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ABSTRACT

The Educational Planning and Assessment System (EPAS) of the American College Testing Program consists of three testing programs: EXPLORE, PLAN, and the ACT Assessment Program (ACT). EXPLORE is administered in the 8th grade, PLAN in the 10th grade, and the ACT in the 11th or 12th grade. This study investigated relationships among the composite scores of these three test batteries and the relationships the three composite test scores have with high school grade point average (HSGPA). The primary interest of the study was whether taking a set of college preparatory courses, here labeled the "core" set of courses, has a positive relationship with students' ACT scores, when the students have identical EXPLORE scores before starting high school. The study presents evidence that the three test batteries comprising EPAS are valid and consistent measures of students' academic achievement. It also concludes that no matter what students' initial level of achievement, as represented by their EXPLORE composite scores, students who take the core set of courses are more likely to have higher ACT composite scores than students who take less than the core set of courses. (Author/SLD)

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David J. Woodruff

Abstract

ACT's Educational Planning and Assessment System (EPAS) consists of three testing programs: EXPLORE, PLAN, and the ACT Assessment Program (ACT). EXPLORE is administered in the eighth grade, PLAN in the tenth grade, and ACT in the eleventh or twelfth grade. This report investigates relationships among the Composite scores of these three test batteries and the relationships the three Composite test scores have with high school grade point average (HSGPA). The primary interest of the study was whether taking a set of college preparatory courses, here labeled the "core" set of courses, has a positive relationship with students' ACT scores, when the students have identical EXPLORE scores before starting high school. The study presents evidence that the three test batteries comprising EPAS are valid and consistent measures of students' academic achievement. It also concludes that no matter what students' initial level of achievement, as represented by their EXPLORE Composite scores, students who take the core set of courses are more likely to have higher ACT Composite scores than students who take less than the core set of courses.

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Relationships Between EPAS Scores and College Preparatory Course Work in High School

This report presents the results of a study of the three testing programs comprising ACT's Educational Planning and Assessment System (EPAS): EXPLORE, PLAN, and the ACT Assessment (ACT). The study used the Composite scores of students who recently took all three of the test batteries while attending middle/junior high school and high school. The analyses considered the inter-relationships among the Composite scores of the three test batteries and the relationships of the Composite scores with high school grade point average (HSGPA). The study also considered differences between students who took the ACT in their junior year of high school and students who took the ACT in their senior year of high school. The main focus of the study was whether taking the "core" set of courses is related to ACT Composite scores when students had identical EXPLORE Composite scores before starting high school. Results of the analyses are presented in several tables and in two graphs.

The core set of courses is defined as taking four years of English courses, three years of mathematics courses, three years of social studies courses, and three years of science courses. In determining whether a student has satisfied the core set of courses, all courses that the student has taken, is taking, and plans to take at the time of the ACT administration are counted. A student's core status therefore measures both the student's achievements and the student's goals. For simplicity of expression, the phrase "took the core set of courses" is used in this report. However, it should be understood that the student might be in the process of taking the core set of courses, rather than having completed all of the core courses at the time of testing.

Each of the three test batteries comprising EPAS is composed of four tests: English, Mathematics, Reading, and Science. The Composite score for each battery is the average of that battery's four test scores. The content of the three test batteries is carefully constructed to reflect

the middle/junior high and high school college preparatory curriculum. ACT conducts national curriculum studies to ensure the continued appropriateness of the content of the three test batteries comprising EPAS. The last such study reviewed state educational standards for the 49 states that had published such standards, and surveyed 21,900 middle/junior high and high school teachers, along with 1,500 curriculum specialists. ACT also has developed Standards for Transition for the three EPAS test batteries. These standards describe the skills and knowledge that most students scoring in particular score ranges can demonstrate. These standards help students better understand their scores on the three test batteries in terms of the knowledge and skills necessary for success in school.

Given the curriculum-based content of the ACT, one would expect that students who take more college preparatory courses in high school would have higher ACT scores. Noble and McNabb (1989) found a positive relationship between core course work and ACT scores. Schiel, Pommerich, and Noble (1996) studied the relationship between college preparatory course work and ACT scores for students with identical PLAN scores. They found a positive relationship between core course work and ACT scores, even among students with the same PLAN Composite score. The present study examines the relationship between high school course work and ACT scores among students who have the same EXPLORE Composite score.

Data

The data consist of those students in the high school graduating class of 2002 who took all three of the EPAS test batteries while attending middle/junior high school and high school. All of the students attended public junior and senior high schools, and the primary language spoken in the home was English. The sample of students was 57% female and 43% male. Approximately

80% of the students were Caucasian, a little over 8% were African American, and the remaining 12% represented a variety of ethnic backgrounds.

At the time of ACT testing, students report course and grade data; from their self-reports the students' core status and high school GPA were calculated. Some students may take the ACT more than once. In this study only the most recent ACT score was included in the analyses. Table 1 presents mean Composite scores for the three test batteries for four student groups. The four student groups are formed from information collected at the time the ACT is administered. The groups are defined by grade level at the time of ACT testing (junior or senior year), and whether the students took the core set of courses, or less than the core set of courses, at time of ACT testing. The ACT Composite score means in Table 1 for the core and the less-than-core senior student groups are fairly close in value to the same student group means based on all nationally tested students in each year of the last five years (ACT High School Profile Report: High School Graduating Class 2002). This indicates that the sample of senior students used in this study does not differ appreciably in achievement from the national population of all tested students. Comparing the means in Table 1, one sees that the students who took the core set of courses in high school have higher test score means than the students who took less than the core set of courses in high school. This result is true for students who took the ACT as juniors and for students who took the ACT as seniors. This result will be examined more closely later.

TABLE 1

Composite Score Means for the Three Test Batteries, by Grade and Core Course Work at Time of ACT Testing

Year Took ACT	Took Core	N	EXPLORE	PLAN	ACT
Junior	Yes	7,948	18.4	20.5	23.3
Junior	No	3,848	16.5	18.7	20.7
Senior	Yes	21,236	17.0	19.1	21.9
Senior	No	10,534	15.2	17.4	19.4

Method

Correlations among the three Composite scores of EPAS were computed, as were the correlations of these Composite scores with high school GPA. In addition, mean differences in ACT Composite scores between students who satisfy the core requirement and those who do not are computed for each group of students with the same EXPLORE Composite score. It is important to recognize that the data used in this study are observational rather than experimental data. The students were not randomly assigned to the two different groups: "take the core set of courses" and "take less than the core set of courses." Their group membership was determined by self-selection. Of course, it would be nearly impossible to do an experiment where high school students were randomly assigned to take either the core set of courses or less than the core set of courses. Though observational data, unlike experimental data, cannot prove a causal relationship, it can support such an inference.

Results

Table 2 presents correlations of HSGPA with the Composite scores of each of the three test batteries for students taking the ACT in their junior year of high school and for students taking the ACT in their senior year of high school. Within each year, students are further divided into core and less-than-core groups. The correlations are quite high when one considers the wide variety of subjects in which students can take classes and the differing grading standards among subjects, teachers, and schools. The values of these correlations support the assertion that the three test batteries are measuring the knowledge and skills taught in the middle school and high school curricula. The ACT has a slightly higher correlation with HSGPA than do PLAN and EXPLORE, but that is to be expected, because the ACT is given nearer the end of high school than are the other two test batteries. The correlations of the three test batteries with HSGPA are

essentially equal for juniors and seniors. Note that not all students reported their grades, so the HSGPA analysis reported in Table 2 is based on a smaller sample of students than the analyses that follow.

TABLE 2

Correlations of HSGPA with EXPLORE, PLAN, and ACT Composite Scores, by Grade and Core Course Work at Time of ACT Testing

Year Took ACT	Took Core	N	EXPLORE	PLAN	ACT
Junior	Yes	7,602	0.51	0.52	0.54
Junior	No	3,494	0.52	0.55	0.56
Senior	Yes	20,477	0.53	0.53	0.55
Senior	No	9,500	0.52	0.54	0.54

Correlations among the Composite scores of the three test batteries for the four different student groups are presented in Table 3. All the students in this study took EXPLORE in the eighth grade, though students can take EXPLORE in the ninth grade. All students took PLAN in the tenth grade. Some students took the ACT in the eleventh grade; other students took the ACT in the twelfth grade. So, the interval between the administration of ACT and PLAN is one or two years. The interval between the administration of PLAN and EXPLORE is two years, and the interval between the administration of ACT and EXPLORE is three or four years. The stability indicated by these high values for the correlations among the three test batteries over such long test administration intervals indicates that the EPAS is consistently measuring a common set of attributes as students progress through the grades. EPAS is curriculum-based, and is designed to measure educational achievement. The inter-correlations among the three EPAS test batteries are consistent with the objective of measuring the skills and knowledge students acquire in school.

TABLE 3

Correlations Among the EXPLORE, PLAN, and ACT Composite Scores by Grade and Core Coursework at Time of ACT Testing

Year Took ACT	Took Core	N	r(ACT, PLAN)	r(PLAN, EXPLORE)	r(ACT, EXPLORE)
Junior	Yes	7,948	0.89	0.81	0.82
Junior	No	3,848	0.89	0.82	0.82
Senior	Yes	21,236	0.86	0.82	0.81
Senior	No	10,534	0.84	0.80	0.80

We now consider the relationship between taking the core set of courses and students' ACT Composite scores. Table 4 presents data for those students who took the ACT in their junior year of high school. In particular, the fifth column of the table shows differences in mean ACT Composite scores between those students who took the core set of courses and had a specific EXPLORE Composite score and those students who took less than the core set of courses and had the same EXPLORE score. The values of the EXPLORE Composite score are given in the first column. Although EXPLORE scores range from 1 to 25, there were only sufficient data for meaningful results for the score range 8 to 23. Whether the students took the core set of courses is indicated in the second column where C indicates core and L indicates less-than-core. The sample size for each subgroup is given in the third column and the mean ACT Composite score for each subgroup is given in the fourth column. The reason for conditioning on EXPLORE score is to give evidence that regardless of their starting place when beginning high school (EXPLORE score), the courses that students take in high school are related to their ACT score.

In the fifth column, the differences between the mean ACT Composite score for the core group and the mean ACT Composite score for the less-than-core group are presented. All of the differences are positive, and the unweighted mean of the differences is equal to 0.70, as can be seen in the last row of the fifth column.

TABLE 4

ACT Composite Score Means and Standard Deviations, Given EXPLORE Composite Score and Core Status of Students Who Took the ACT in the Junior Year of High School

EXPLORE Score	Core Status*	N	Mean	Difference (C-L)	Standard Deviation
8	C	26	15.6	1.7	6.10
8	L	63	13.9		1.68
9	C	49	14.8	0.2	2.13
9	L	64	14.6		2.42
10	C	95	15.6	0.7	2.85
10	L	105	14.9		2.84
11	C	124	16.1	0.7	2.53
11	L	157	15.4		2.15
12	C	183	16.6	0.2	2.23
12	L	175	16.4		2.40
13	C	269	17.9	1.0	2.68
13	L	223	16.9		2.39
14	C	355	18.7	0.7	2.47
14	L	316	18.0		2.30
15	C	488	19.4	0.9	2.54
15	L	320	18.5		2.32
16	C	649	20.4	0.6	2.61
16	L	355	19.8		2.45
17	C	679	21.3	0.7	2.51
17	L	384	20.6		2.38
18	C	798	22.2	0.5	2.55
18	L	394	21.7		2.38
19	C	843	23.5	0.9	2.58
19	L	363	22.6		2.65
20	C	874	24.6	0.4	2.59
20	L	325	24.2		2.67
21	C	915	26.2	0.8	2.83
21	L	242	25.4		2.86
22	C	709	27.8	0.7	2.83
22	L	163	27.1		3.23
23	C	583	29.4	0.1	2.74
23	L	118	29.3		3.00
				Mean=0.7	

*C denotes core. L denotes less-than-core.

The sixth column of Table 4 contains the ACT Composite score standard deviation for each of the 32 different EXPLORE score-by-core status student subgroups. The standard deviations and means are used to compute effect sizes. Effect sizes provide a practical interpretation of the mean differences, as discussed below.

The results presented in Table 4 indicate that for students with the same EXPLORE Composite score in junior high school, taking the core set of courses in high school is associated with an average 0.70 point increase in their ACT Composite score. One way of evaluating the meaningfulness of this increase is to perform statistical significance tests. However, statistical significance is a function of sample size, and when sample size is large, as in this case, very small differences can be highly statistically significant. A more practical index of the size of a difference is an effect size (Light, Singer, and Willet, 1990). In comparing the difference between the means of just two groups, an effect size is defined as the difference between the two means divided by the weighted average of the two within-group standard deviations. In the present case, there are sixteen between-group mean differences, so the mean of these sixteen mean differences, which equals 0.70, is used. The divisor is the weighted mean within-group standard deviation of the thirty-two groups, which equals 2.60. Hence the effect size for the juniors is 0.70/2.60 = 0.26. This is considered a modest effect size (Light, Singer, and Willet, 1990). Schiel (1998) discusses other interpretations of differences between mean ACT scores.

Table 5 presents the same data and statistical analyses as Table 4, but for students who took the ACT in their senior year of high school. In Table 5 EXPLORE Composite scores range from 6 to 25. The results for the seniors in Table 5 show a larger gain for the core group than the results for the juniors in Table 4. The mean of the nineteen mean differences is 0.86. The weighted mean within-group standard deviation equals 2.49. Therefore, the effect size for the

seniors is 0.86/2.49 = 0.35. This is a modest effect size. For those students who take the ACT in the senior year of high school and have the same EXPLORE Composite score in junior high school, taking the core set of courses is associated with an average increase of almost one point (0.86) in their ACT Composite score. This is a larger gain than that found for those students taking the ACT in their junior year of high school.

The larger gain for seniors could be due to the seniors having taken more core courses than the juniors at the time of ACT testing. Recall that core status classification is based on the courses the students have taken, are taking, and plan to take at the time of ACT testing. Students taking the ACT as seniors probably have taken and are taking more core courses than students taking the ACT as juniors, whereas the core status classification of the juniors may be based more on courses the juniors are planning to take, but have not yet taken.

An examination of the sample size (N) column in Table 4 and Table 5 shows that as the EXPLORE Composite score increases, there is a larger proportion of students taking the core set of courses. This indicates that students with higher EXPLORE Composite scores are more likely to take the core set of courses than are students with lower EXPLORE Composite scores. In an experimental study, this could be controlled by randomly assigning equal numbers of students to take the core set of courses and to take less than the core set of courses. Nonetheless, of those students with the same EXPLORE Composite score, those taking the core set of courses have an average increase of nearly one point in their ACT Composite score, as compared to those students who do not take the core set of courses.

TABLE 5

ACT Composite Score Means and Standard Deviations, Given EXPLORE Composite Score and Core Status of Students Who Took the ACT in the Senior Year of High School

EXPLORE Score	Core Status*	N	Mean	Difference (C-L)	Standard Deviation
6	C	34	16.1		4.40
6	L	37	13.6	2.5	2.79
7	C	80	15.3		3.44
7	L	108	13.7	1.6	2.12
8	C	148	15.0		2.21
8	L	220	14.3	0.7	2.33
9	C	251	15.1		2.36
9	L	340	14.5	0.6	2.10
10	C	400	15.8		2.37
10	L	503	15.2	0.6	2.14
11	C	669	16.5		2.33
11	L	589	15.7	0.8	2.24
12	C	912	17.0		2.34
12	L	800	16.3	0.7	2.18
13	C	1248	17.8		2.35
13	L	934	17.1	0.7	2.25
14	C	1621	18.6		2.36
14	L	1060	17.9	0.7	2.32
15	C	1765	19.5		2.37
15	L	1020	18.8	0.7	2.40
16	C	2017	20.5		2.56
16	L	1016	19.7	0.8	2.41
17	C	2053	21.5		2.52
17	L	943	20.6	0.9	2.51
18	C	2129	22.5		2.58
18	L	809	21.7	0.8	2.69
19	C	2117	23.5		2.62
19	L	707	22.6	0.9	2.67
20	C	1955	24.9		2.60
20	L	568	24.2	0.7	2.86
21	C	1676	26.3		2.63
21	L	420	25.5	0.8	2.82
22	C	1159	27.4		2.57
22	L	279	26.6	0.8	2.91
23	C	683	28.8		2.48
23	L	130	28.3	0.5	2.31
24	C	282	30.0		2.59
24	L	34	29.4	0.6	2.75
				Mean=0.86	

*C denotes core. L denotes less-than-core.

Graphical representations of the data in Tables 4 and 5 are presented in Figures 1 and 2. Figure 1 presents data for those students who took the ACT in their junior year of high school. EXPLORE Composite scores are represented on the horizontal axis; these are the scores given in the first column of Table 4. The conditional mean ACT Composite scores given in the fourth column of Table 4 are represented on the vertical axis. The ACT Composite score conditional means for the students who took the core set of courses are represented by large solid circles and are connected by lines. The ACT Composite score conditional means for the students who took less than the core set of courses are represented by large hollow circles and also are connected by lines. The two lines represent the relationship between ACT Composite scores and EXPLORE Composite scores; one line is for the core group and the other line is for the less-than-core group. The core group line everywhere lies above the less-than-core group line and this graphically demonstrates the average increase in ACT scores that students with a given EXPLORE score may gain by taking the core set of courses.

Figure 2 is identical in form to Figure 1, except that it uses the data given in Table 5. Figure 2 is similar to Figure 1, except that the separation between the core group line and the less-than-core group line is slightly larger and the two lines are slightly smoother in Figure 2. Figure 2 graphically demonstrates that seniors with the same EXPLORE Composite score who take the core set of courses tend to have slightly larger gain in their ACT Composite scores than do juniors, though juniors also show gain. The two lines in Figure 2 that relate mean ACT Composite scores to EXPLORE Composite scores for the two core status groups are slightly smoother than the same two lines in Figure 1. This is most likely due to the larger number of seniors in the study. There are 31,716 seniors and 11,406 juniors in the study; hence there are more than 2.5 as many seniors as there are juniors. It is typically the case that more students take

Figure 1. Plot of ACT Composite Means Conditional on EXPLORE Scores for Core and Less-Than-Core Juniors.

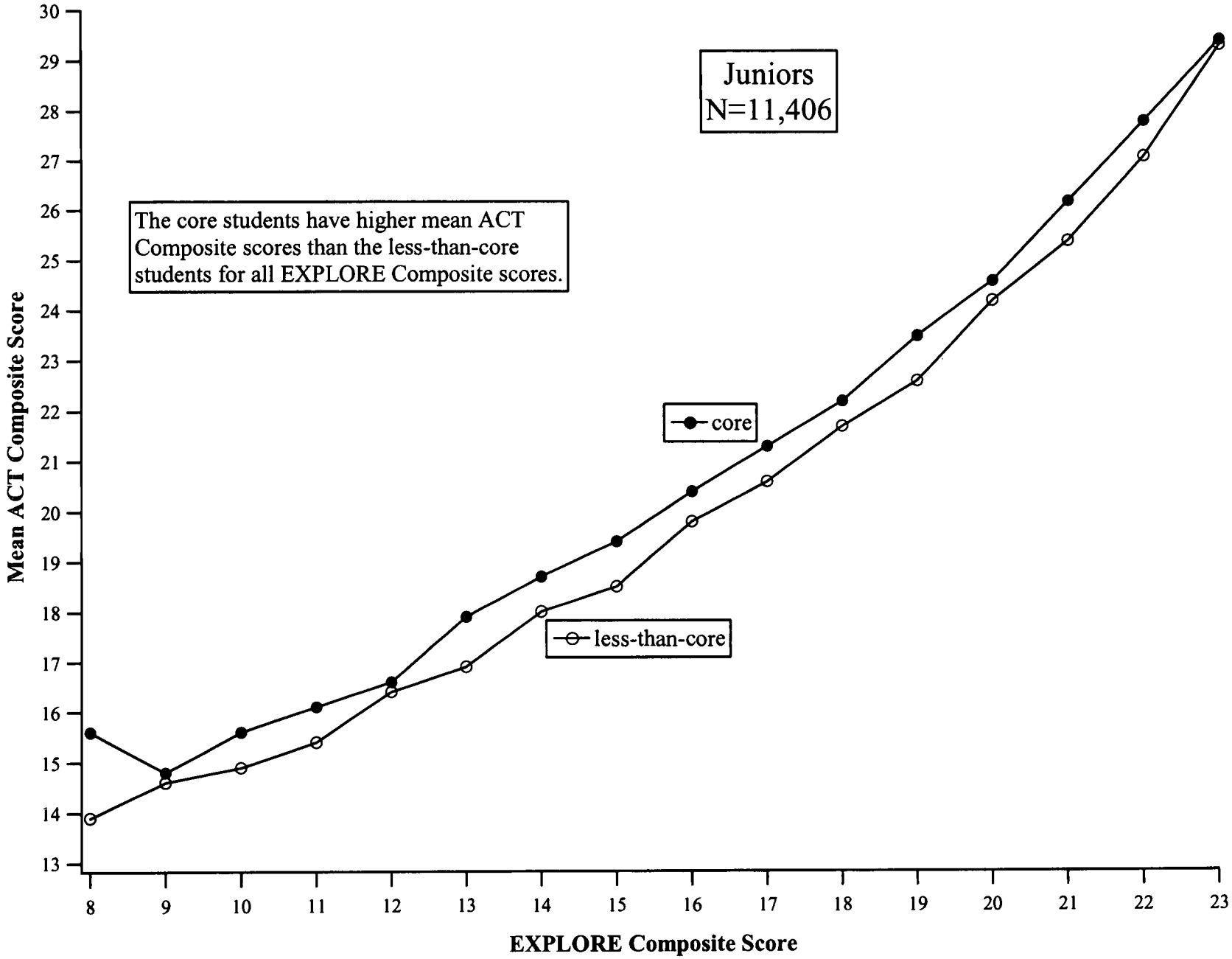
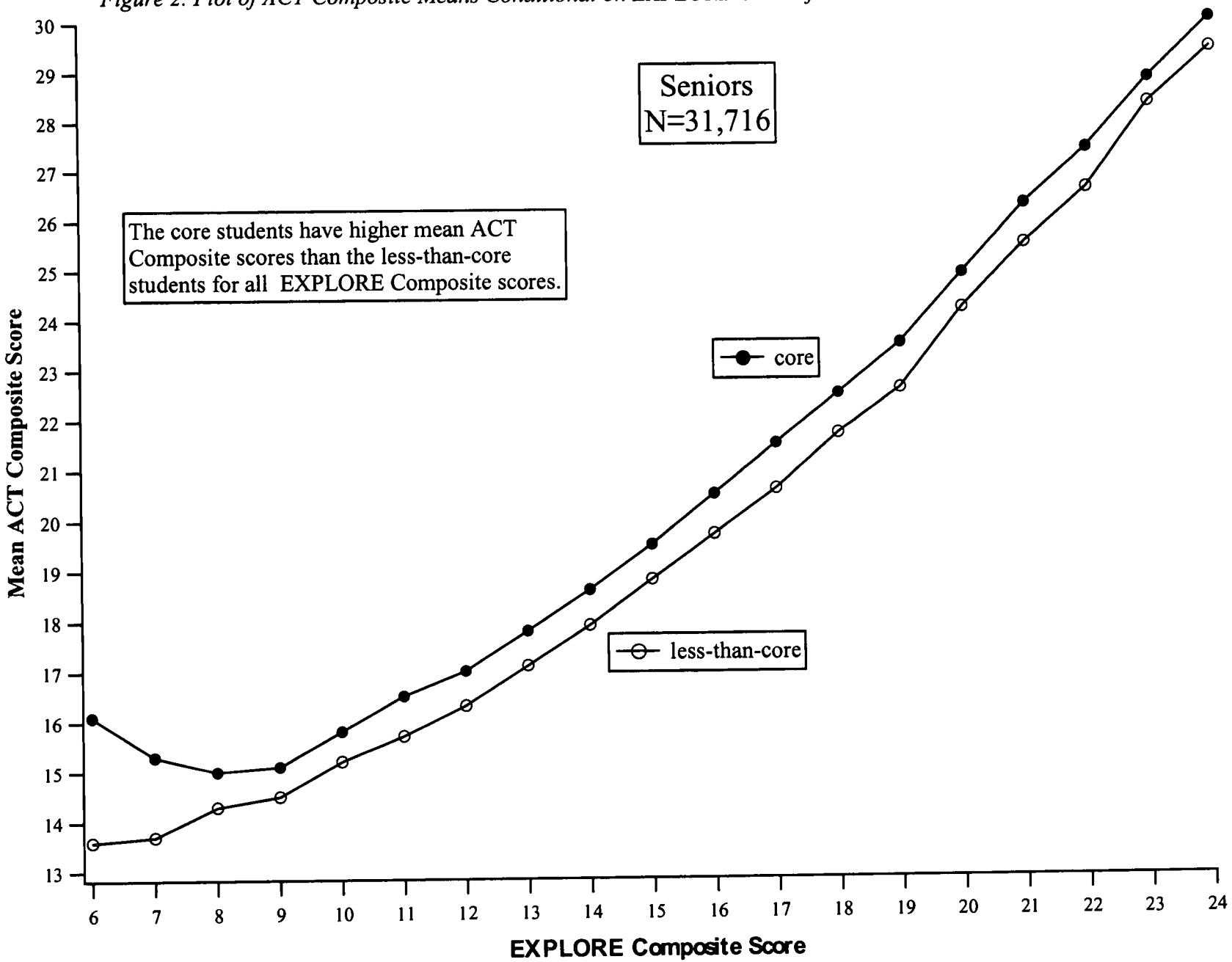


Figure 2. Plot of ACT Composite Means Conditional on EXPLORE Scores for Core and Less-Than-Core Seniors.



the ACT in the senior year of high school rather than the junior year of high school. In addition, any students who took the ACT in both the junior and senior year of high school would have only their senior year ACT score included in the study.

Discussion

EPAS is curriculum-based, and the ACT is designed to measure the knowledge and skills taught in high school that are necessary for success in college. It is sensible that students may be able to improve their ACT scores by taking the core set of college preparatory courses. Previous studies listed above have found this result. This study has found that regardless of EXPLORE Composite scores in the 8th grade, students who commit to taking the core set of courses in high school can, on average, increase their ACT Composite scores by almost one point. Thus it appears worthwhile for parents, teachers, and counselors to encourage students to commit to taking the core set of courses.

In summary, the final conclusions of this study are three. First, the three test batteries comprising EPAS have substantial correlations with HSGPA. This result supports the validity of EPAS as a measure of the high school curriculum. Second, the three test batteries are highly correlated with each other despite test administration gaps of one to four years, and are consistently measuring common attributes as students progress through grades 8 to 12. These high Composite score correlations are consistent with the primary goal of EPAS, which is to measure the skills and knowledge students acquire in junior high and high school. Third, no matter what their academic level before high school, as represented by their EXPLORE Composite score, students taking the core set of courses in high school are more likely to have higher ACT Composite scores than students taking less than the core set of courses.

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