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Combining Academic and Vocational Courses in an Integrated Program to Reduce High School Dropout Rates: Second-Year Results From Replications of the California Peninsula Academies

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This paper reports results from the first two years of an effort in 10 high schools to replicate the California Peninsula Academies. The Academy model combines the core academic curriculum with technical instruction in a particular occupational field. Local employers representing that field participate in various ways. The program is intended to improve school performance of students who would otherwise be likely to drop out. Evidence presented here indicates that Academy students generally have compiled better grades and more course credits than students in comparison groups at the same high schools. At three sites in particular, Academy students have consistently out-performed comparison groups in the first two years.

This paper reports interim results from an evaluation of a program designed to reduce high school dropout rates by organizing the entire high school curriculum around a vocational theme. High school vocational classes are often said to help prevent some students from dropping out of school (e.g., Bell, 1975). The practical content and relatively informal conduct of vocational classes are seen as appealing to students who are less interested in conventional academic classes (e.g., Goodlad, 1984, pp. 146, 230). The fact that so many students elect to take vocational courses in high school is *prima facie* evidence that some students would have less reason to come to school if those courses were not available. There is also some statistical evidence that taking vocational classes has a significant, though small, effect on reducing the probability that a student will drop out of high school (Mertens, 1982); however, that statistical relationship is not always evident (Catterall & Stern, 1986).

Despite their potential for keeping would-be dropouts in high school, vocational classes have been criticized for not achieving their main ostensible purpose: namely, increasing students' chances of success in the labor market. Graduates of high school vocational programs are no less likely to be unemployed than other high school graduates who enter the labor force (Mertens, McElwain, Garcia, & Whitmore, 1980; National Institute of Education, 1981; Psacharopoulos, 1987). A California study found that vocational graduates experienced as much unemployment as high school dropouts (Stern, Hoachlander, Choy, & Benson, 1986). Some studies have found that graduates of certain vocational programs—in particular, secretarial training—do earn higher wages than other high school graduates (National Institute of Education; Rumberger & Daymont, 1984). However, vocational

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courses on average cost more to offer than courses in academic subjects, because special equipment is usually required and there are often fewer students in a class (Psacharopoulos, 1987).

Furthermore, recent statements by groups representing chief executive officers in large firms have urged high schools to place greater emphasis on preparation in general academic subjects and problem-solving than on teaching specific skills for entry-level jobs (Committee for Economic Development, 1985; National Academy of Sciences, 1984). Although small employers or lower level supervisors in large firms may attach higher priority to specific job skills than do the chief executives of large corporations, the view of the latter group is more consonant with recent educational reforms, which have increased the number of academic courses required for high school graduation in most states, and have thereby reduced the amount of time available in students' schedules for electives, including vocational classes. The higher cost of vocational classes, lack of consistent evidence that most high school vocational courses improve students' prospects for employment, and increased emphasis on the academic "core" curriculum have combined to reduce vocational course offerings and vocational enrollments in U.S. high schools (e.g., for California data see Kirst & Hayward, 1987).

Yet the problem of high school dropouts has become increasingly urgent, because—somewhat paradoxically—the disadvantage resulting from lack of a high school diploma has grown worse as dropouts have become a smaller minority in the labor force. As recently as 1959, less than half of the civilian labor force aged 18 to 64 were high school graduates. However, by 1970 the proportion had risen to almost two thirds, and by 1985 more than five out of six members of the labor force aged 25 to 64 had high school diplomas (Statistical Abstract of the U.S., 1986). This is a very major change in a relatively short time, and its consequences are evident in the earnings of high school dropouts compared to graduates. Among men aged 25 to 64 who worked full time in 1961, those with one to three years of high school on average earned 87% as much as those who had completed exactly four years of high school. By 1981 that ratio had fallen to 75%. In absolute terms, the difference in average annual earnings between men with exactly four years of high school and men who had completed only one to three years of high school nearly doubled from $2,387 in 1961 to $4,489 in 1981 (both differences expressed in 1981 dollars; Grant & Snyder, 1983, p. 191). As high school graduation has become the norm, high school dropouts have found themselves increasingly unable to compete for high-paying jobs. The fact that the high school graduation rate has not risen since the 1970s, after more than half a century of steady ascent, has therefore become a matter of urgent public concern (e.g., see Rumberger, 1987).

States and localities are searching for alternative instructional programs that will keep students in school (e.g., see Orr, 1987). As we have noted, vocational education traditionally has been seen as a means to keep students from dropping out, but recently employers and educators have urged the schools not to let vocational education or other alternative programs encroach on the academic core curriculum of the high school (Committee for Economic Development, 1985; Finn, 1986; National Commission on Excellence in Education, 1983). It is therefore important to consider instructional programs that attempt to combine the practical appeal of vocational education with a full set of academic courses. One such program, called the Peninsula Academies, has been developed in two California high schools, and subsequently has been replicated in 10 other California high schools. In this paper we report results from the first two years of the replication effort.

The Academy Model

The original two Peninsula Academies enrolled their first students in the fall of 1981, at two high schools on the peninsula that lies south of San Francisco. One was a "Computer Academy" at Menlo-Atherton High School, and the other was an "Electronics Academy" at Sequoia High School, both located within Sequoia Union High School District. As of 1987–88 both programs were still operating and planning to continue for the indefinite future.

Each Peninsula Academy is organized as a school within a school. Students enter the Academy in grade 10 and continue through grade 12. Counselors and teachers refer students to the program whose performance in ninth grade—poor attendance, low grades, too few course credits—indicates a high risk of dropping out of school The 20 to 30 students at each grade level take all or most of their classes together. Courses include an academic core of English, math, and science, as well as a "lab" or shop class in the particular technology on which the Academy is focused. The sequence of topics in different classes is planned so that students can see connections between what they are doing in different courses at the same time. A *Replication Guide for the Peninsula Academies* (American Institutes for Research, 1984) describes the curriculum and organizational structure in more detail.

In addition to making more manifest the connections between academic and vocational subjects, the Academies also forge direct links between classrooms and workplaces. Local employers' representatives participate in designing the technical-vocational part of the curriculum. Companies donate equipment. Volunteers from participating companies act as "mentors" for Academy students, spending time with them individually to talk about the student's interests and career plans, visit work sites, and help the student feel personally connected to a set of work organizations with which the student otherwise would have little or no contact. Furthermore, these same companies provide summer jobs for Academy students who successfully complete their junior year. Having a paid summer job which is related to the Academy's instructional focus creates a powerful connection between school work and "real" work.

From 1981 through 1986 the original two Peninsula Academies were evaluated by the American Institutes for Research (Reller, 1985, 1987). Incoming Academy students at each site were matched with a comparison group of students who were similar in ethnic composition, gender, and achievement test scores. After participating in the program, Academy students were found to accumulate a larger number of course credits than the comparison group, and a larger proportion of the Academy students graduated from high school at the normal time (Reller, 1985). The evaluation also produced information about graduates of the program and comparison students 15 and 27 months after they graduated from high school. This followup found that the former Academy students more often held skilled technical jobs, and a larger proportion of Academy graduates also went on to some kind of postsecondary schooling (Reller, 1987). Apparently the Peninsula Academies were successful both in preparing students for work after high school and in enabling students to continue their education.

The Replications: Evaluation Design

Evidence of the original two Peninsula Academies' success prompted the California legislature to sponsor replications of the Academy model at 10 other high schools. Four of these were designed around computer-related occupations, two focused on electronics, two on health services, one on financial services, and one on food services (for a detailed description of the program at each site, see Dayton, Weisberg, Stern, & Evans, 1987).

Students participating in the Academy programs were selected during the second semester of their ninth grade year (except in two sites which altered the Peninsula Academy model to begin in ninth grade instead of 10th; in these two sites the Academy students were chosen during their eighth grade year). The selection process varied slightly from site to site, but usually began by distributing information about the program to students and staff. The pool of potential enrollees was formed of students who expressed interest or who were nominated by teachers or counselors. Students were chosen from this pool if they had a record of low achievement—poor attendance, low grades, insufficient course credits—but were not more than two grade levels behind in standardized test scores. The purpose was to select students who were at high risk of not graduating on time, but who appeared to possess at least enough intellectual ability to do high school work.

For the purpose of evaluation, a comparison group at each site was selected during the 10th grade year (ninth grade year in the two sites that began the Academy program in ninth grade). At each site, comparison group students come from the same school and grade level as students in the Academy program. The comparison groups were selected by combing the school rosters for students whose attendance, credits, grades and standardized test scores in the previous year resembled those of Academy students. The age, gender, and race or ethnicity of comparison students were also recorded.

The evaluation design is thus a quasi-experiment. It is not a true experiment because students were not assigned at random to the Academy and comparison groups. Instead, some Academy students selected themselves and others were nominated by teachers or counselors. Therefore, it is possible that *unmeasured* differences exist between the Academy and comparison groups. Differences resulting from nonrandom selection may make the program appear more effective, or less effective, than it really is. For instance, if students were selected for the Academy because they were thought to be bright but disaffected from school, the program would seem more effective than if disaffected students of only average or inferior intelligence were selected. Conversely, if students selected for the Academy were the most recalcitrant or intractible, the program would appear less effective than if the students selected were more docile. Unfortunately, even statistical procedures designed to correct for selection bias (see Maddala, 1983) cannot substitute for random assignment (see Burtless & Orr, 1986; LaLonde, 1986); and, in any event, these procedures could not be applied here, due to the absence of data that could be used to predict membership in the Academy or comparison group. Thus, the evaluation results may to some unknown extent reflect the consequences of selection rather than effects of the Academy program.

Nevertheless, it is possible at least to control statistically for effects of *measured* differences between Academy and comparison students. A regression model was used to test whether Academy students performed better than students in the comparison group each year, controlling for each student's performance in the previous year, and also controlling for age, gender, and race or ethnicity.

The simplest model for this purpose is

$$\hat{y}_{ij,t} = a + by_{ij,t-1} + cx_{ij} + dD_{ij}. \quad (1)$$

Here $\hat{y}_{ij,t}$ denotes the predicted performance (attendance, credits, grades, or courses failed) of the ith individual student in the jth program (either an Academy or comparison group), in year t. $y_{ij,t-1}$ is the previous year's value of the same performance measure for the same student. x_{ij} stands for a set of predictor variables (gender, race or ethnicity, date of birth) which pertain to that same student but do not change from year to year. D_{ij} is a binary variable indicating whether the ith student is in the Academy or comparison group. The coefficients a, b, c, d can be estimated from the data, using ordinary least-squares regression on the pooled set of Academy and comparison students at each site. Coefficient d measures the average difference in the predicted outcome between Academy and comparison students, controlling for the other predictors. If d is statistically significant, it means that the performance of the two groups is significantly different, for reasons not associated with the other predictors in the equation.

Before estimating Equation 1, however, it is necessary to test whether b and c, the coefficients on other predictors in the equation, are really the same for the Academy and comparison groups. This is done by estimating one regression for the Academy students and another for the comparison group at each site, then computing the F-statistic

$$F(n_2 - n_1, N - n_2) = \frac{(E_1 - E_2)/(n_2 - n_1)}{E_2/(N - n_2)}$$

where E_1 = the sum of squared errors from regression (1);
E_2 = the combined sum of squared errors from the regression equations estimated separately for Academy and comparison students;
n_1 = the number of regression coefficients estimated in (1);
n_2 = the total number of coefficients estimated in the separate regressions for Academy and comparison students; and
N = total number of students in the Academy and comparison group combined at each site.

This test is done for each outcome variable at each program site. If the F-statistic is smaller than the critical value, it is appropriate to pool the data on Academy and comparison students in order to estimate (1). If the F-statistic is larger than the critical value, then (1) is not appropriate, and a slightly more complicated procedure must be used to determine whether Academy students' performance is different from that of the comparison group, controlling for the other predictors. This procedure is described in the Appendix.

A total of 120 F tests would be possible with 10 sites, four outcomes, and three cohort-year combinations (the first cohort entered the program in the fall of 1985 and produced two years of data; the second cohort entered in the fall of 1986 and so far has yielded one year of data). However, one site botched the replication effort to such an extent that the state cut off its funding and sufficient data were not collected for evaluation. In two other sites a very large cohort (approximately 100 students) was admitted to the program in the first year and no new cohort was added in the second year. Finally, there were four instances of data not being available on particular outcomes. As a result, only 96 of the possible 120 F tests could be computed. Of these 96, eight indicated rejection of the null hypothesis that slope coefficients were the same for the Academy and comparison groups. In these eight instances, separate regressions had to be used to test whether the Academy program was effective. In the remaining 88 instances, (1) was used.

Table 1 gives a sample of results using (1). These are results for four outcomes, in one site, for one cohort in one year. The first column shows that the percentage of days a student attended school in 1985–86 was positively and significantly associated with the percentage of days the student attended in 1984–1985; it was also significantly higher for male students and for students who were in the Academy program. In the other three columns in Table 1, only the 1984–85 outcome is significant in predicting the 1985–86 outcome, and in each case the coefficient is positive, as one would expect.

In addition to these linear regression analyses of attendance, grades, credits, and courses failed, a set of logistical (logit) regressions were estimated to predict the probability of dropping out of school for Academy and comparison group students during these first two years. The logistic equivalent of (1) was estimated, and the conventional (asymptotic) t statistic was used to test whether the coefficient on the binary variable denoting Academy membership was significant or not.

Results of Replications

Table 2 shows the results of testing whether statistically significant differences ($p < .05$) existed between Academy and comparison students at each of the nine sites where data were available. In the table, a plus sign indicates that Academy students did significantly better than the comparison group (i.e., Academy students had higher attendance, credits, or grades, failed fewer courses, or were less likely to leave school) when pre-existing differences are taken into account. A minus sign means that Academy students did significantly worse. The amount of difference in each outcome that was required in order to register as statistically significant depended, as always, on the number of students in each group and on the overall proportion of variance accounted for by the regression equation. For each of the five outcomes, the minimum absolute

TABLE 1
Regressions for Site A, 1985-86 outcomes for cohort entering fall, 1985 (t-statistics in parentheses)

	Outcome			
Predictor	Attendance	Credits	GPA	Courses failed
1984–85 outcome	0.372	0.527	0.347	0.414
	(4.25)	(4.84)	(3.67)	(4.12)
Male	5.582	−1.495	−0.126	−0.289
	(2.15)	(−0.56)	(−0.83)	(−0.70)
Month of birth	0.273	0.077	−0.000	−0.022
	(1.04)	(0.29)	(−0.02)	(−0.52)
Black	1.205	3.168	−0.033	0.066
	(0.29)	(0.74)	(−0.14)	(0.10)
Hispanic	−1.020	0.947	−0.033	0.173
	(−0.38)	(0.34)	(−0.21)	(0.40)
Academy	5.488	0.722	0.122	−0.066
	(2.20)	(0.28)	(0.84)	(−0.16)
Intercept	31.457	20.594	1.365	2.422
	(1.76)	(1.126)	(1.37)	(0.88)
R^2	0.310	0.267	0.187	0.186
n	84	77	77	88
F	5.776	4.241	2.674	3.076

difference that was statistically significant in Table 1 was as follows:

- attendance: 2.1% of days;
- credits: 2.8 credits per year (a typical one-semester course is 5 credits; approximately 200 credits are required for graduation);
- GPA: 0.3 points (on a scale where A = 4, D = 1, F = 0);
- courses failed: 1.1 semester courses failed per year;
- school dropout probability: 29% within one year.

Since all of the differences indicated as statistically significant in Table 2 are at least this big in absolute terms, it does appear that these differences are educationally important as well as statistically significant.

There are several ways to read Table 2. One way is to compare rows. This reveals which sites had more success for Academy students relative to the comparison group. Site G is the clear winner at this point in time. In the first two years the Academy at Site G produced statistically significant differences in favor of the Academy students on 12 outcomes, out of a possible 15. Sites H and D were next in frequency of positive outcomes for Academy students. Students in the Academy at Site H showed significantly better outcomes than the comparison group in nine out of a possible 15 instances. At the Site D Academy, where there was only one cohort of students and therefore only 10 possible comparisons, the Academy students showed more positive outcomes in six instances. These three programs are therefore demonstrating unambiguous success so far. Academies at the other sites produced some scattered positive results that were statistically significant. Only two statistically significant negative results were observed.

Another way to read Table 1 is to compare columns. This reveals that the Academy programs as a group had relatively more success in helping students compile good academic records than in keeping students at school. The superior academic records of Academy students are reflected in larger numbers of course credits, better grades, and fewer courses failed. Success in keeping students at school is measured by better attendance

TABLE 2
Statistically significant differences (p < .05) between Academy and comparison groups, by cohort, year, and site

	Attendance	Credits	GPA	Courses failed	School dropout probability
Cohort entering fall 1985:					
1985-86 outcomes					
Site A	+				
Site B		+	+		
Site C		+		+	
Site D		+		+	
Site E			+		
Site F		+	+		
Site G	+	+	+	+	
Site H	+	+	+	+	
Site I				−	
Cohort entering fall 1985:					
1986-87 outcomes					
Site A					
Site B					−
Site C					
Site D	+	+	+	+	
Site E					
Site F					
Site G	+	+		+	+
Site H			+	+	
Site I					
Cohort entering fall 1986:					
1986-87 outcomes					
Site A					
Site B		+	+		
Site C	+		+		
Site E					
Site F			+		
Site G	+	+	+	+	
Site H	+	+	+	+	

and a lower probability of dropping out. It is possible that grades and credits are biased in favor of Academy students, if Academy teachers have a greater investment in their students' success and therefore either give students more help or grade more liberally, or both. In any event, better grades and more course credits will have real consequences: as these students approach graduation, the superior academic records of Academy students will translate into a higher probability of graduating on time, which is one of the main stated objectives for the Academy program. Data to be collected in the next two years will reveal whether this in fact does happen. At the present time, the main accomplishment of the Academy programs has been to help these sophomores and juniors (or freshmen and sophomores at Site D) achieve better academic records.

The third kind of comparison that can be made in Table 1 is between cohorts and years. The cohort that entered grade 10 (grade 9 at Sites D and I) in the Fall of 1985 yielded outcome data for 1985–86 and 1986–87. The cohort that entered grade 10 in the Fall of 1986 has produced only one year of outcome data so far, for 1986–87. Of the 45 possible comparisons for the first cohort in the first year, 18 were positive and statistically significant, and one was negative and significant. For the first cohort in its second year, 10 of 45 comparisons were significantly positive and one was significantly negative. For the second cohort in its first year, 12 of 35 possible comparisons were significantly positive and none was significantly negative. (There are fewer possible comparisons here because Sites D and I did not admit a second cohort in 1986–87.) These different proportions suggest that the Academy programs may have somewhat more pronounced success with students during their first year in the program than in subsequent years. Data to be collected in the next two years will demonstrate whether or not this remains true.

Conclusions

The first conclusion from these interim findings is that the benefits of the Peninsula Academy model can indeed be replicated at other sites. Of the 125 tests in Table 2, 41 showed significantly positive results from Academy programs, and only two were significantly negative. Even allowing for the fact that approximately six of these tests would yield positive and "significant" (at $p < .05$) results by chance, this is a generally positive pattern. In the 10 sites where replication was attempted, three produced unambiguous evidence that Academy students performed better than the comparison group. The Academy model therefore appears to have real potential for helping some likely dropouts to succeed in high school.

The second conclusion is complementary to the first: seven of the 10 replication sites so far have not produced unambiguous evidence that students in the Academy program are out-performing students in the comparison group. In some of these sites the model was not fully implemented (see Dayton et al., 1987); here it can be said that the model was not given a real test. However, incomplete implementation is one of the hazards any replication effort has to face. Since the Peninsula Academy program has been given a Distinguished Performance Award by the National Alliance of Business, and has been given additional national publicity by the U.S. General Accounting Office (1987), it is important to avoid the assumption that all replication efforts will inevitably succeed. As the evaluation continues, it should attempt to explain why some sites appeared to be more effective than others.

A third conclusion is that this kind of result—success in some locations but not in others—is probably what should be expected as new programs are developed and then replicated. Achieving renewed progress toward universal high school completion will require development and replication of many different kinds of programs (see Orr, 1987; U.S. General Accounting Office, 1987). Careful evaluation is necessary at each step to avoid wasting scarce resources. A program that does not produce desired benefits in a particular setting should be discontinued after a reasonable period of time, as was done in one of the Academy replication sites. By integrating evaluation into the process of program development and replication, it is possible to avoid shooting in the dark.

APPENDIX

If the F-statistic in the text is greater than the critical value, then it is appropriate to use separate regressions for the Academy and comparison groups. We then use the following procedure to test whether performance of the average student in an Academy program was better than would be predicted if that student had been in the comparison group instead. Let

$\hat{y}_{AA}$ = predicted value of outcome (attendance, credits, grades, or courses failed) for a student whose predictor variables had values equal to the mean for students in an *Academy* program, where the predicted outcome is computed from regression coefficients estimated for the *Academy* group;

$\hat{y}_{AC}$ = predicted value of outcome for a student whose predictor variables had values equal to the mean for students in the *Academy* program, where the predicted outcome is computed from regression coefficients estimated for the *comparison* group;

$\hat{y}_{CC}$ = predicted value of outcome for a student whose predictor variables had values equal to the mean for students in the *comparison* group, where the predicted outcome is computed from regression coefficients estimated for the *comparison* group; and

$\hat{y}_{CA}$ = predicted value of outcome for a student whose predictor variables had values equal to the mean for students in the *comparison* group, where the predicted outcome is computed from regression coefficients estimated for the *Academy* group.

Comparison of $\hat{y}_{AA}$ and $\hat{y}_{AC}$ tells us whether a student with the average characteristics of the Academy group did better in the Academy than he or she would have been predicted to do in the comparison group. Likewise, comparing $\hat{y}_{CC}$ and $\hat{y}_{CA}$ indicates whether a student with the average characteristics of the comparison group did better in the comparison group than would be predicted if he or she has been in the Academy program instead. If both of these comparisons favor the Academy program, it is apparent that the Academy program is having a positive effect. Statistical significance of those differences is tested by determining whether $\hat{y}_{AC}$ lies outside the 95% confidence interval for predictions around $\hat{y}_{AA}$, and whether $\hat{y}_{CA}$ lies outside the 95% confidence interval for predictions around $\hat{y}_{CC}$.

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