioned by both researchers and policy makers (Barnes & Ginsberg, 1979; Cross, 1979; Linn, 1979; Jaeger, 1979; Wiley, 1979; Wisler, 1979). TIERS generates a number of variables, described as project vectors, which intuitively relate to student achievement. These vectors include project setting, grade level, hours/week, total hours, student-to-instructor ratio, posttest NCE scores, and NCE gain. (NCE scores are normalized standard scores with a mean of 50 and a standard deviation of 21.06.) The potential value of these project characteristics as achievement correlates has not been determined. The present study is an attempt to assess the predictive value of some of these project characteristics.

PROCEDURE

Data relating to a number of project vectors were gathered from 1978-79 Title I evaluation reports submitted by local school districts to the Hawaii State Department of Education. The project vectors included project enrollment, project hours; absenteeism, per pupil cost, student-to-instructor ratio and achievement (including pretest status, average NCE gain and percentage of students making positive NCE gain).

Project enrollment was the number of students ever enrolled in a project. Since the Title I students were somewhat mobile, the number of students enrolled was not necessarily the number of students pre and posttested for the evaluation. A small percentage of students entered and left some projects between pre and posttest times. The early exited students were generally replaced by new students. Thus, project enrollment was a generally accurate measure of the Title I student population. Project hours was the average number of instructional hours provided to students in a project during the school year. Absenteeism was the average number of days absent from class. Per pupil cost was derived by dividing total project funding by the number of project students. In some cases, per pupil cost was based on estimates rather than actual expenditures. The student-to-instructor ratio was obtained by dividing project enrollment by full-time-equivalents of the instructional staff. This was different from the face-to-face ratio generally reported by local districts using TIERS.

Two indices of achievement were used in the study--both derived from the use of Model A1 as described by Tallmadge and Wood (1978). The first index was the average NCE gain made by project students on a fall-to-spring testing cycle. The second index was the percentage of students making positive NCE gains. The latter index provided a similar yet separate measure of achievement status of project students as a group. In addition, the achievement status of a project at pretest time was indicated by the average pretest NCE score of the project students.

In approximately 80 percent of the projects, students were tested with the 1978 version of the Metropolitan Achievement Tests. The other projects used the 1977-78 version of the California Achievement Tests.

Data on project characteristics were collected through on-site observations, reviews of project documents and interviews with project staff by the external evaluator. For the present study, data on project characteristics and student achievement were gathered from 89 Title I projects covering grades 2-12.

In all data analyses, project was used as the unit of analysis. In the case of achievement data, NCE gains were averaged across grade levels to obtain an achievement index for each project. Percentages of students making positive gains were similarly averaged to yield an overall index for each project. It should be noted that preliminary evidence on national aggregates suggests that lower grade level students (i.e., grades 2-6) tend to make greater NCE gains than higher grade level students (i.e., grades 7-12). However, most projects included in the present study covered similar grade levels. For this reason, it appeared appropriate to average NCE gains across grade levels to obtain an overall achievement index for each project.

Descriptive statistics were first obtained for the project characteristics. The projects were then divided into high, medium and low groups based on achievement indices. Projects with achievement scores one-half standard deviation above the grand mean were classified as the high group. Conversely, projects one-half standard deviation below the grand mean were classified as the low group. The in-between projects made up the medium group. Two separate classifications were obtained on the basis of size of achievement gains and percentage of project students making positive gains. Analyses of variance (ANOVAs) were performed to detect group differences with respect to the selected project characteristics.

Two types of multivariate analyses were performed on the data. First, a multiple regression analysis was conducted on data for all 89 projects. Project characteristics (other than achievement indices) were used as independent variables. Size of achievement gains and percent of project students making positive gains served as the dependent variables. Multiple and zero-order correlations were obtained for the two achievement indices, separately. A discriminant function analysis was then performed on the data pertaining to the low, medium and high groups. F matrix for group separation and canonical correlations were computed for each achievement index.

RESULTS

Table 1 displays means and standard deviations of project characteristics and achievement indices. The results suggested that the Title I projects provided an average of 96 instructional hours to approximately 97 participants during the school year, with a per pupil cost of $670. The student-to-instructor ratio was 24.5, somewhat comparable with that of a normal class size. It should be noted that instruction was generally provided on an individual basis or to a group much smaller than what the ratio would indicate. The ratio was derived by dividing project enrollment by full-tiome-equivalents of project staff.

Absenteeism was moderately high, averaging 16.5 days absent. The average pretest NCE scores of 18.0 (which converts to a percentile rank of 6.0) appeared consistent with the intent that Title I projects should serve the most needy youngsters. The average NCE gain for the 89 projects was 8.5, which was consistent with the national trend.

(Preliminary data indicated that national aggregates of NCE gains would fall between 1-15 NCE points). Well over two-thirds (72 percent) of the participating students made positive NCE gains, namely, they achieved better than comparable students not receiving Title I services.

Table 1 about here

Intercorrelations among project characteristics and achievement indices are displayed in Table 2. Overall, the correlations ranged from low to moderate in magnitude, with more than half of the coefficients being statistically non-significant at the .05 level. Of the significant correlations, several are noteworthy. First, project size as measured by enrollment correlated positively (r=.226) with absenteeism, suggesting that larger projects tended to have greater attendance problems. The larger projects, however, tended to be less expensive on a per-pupil-cost basis (r=-.233), having a higher student-to-instructor ratio (r=.381). These projects, on the other hand, also seemed to have lower percentages of participants making positive NCE gains (r=-.244).

There was some evidence that higher project costs were due to longer instructional hours provided to participants (r=.228) and lower student-to-instructor ratio (r=-.224). A somewhat perplexing finding was the negative correlation (r=-.332) between pretest status and students-to-instructor ratio, which seemed to suggest that projects with

lower achieving students had fewer Title I staff (thus higher ratio) on the average.

The most significant finding was perhaps the relatively high correlations between achievement on the one hand and per pupil cost and pretest achievement status on the other. Achievement as measured by size of NCE gains correlated positively with cost (r=.428) and negatively with pretest achievement status (r=-.319). Achievement as measured by percent of students making positive gains correlated positively with cost (r=.434) and negatively with pretest achievement status (r=-.164). These results suggested that the better funded projects tended to produce greater NCE gains and higher percentages of project students making positive NCE gains. Moreover, projects with lower pretest achievement status tended to produce greater NCE gains. Pretest achievement status, however, was not significantly related to percentage of students making positive NCE gains.

Table 2 about here

Multiple regression analyses performed on the data provided similar results. The standardized coefficients in Table 3 suggested that the two most significant factors related to size of NCE gains were per pupil cost (B=.378) and pretest achievement status (B=- 275). When percent of students making positive gains was used as the criterion variable, the

major achievement correlates were shown to be enrollment (B=-.245), per pupil cost (B=.419) and student-to-instructor ratio (B=.228).

When all six independent variables (i.e., project enrollment, project hours, absenteeism, per pupil cost, student-to-instructor ratio, pretest achievement status) were included, the multiple regression analyses yielded multiple correlations of .512 and .512, accounting for approximately 26 percent of the variance in each of the dependent variables. When only per pupil cost and pretest achievement status were included, the multiple correlations were .506 and .448, accounting for about one-fourth of the variance in size of NCE gains and one-fifth of the variance in percent of students making positive gains, respectively. See Table 4.

Tables 3 and 4 about here

The distribution of project on achievement as measured by size of NCE gains was somewhat positively skewed and leptokurtic (skewness=1.56, kurtosis=5.92). As a result, when one-half of a standard deviation above and below the mean was used as the cutoffs, 23, 38 and 28 of the projects were classified as the high, medium and low achieving projects, respectively. A one-way ANOVA performed on the data showed that the

three groups differed significantly ($P < .05$) with respect to per pupil cost and pretest achievement status. Lower pretest status and higher per pupil cost were shown to be contributing factors to higher NCE gains. No significant differences were found with respect to the other project characteristics. Means and standard deviations of NCE gains and characteristics of low, medium and high acnieving projects are displayed in Table 5.

Table 5 about here

The distribution of projects on achievement as measured by percent of students making positive NCE gains was slightly negatively skewed and platykurtic (skewness= .26, kurtosis=-.84). Consequently, when one-half of a standard deviation above and below the mean was used as the cutoffs, 35, 28 and 26 of the projects were classified as high, medium and low achieving projects. A one-way ANOVA performed on the data showed that the three groups differed significantly with respect to enrollment and per pupil cost. Smaller enrollment and higher per pupil cost were shown to contribute to higher percentage of students making positive NCE gains. No significant differences were found with respect to othe other project characteristics. Means and standard deviations of percent of students making positive NCE gains and characteristics of low, medium and high achieving projects are displayed in Table 6.

Table 6 about here

The discriminant function analyses performed on the data showed that the low group was significantly different from the medium and high groups with respect to project characteristics. No significant difference was found between the medium and high groups. This was true when either size of NCE gains or percent of students making positive gains was used as the criterion variable. A sizeable canonical correlation of .53 was found between project characteristics and group membership based on size of NCE gains. The canonical correlation was .54 when group membership was based on percent of students making positive NCE gains. Results of the discriminant function analyses are in Tables 7 and 8.

Tables 7 and 8 about here

DISCUSSION

Among project characteristics included in the study, previous investigations have shown class size (Glass & Smith, 1978; Glass & Smith, 1979), learning time (DeVault, et al., 1977; Fisher, et al., 1978; Harnischfeger & Wiley, 1978; Stallings, 1980), district enrollment (Polley, 1976) and expenditures (Polley, 1976) to be related to student achievement. Attendance rate, once socioeconomic factors were accounted for, was found not to be associated with achievement (Polley, 1976). Results of the present study generally lend support to or are at least consistent with previous findings even though the latter were obtained with general student populations rather than Title I students. Project hours, for instance, correlated positively with achievement measured either by size of NCE gains ($r=.133$) or percent of students making positive NCE gains ($r=.158$). While the correlations were statistically non-significant at the .05 level, the findings were consistent with the positive relationship between learning time and achievement found in previous studies (Stallings, 1975; DeVault, et al., 1977; Fisher, et al., 1978). It is noted that findings from some of the previous studies indicate that mere length of the school day or class period does not necessarily contribute to student achievement. The positive relationship depends on how the available time was used, not just the amount of time available (Stallings, 1980).

Project enrollment correlated negatively with achievement as measured by size of NCE gains ($r=-.170$) and percent of students making positive NCE gains ($r=-.244$, $p<.01$). The negative correlations appear generally consistent with Polley's (1976) finding that larger district enrollment tended to lead to poorer average achievement. As in Polley's investigation, absenteeism was found not to be related to student achievement.

No relationship was found between student-to-instructor ratio and achievement. The ratio, as defined in the study, was however different from class size as defined in previous studies (Glass & Smith, 1978; Glass & Smith, 1979). As indicated earlier, the ratio was derived by dividing total project enrollment by full-time-equivalents of Title I staff. The ratio was therefore different from class size used in previous investigations. While the results suggest that on the average full-time-equivalents of instructional staff did not seem to have any significant effects on student achievement, this finding does not necessarily contradict previous findings of small class size leading to higher achievement.

Previous findings relating to expenditures receive support from the present study. Polley (1976) found a positive relationship between median teacher salaries and student achievement. Moreover, per pupil cost on principals' salaries was also positively related to achievement. The major share (over 80%) of Title I expenditures consists of personnel costs. The per pupil cost index used in the present study was highly similar to expenditure indices used in Polley's study. Cost indices used in the present study correlated significantly with achievement as measured by size of NCE gains ($r=.428$, $p<.01$) and percent of students making positive NCE gains ($r=.434$, $p<.01$).

Pretest achievement status correlated negatively with achievement as measured by size of NCE gains ($r=-.319$, $p<.01$) and percent of students making positive NCE gains ($r=-.164$, $p>.05$). The finding suggests that lower achieving students in the projects tended to make higher NCE gains at the end of the projects. While this would appear to be consistent with the Title I intent of serving the most needy youngsters, it does at the same time present a new perspective for interpreting NCE gains.

To summarize, the study produced consistent evidence that two potent variables for predicting Title I student achievement are per pupil cost and pretest achievement status. Together, they accounted for approximately one-fourth of the variance in student achievement. Somewhat ironically, these two project characteristics were recently removed from the list of project vectors in the Title I data reporting forms.

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Table 1.

Means and Standard Deviations of
Project Characteristics and Achievement Indices (N=89)

Variable	Mean	S.D.
Project Enrollment (PEN)	96.9	77.8
Project Hours (PHO)	96.0	52.0
Absenteeism (ABS)	16.5	9.8
Per Pupil Cost (PPC)	670.6	227.0
Student/Instructor Ratio (SIR)	24.5	6.9
Pretest Achievement Status (PAS)	18.0	7.6
Size of Gain (SOG)	8.5	6.3
Percent of Students Making Positive Gain (PPG)	72.1	14.8

Table 2

Intercorrelations Among Project Characteristics and Achievement Indices (N=89)

	PEN	PHO	ABS	PPC	SIR	PAS	SOG
PHO	-.001						
ABS	.226*	.118					
PPC	-.233*	.228*	.043				
SIR	.381**	.154	.085	-.224*			
PAS	.024	-.116	-.169	-.119	-.332**		
SOG	-.170	.133	.007	.428**	-.014	-.319*	
PPG	-.244*	.158	.022	.434**	.055	-.164	.821**

*p < .05
**p < .01

Table 3

Standardized Regression Coefficients for the Independent Variables

	Size of Gain	% of Students Making Positive Gain
PEN	-.067	-0.245*
PHO	.018	.019
ABS	-.040	.044
PPC	.378**	.419**
SIR	.005	.228*
PAS	-.275**	-.023

*p < .05
**p < .01

Table 4

Squared Multiple Correlations (SMC) of
Dependent Variables with Independent Variables

Variable	SMC	F	P
Size of Gain	.263*	4.88 (6,82)	.001
	.256**	14.77 (2,86)	.001
% of Students with Positive Gain	.262*	4.84 (6,82)	.001
	.201**	10.82 (2,86)	.001

* Independent variables are project enrollment, project hours, absenteeism, per pupil cost, student/instructor ratio, and pretest achievement status.

** Independent variables are per pupil cost and pretest achievement status.

Table 5

Means and Standard Deviations of Characteristics of High, Medium and Low Achieving Projects Based on Size of NCE Gains

Variable	Project Grouping			F (2,86)
	High (N=23)	Medium (N=38)	Low (N=28)	
Project Enrollment	81.0 (47.5)	92.0 (76.8)	116.6 (95.7)	1.47
Project Hours	115.2 (90.4)	94.3 (25.5)	82.4 (27.2)	2.65
Absenteeism	17.3 (10.2)	16.1 (8.1)	16.4 (11.8)	.11
Per Pupil Cost	760.8 (252.7)	724.3 (175.9)	523.6 (200.1)	10.67**
Student/Instructor Ratio	23.6 (6.6)	25.7 (5.9)	23.6 (8.2)	.94
Pretest Achievement Status	16.2 (5.7)	16.7 (7.7)	21.2 (8.0)	4.00*
Size of Gain	15.9 (6.2)	8.5 (1.7)	2.3 (2.2)	

*$p < .05$
**$p < .001$

Note: Standard deviations are in parentheses.

Table 6

Means and Standard Deviations of Characteristics of High, Medium and Low Achieving Projects Based on Percent of Students Making Positive NCE Gains

Variable	Project Grouping			F (2,86)
	High (N=35)	Medium (N=28)	Low (N=26)	
Project Enrollment	82.2 (54.9)	83.1 (60.1)	131.5 (107.4)	3.87*
Project Hours	97.9 (24.8)	105.6 (84.4)	82.9 (26.3)	1.33
Absenteeism	17.2 (9.3)	15.4 (8.6)	16.8 (11.9)	.26
Per Pupil Cost	753.6 (198.9)	701.6 (220.6)	525.5 (205.8)	9.43**
Student/Instructor Ratio	24.2 (5.9)	25.9 (6.2)	23.4 (8.6)	1.00
Pretest Achievement Status	17.5 (7.1)	16.1 (7.1)	20.6 (8.3)	2.52
% of Students Making Positive Gain	86.7 (5.6)	71.3 (4.3)	53.2 (6.5)	

*$p < .05$
**$p < .01$

Note: Standard deviations are in parentheses.

Table 7

F - Matrix for Group Separation Using Size of NCE Gain as Criterion Variable

	Low	Medium
Medium	4.17**	
High	4.19**	.77

Note: df = 6,81
Canonical correlation = .53

**p < .01

Table 8

F - Matrix for Group Separation Using
Percent of Students Making
Positive Gain as Criterion Variable

	Low	Medium
Medium	4.27**	
High	4.75**	.49

Note: df = 6,81
Canonical correlation = .54

**p<.01