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School-level Benefits of Using PLAN® Over Time

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Abstract

This study investigated school-level benefits of using the PLAN program over time. Outcome variables included the average gain in ACT Assessment scores, the proportion of students whose ACT scores achieved college readiness benchmarks, and the proportion of students who took particular patterns of college preparatory coursework in high school. Schools were the unit of analysis and were divided into four categories of PLAN participation. Over time, schools that consistently tested all of their sophomores with PLAN had increases in average ACT Composite scores .31 units higher than the average increases of schools that did not use PLAN. Schools that used PLAN also typically had greater positive increases than PLAN non-users with respect to the other outcome variables. Moreover, gains in the outcome variables increased with the number of years schools tested all of their sophomores.

Acknowledgment

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School-level Benefits of Using PLAN Over Time

ACT developed the Educational Planning and Assessment System® (EPAS) to help students prepare for high school and the transition to college and work after high school. EPAS® consists of three different assessments that are administered to students at certain points in middle school and high school. EXPLORE is usually taken in grade 8 or 9, PLAN in grade 10, and the ACT Assessment in grade 11 or 12. All three assessments are designed to measure students' academic knowledge and skills at each of the three education points. The EPAS program provides a longitudinal overview for educational and career planning, instructional support, assessment, and evaluation.

Previous research supports the use of EPAS to assess student achievement (e.g., Roberts & Noble, 2004; Schiel, Pommerich, & Noble, 1996). These studies showed the contributions of courses taken between grades 8 and 10, and grades 10, 11 and 12, on PLAN and/or ACT scores, while statistically controlling for prior achievement. In addition, research has shown that students from schools participating in EPAS achieve higher PLAN and ACT scores and are more likely to take rigorous coursework when compared to students from schools not participating in EPAS (Noble, 2003). However, this prior research focused only on one period in time and did not consider at improvement over time or the length of time schools had used either EXPLORE or PLAN.

The purpose of this study is to demonstrate the benefits to schools of the PLAN program when used over time. Only the PLAN/ACT portion of EPAS was investigated here to maximize the time span to be studied and the number of user and non-user schools. Benefits associated with PLAN use over time included increases in ACT test scores, as well as increases in college preparatory coursework taken and readiness for college-level work.

Data

The data consisted of ACT Assessment records of students tested between 1994 and 2003. Their high schools were categorized according to their use of PLAN. The PLAN/ACT matched history for each year was matched to the relevant ACT history to identify PLAN user and non-user schools. For the matched PLAN/ACT files samples sizes ranged from 374,526 students (9,234 schools) in 1993-94 to 438,076 students (6,307 schools) in 2002-03. Sample sizes for the ACT history files ranged from 891,992 students (19,886 schools) in 1993-94 to 1,175,059 students (23,268 schools) in 2002-03. To be included in the study, PLAN user schools could have started using PLAN at any time, but were required to have used PLAN from 2000 through 2003. Moreover, all PLAN user schools were required to have consistently used PLAN over time (i.e., used every year), once they implemented PLAN. Non-user schools were required to have never used PLAN at any time between 1994 and 2003.

PLAN user schools were then classified by type of use. A distinction was made between schools that tested all their sophomores with PLAN and schools that only tested volunteer students. (This is an important distinction because volunteer students tend to be higher-achieving students.) Four PLAN use categories of schools were identified:

1. Schools that consistently tested all of their sophomores with PLAN, once they started using PLAN (consistent census users; n = 1,145).
2. Schools that vacillated over time between testing all of their sophomores and testing a volunteer group of sophomores (inconsistent census users; n = 2,237).
3. Schools that consistently did not census-test (i.e., tested student volunteers)(non-census users; n = 2,087).
4. Schools that never used PLAN (non-users; n = 1,565).

Schools with an average of less than 10 students taking the ACT Assessment from 2000-03 were not included in the data set.

Sampling weights were calculated for each school to account for differences in the statistical precision associated with schools with different sample sizes. Unweighted mean school sample sizes by PLAN use category were as follows:

Type	Mean sample size	SD
Consistent census users	96.22	106.32
Inconsistent census users	82.16	93.09
Non-census users	102.40	92.43
Non-users	26.11	20.88

Weights were calculated using the number of ACT Assessment tested students in the school, as follows:

$$w_j = (n_{ij}/n_{i\cdot})*N,$$

where w_j is the weight for school j,

n_{ij} is the number of students i within school j,

$n_{i\cdot}$ is the number of students i across all schools, and

N is the number of schools.

School-level variables were created by calculating means and proportions for the student-level variables from the ACT record. Means and proportions were also calculated within gender and racial/ethnic groups. These variables included:

- gender,
- ethnicity,
- grade level,
- family income (on a zero to nine scale, with nine being the highest),

- ACT scores,
- educational plans,
- core participation (three years of mathematics, social studies, and science and four years of English),
- college preparatory curriculum,
- major and occupational plans,
- responses to needs items, and
- high school coursework taken or planned.

The ACT school level data were then matched with the Market Data Retrieval data files (MDR; Shelton, Connecticut) to obtain other school characteristics. These variables included accreditation region of the country, type of school (public/private), school location (urban/suburban/rural), and per-grade enrollment. Categorical school characteristics were either dummy-coded or effect-coded for analysis. Accreditation regions were recoded to combine certain regions: the four resulting regions were Southern, Northwest and West, North Central, and Middle States and New England.

Method

Unweighted means, standard deviations, and sample sizes were calculated by type of PLAN use for average ACT Composite and all school characteristics. For each outcome and school, three-year averages were used instead of single years to stabilize the results. Then, average gains were calculated by taking the difference between the 2001–03 averages and the averages for three years prior to PLAN implementation (baseline years). For the non-user group, the baseline years were 1997–99.

ACT college readiness benchmarks were defined as meeting or exceeding an ACT English score of 18, an ACT Mathematics score of 22, and an ACT Science score of 24 (Allen & Sconing, in press). These benchmarks reflect a student's likely success in college English Composition, college Algebra, and college Biology.

Outcome Variables

Average gains for each outcome were regressed on PLAN participation category, number of years of census testing, and school characteristic variables. All analyses were conducted for the total group, for racial/ethnic groups (African American, Caucasian American, Hispanic, Asian American, and Other), and for gender groups. Outcome variables were evaluated for each of these groups, and included the following:

1. ACT scores
2. Preparation for college-level work (meeting or exceeding ACT benchmark scores in English, Mathematics, and Science)
3. Sureness of career and major choices
4. College-bound vs. non-college-bound
5. Need for help in writing, mathematics, reading, study skills, educational plans, or career plans
6. Taking/not taking the core curriculum
7. Taking (or taking/planning to take) specific mathematics or science course patterns (4 and 3, respectively)
8. College preparatory curriculum vs. other

School characteristic variables included the following:

1. Location (rural, urban, suburban)

2. Per grade enrollment
3. Average family income in the school
4. Region
5. Length of participation in EPAS
6. Type of school (public vs. private)
7. Proportion of students taking the ACT Assessment

Regression Analyses

Initial regression models were developed using school-level average ACT gain scores and predictor variables used in prior research (ACT, Inc., in press; Noble, 2003), including school characteristics (e.g., location, region), proportion of ACT-tested students, proportion of juniors, and average family income. Variable and model selection was based on the statistical significance ($p<.001$) of the regression coefficients, model statistical significance ($p<.001$), R^2 value, and standard error of estimate (SEE). Most of the regression coefficients were statistically significant due to the large sample size.

Final model development. Model fit was determined using the model for average ACT Composite score gains. Once a final model was established for this outcome, the same model was developed for all other outcome variables for the total group, and by gender and racial/ethnic group. Predictor variables included in the final model were:

- dummy-coded variables identifying type of school participation,
- the number of years a school census-tested with PLAN,
- an indicator variable identifying schools in one specific state in the North Central accrediting region,
- school type (public/private),

- average family income within a school,
- proportion of ACT tested students within a school,
- school location (urban/suburban/rural), and
- recoded accreditation region of the school.

The variable representing schools from one state was used because the percentages of schools by PLAN use category differed substantially from those of other states. Inclusion of all of these variables would statistically control for school characteristics and eliminate their confounding with PLAN use.

Results

Unweighted descriptive statistics for schools using PLAN (consistent census, inconsistent census, non-census) and not using PLAN are provided in Table 1. The table includes only the variables used in the final regression model.

Average ACT Composite scores for the most recent three years of PLAN use were similar to or slightly higher than the average for three years prior to use for all three types of PLAN user schools. The 2002–03 national average ACT Composite score was 20.8, and only PLAN consistent census user schools had average Composite scores higher than the national average. PLAN consistent census schools had slightly higher average family incomes and higher proportions of ACT-tested students than non-census and non-user schools. Consistent census, inconsistent census, and non-census schools were predominantly from the North Central accrediting region.

TABLE 1

Descriptive Statistics for Schools by PLAN Participation

School level statistics	Means (SD) and proportions			
	Consistent census	**Inconsistent census**	**Non-census**	**Non-user**
Avg. ACT Composite recent 3 years	21.2 (1.84)	20.7 (1.98)	20.7 (1.77)	20.1 (2.51)
Avg. ACT Composite prior 3 years	20.8 (1.58)	20.4 (1.67)	20.6 (1.50)	20.7 (2.42)
Avg. years PLAN use	9.49	9.55	9.59	0
Avg. years census use	6.05	4.12	0	0
Avg. family income	5.00	4.68	4.72	4.84
Pct. of high school graduates ACT tested	55	54	40	18
Pct. public	69	74	97	86
Pct. specific state	12	10	9	1
Pct. rural	53	57	57	41
suburban	27	23	29	35
urban	20	20	14	24
Pct. Middle/New England	3	3	4	37
North Central	73	62	61	15
Northwest/West	3	5	10	21
Southern	21	30	25	26

Regression Results

Schools that used PLAN typically had greater positive increases over time than PLAN non-users for all outcome variables except the following:

- meeting or exceeding the ACT benchmark score in English;
- college-bound vs. non-college-bound;
- need for help in mathematics, reading, study skills, and education or career plans;
- college preparatory curriculum vs. other; and
- taking (or planning to take) certain mathematics and science course patterns.

Moreover, PLAN user schools that consistently census-tested and PLAN schools that consistently tested volunteer students had greater increases than PLAN schools that

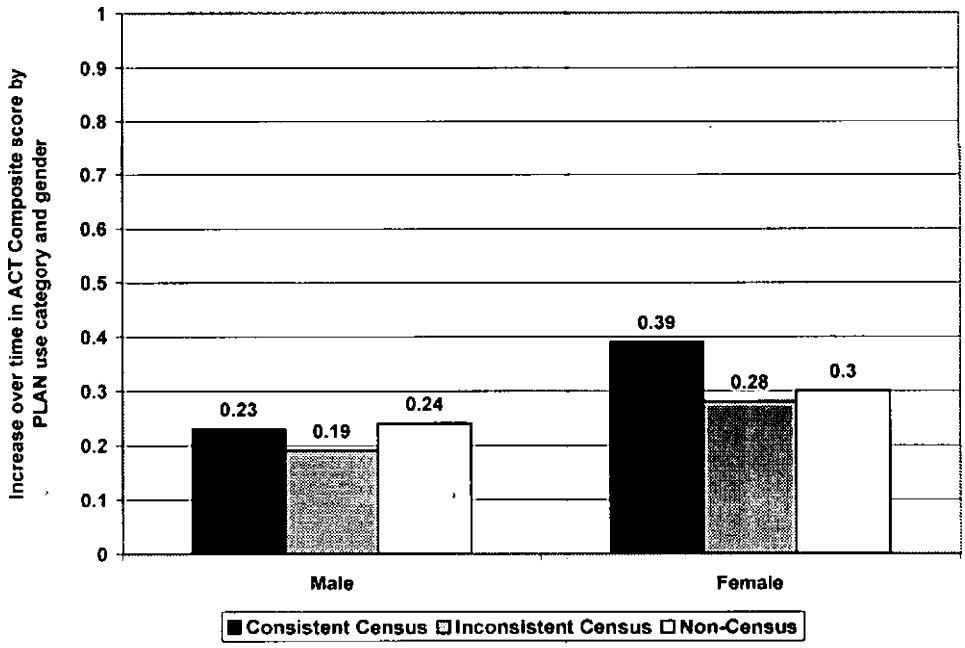
inconsistently census tested their students. Outcome variable gains also increased with the number of years of census testing.

Regression coefficients for each independent variable in a regression model reflect the average increase in the outcome variable associated with a one-unit increase in an independent variable, given all other variables in the model. Outcomes were interpreted in terms of the increase in each outcome variable associated with PLAN use. In all cases the comparison group was the non-user group.

All regression models were statistically significant ($p < .001$), except for sureness of major and occupation and mathematics coursework patterns taken and planned for Asian and Hispanic students. Model R^2 values ranged from .20 to .25 for average score gains, from .15 to .24 for percentages of students meeting the college readiness benchmarks, and less than .10 for percentages of students needing help in particular areas and percentages of students taking specific course patterns. All differences by PLAN use category described below were statistically significant ($p < .05$), unless otherwise identified.

ACT score results. The average ACT Composite score increase for schools that consistently census-tested with PLAN over time was .31 score units higher than that for schools not using PLAN. Average score increases for inconsistent census users and non-census users were somewhat lower (.24 and .27, respectively). Greater gains over time in ACT Composite scores were found for females than for males from schools using PLAN, regardless of how PLAN was implemented, compared to males and females from non-user schools (see Figure 1). This pattern also held true for ACT Reading and Science scores.

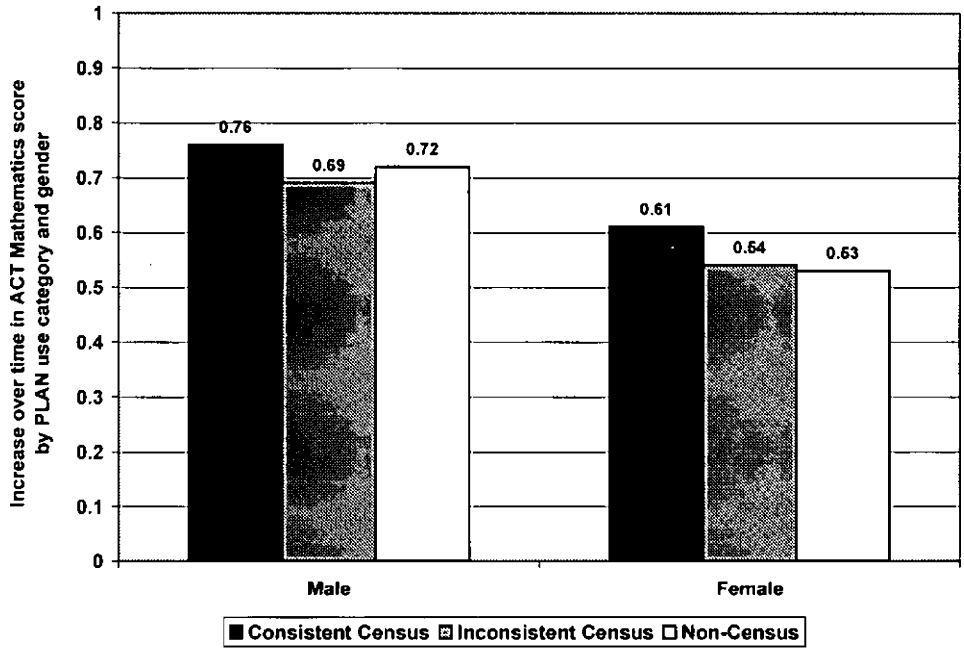
FIGURE 1. Average Increase in ACT Composite Score, by PLAN Use Category and Gender



For Other Race students, PLAN use was associated with a .77 to .99 ACT Composite score increase over time, regardless of how the school implemented PLAN, compared to PLAN non-user schools. This pattern was found for all ACT subject tests. Upon further investigation, it was found that the majority of PLAN and ACT-tested students that responded as Other Race on the ACT Assessment had identified themselves as Caucasian or Asian American students when they took PLAN.

On average, PLAN use was associated with an ACT Mathematics score increase of .58 to .63 score units compared to PLAN non-user schools, with consistent census user schools having the greatest average increase. ACT Mathematics scores for males at PLAN user schools were .69 to .76 score units higher, and scores for females were .53 to .61 score units higher than those at PLAN non-user schools (see Figure 2). Score increases were somewhat higher for males than for females for all three PLAN user groups.

FIGURE 2. Average Increase in ACT Mathematics Score, by PLAN Use Category and Gender



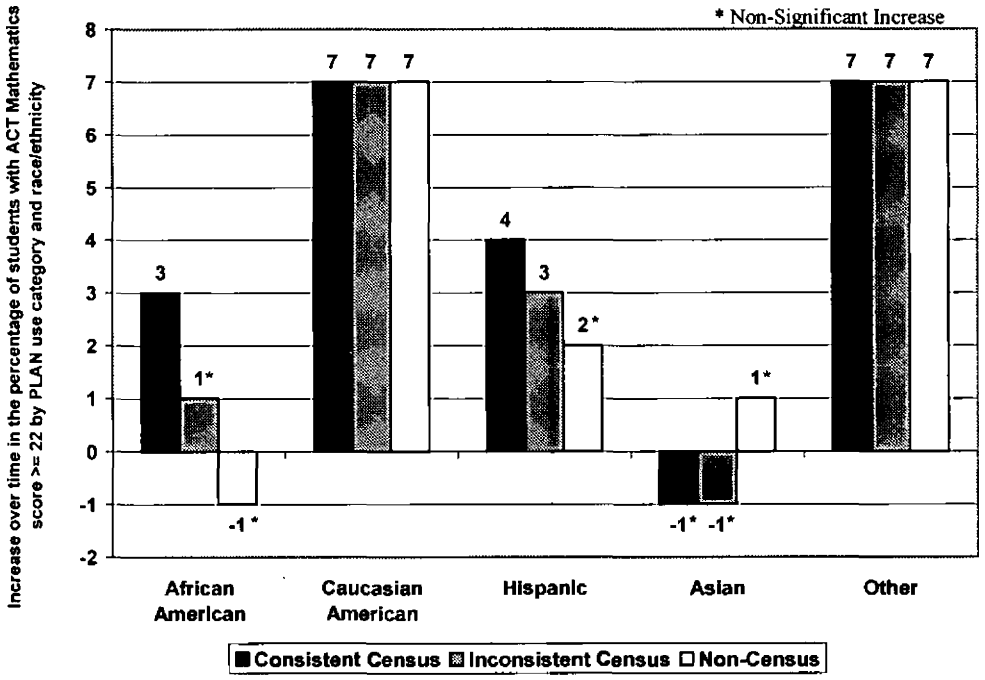
Hispanic students from consistent census user schools had higher PLAN Mathematics score increases than those at non-user schools (by .58 score units). High gains were also found for Caucasian American students (.87) and Other Race students (.99) from consistent census user schools.

College readiness benchmark results. PLAN user schools had slightly higher increases in average percentages of students prepared for college-level work, compared to PLAN non-users, with a 5% increase for students meeting the ACT Mathematics benchmark of 22 and a 3% increase for students meeting the ACT Science benchmark of 24. These findings were consistent across gender groups.

Average increases over time for racial/ethnic groups in percentage of students meeting the ACT Mathematics benchmarks are shown in Figure 3. On average, schools consistently using PLAN census testing had higher increases in the percentage of Hispanic students (4%) and

African American students (3%) meeting the Mathematics readiness benchmark, compared to PLAN non-user schools. In addition, PLAN user schools had an average increase of 6% to 7% of Other Race students meeting the ACT Mathematics and Science college readiness benchmarks, compared to PLAN non-user schools.

FIGURE 3. Average Increase in Percentage of Students Meeting the ACT Mathematics Benchmark, by PLAN Use Category and Race/Ethnicity



Need for help results. PLAN user schools had a greater decrease in the average percentage of students needing help with Writing than did PLAN non-user schools (4% to 5% decrease). This decrease was larger for females (6% to 7%) than for males (3% to 4%), and was especially true for all racial/ethnic groups except Caucasian American students (see Figures 4 and 5).

FIGURE 4. Decrease in Average Percentage of Students Needing Help with Writing, by PLAN Use Category and Gender

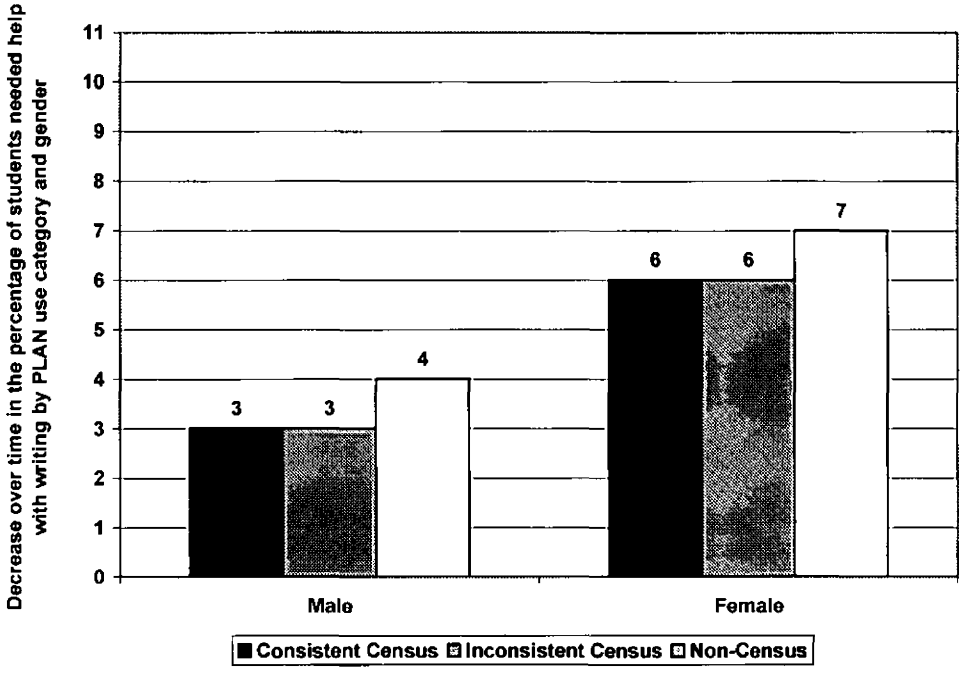
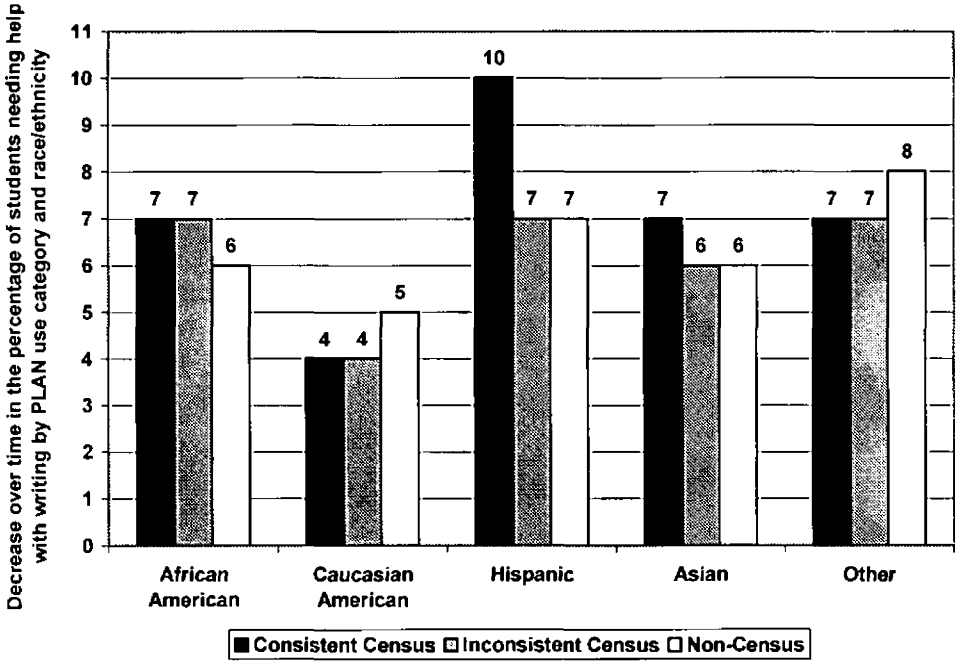


FIGURE 5. Decrease in Average Percentage of Students Needing Help with Writing, by PLAN Use Category and Race/Ethnicity



Core coursework results. PLAN user schools had a higher increase in average percentage of students taking core coursework than PLAN non-user schools (9% to 11%). This increase was higher for females (10% to 12%) than for males (8%), as shown in Figure 6. The average increase in the percentage of African American, Caucasian American, Hispanic, and Other Race students taking core coursework was also higher for PLAN user schools, as shown in Figure 7.

FIGURE 6. Increase in Average Percentage of Students Taking Core Coursework, by PLAN Use Category and Gender

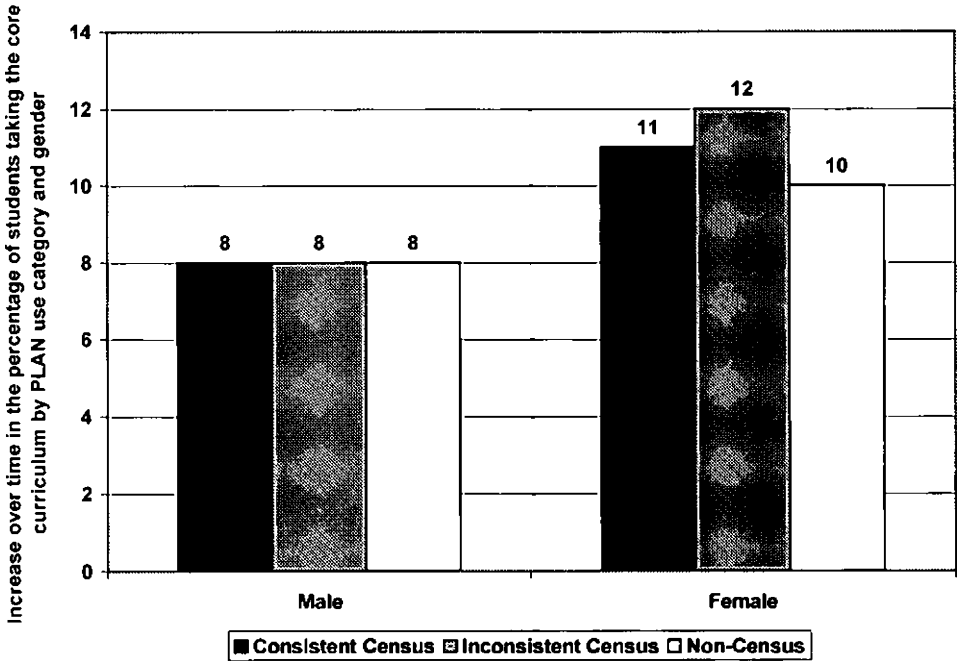
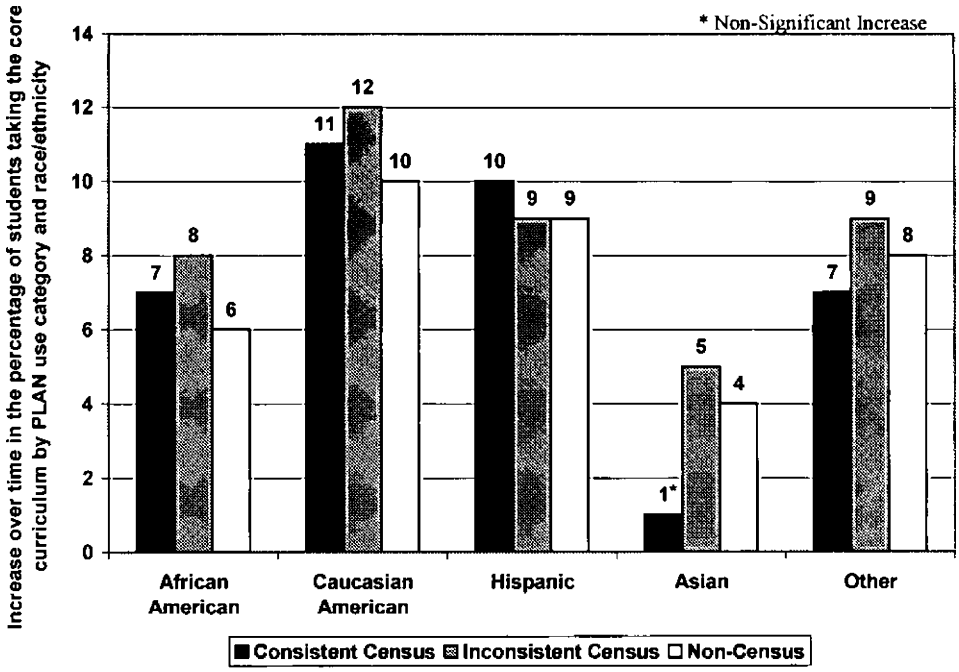
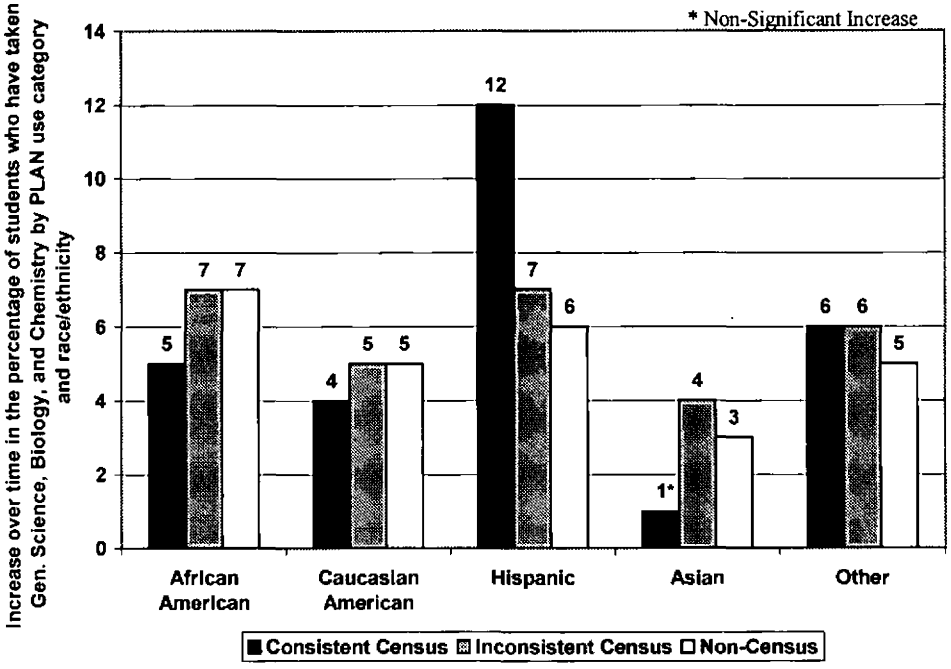


FIGURE 7. Increase in Average Percentage of Students Taking Core Coursework, by PLAN Use Category and Race/Ethnicity



Specific course pattern results. The average increase in the percentage of students who had taken or were currently taking General Science, Biology, and Chemistry was 5% higher for PLAN user schools than for PLAN non-user schools, irrespective of type of PLAN use. This increase was the same for males and females. There was an especially pronounced increase for Hispanic and African American students (see Figure 8). This same trend (2% higher for PLAN user schools) was also observed for students who had taken or planned to take this course pattern. Students at PLAN user schools who had taken or planned to take this course pattern plus a Physics course also had higher increases (6% to 7%) consistent with the above trend, irrespective of type of use. This increase was especially high for Hispanic students (5% to 9%).

FIGURE 8. Increase in Average Percentage of Students Taking a Specific Science Course, by PLAN Use Category and Race/Ethnicity



In addition, average increases in the percentage of students who had taken or were currently taking specific mathematics course patterns were 1% to 3% higher for PLAN user schools, regardless of type of use, than for PLAN non-user schools. Similar increases were seen for males and females across all mathematics course patterns. For course pattern 1 (Algebra 1, Algebra 2, Geometry, Trigonometry, and Calculus), increases were highest for Hispanic and Asian students (1% to 3%). Increases for Hispanic students were also high for course pattern 2 (Algebra 1, Algebra 2, Geometry, and Trigonometry). For course pattern 3 (Algebra 1, Algebra 2, Geometry, Trigonometry, and Other Advanced Mathematics), increases across racial/ethnic groups were fairly consistent. The same trend was observed for students who had taken or planned to take this course pattern.

Discussion and Implications

Results of this study indicate that schools benefit from using PLAN in terms of score gains over time and increases in the percentage of students meeting or exceeding college

readiness benchmarks in mathematics and science. In addition, schools using PLAN had increased percentages of students taking core coursework and challenging course patterns, and decreased percentages of students needing help with writing, compared to non-user schools. Moreover, longer time spans of census testing were associated with greater gains in outcome variables. Schools that were consistent census users or non-census users outperformed inconsistent census users for all outcomes except the percentage of students taking the core curriculum. These findings indicate that it is beneficial for schools to use the PLAN/ACT portion of EPAS in a consistent manner over time. Consistency could be a good indicator of how firmly entrenched the program is in the school and therefore, how much the program affects outcomes in a desirable manner.

Although the results indicate that consistency over time is a desirable implementation goal for EPAS, this study did not look specifically at how schools were using PLAN, only at the type and length of use. Data were not available on how schools used PLAN for student planning, instructional support, assessment, and evaluation. The benefits associated with the implementation of the EPAS program are directly related to how it is used. Certain uses of PLAN information could, for example, result in greater achievement.

Differences among racial/ethnic groups depended on the outcome variable of interest. In general, greater gains were found for Hispanic, Caucasian American, and Other Race students than for Asian American or African American students. This may be due, in part, to the differences in sample sizes by racial/ethnic group; sample sizes for African American and Asian American students were the smallest of all of the racial/ethnic groups.

It may also be beneficial to target certain subject areas to determine whether level of implementation differs across subjects. Although increases were observed in the percentage of

students meeting or exceeding the mathematics and science benchmarks, there was no increase observed for the English benchmarks. English could be targeted to investigate why reaching the English benchmark was not differentially affected by PLAN use.

With today's emphasis on educational planning and accountability, the EPAS program offers educators a viable option for tracking student performance and advancement. Use of the program is also related to reducing achievement gaps across racial/ethnic and gender groups. Schools that use PLAN consistently over time show improvements that non-user schools do not. This argues for schools to start using PLAN in a consistent manner (whether census testing or not) over consecutive years as a way to improve student performance.

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