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Course Placement and Credit-by-Examination:

How Well Are Students Prepared to Succeed in College?

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### Abstract

An increasing number of students are earning college credit in high school. These students are entering college with credit earned through such avenues as dual enrollment coursework, transfer college coursework, Advanced Placement, International Baccalaureate, College-Level Examination Program, and other forms of credit-by-examination (CBE). Colleges are also expanding the number and type of courses for which students may earn credit. Critics express concern that these students are not as prepared as students who take in-residence courses in terms of their success in sequent courses. Results indicate that students who earn prerequisite course credit through Advanced Placement CBE perform better in sequent courses in biology, rhetoric, English, and mathematics compared to students who earn in-residence prerequisite course credit.

## Course Placement and Credit-by-Examination: How Well Are Students Prepared to Succeed in College?

The purpose of this research is to investigate whether students who earn college credit for prerequisite courses in biology, rhetoric, English, history, and mathematics through dual enrollment, transfer, or various types of credit-by-examination perform as well in sequent courses as students who earn prerequisite course credit in-residence.

Most college credit earned while in high school can be obtained through one of three general categories: examination-based, school-based, and college-based. Examination-based college-credit is credit earned through such national programs as Advanced Placement (AP), the College-Level Examination Program (CLEP), and International Baccalaureate (IB). These programs offer nationally standardized examinations that are intended to correspond to college course content. (Hoffman, 2003; Johnstone & Del Genio, 2001).

The College Board (2006) reports that students who do well on Advanced Placement exams are “more likely to graduate college in five years or less, students who use AP to place out of introductory courses are more likely to pursue higher-level course study in their exam discipline, and AP Exam grades are valid predictors of college success.” Specifically, Morgan and Ramist (1998) analyzed student performance from 21 colleges and universities and discovered that students who placed out of introductory courses in math and science through Advanced Placement exams had better grades in the sequent courses than students who took the courses in-residence at the college or university. Score on the Advanced Placements exams also correlated with grade in the sequent course. These findings were also replicated by Dodd, Fitzpatrick, De Ayala, and Jennings (2002) for calculus, biology, and English courses.

School-based credit, also referred to as dual or concurrent enrollment, is granted when students take classes offered in high school and taught by college professors, adjunct college faculty, or high school teachers who are often under the guidance of college faculty. These courses earn both high school and college course credit. College-based credit is granted when students take college courses, taught by college instructors, on a college campus either while enrolled in high school or after high school graduation and earn college course credit only (Hoffman, 2003; Johnstone & Del Genio, 2001). Unlike Advanced Placement or International Baccalaureate programs, students who take dual enrollment courses are eligible to apply that credit to a college degree and do not need to take end-of-course examinations (U.S. Department of Education, n.d.).

The benefits of earning college credit while in high school are that students may save on tuition by graduating a semester or two early, taxpayers might have to accommodate students for fewer years in public colleges, and students may be able to enter the job market more quickly. (Johnstone & Del Genio, 2001). Additionally, students may be better prepared for the academic challenges of college and they may have a better sense of the skills needed to succeed in college having been exposed to actual college courses (U.S. Department of Education, n.d.). However, despite these benefits there is growing concern about whether this college-level learning in high school, regardless of how it was obtained, is equivalent to learning by a student in a college classroom taught by college faculty (Johnstone & Del Genio, 2001).

## Method

Prerequisite courses in biology, rhetoric, English, history, and mathematics at a large, public university were identified for which dual enrollment, transfer, or credit-by-examination (CBE) credit is accepted. Corresponding sequent courses were also identified. Refer to the Appendix for a key to the prerequisite and sequent courses used in the study. Students were included in the analysis if they were enrolled at the university during the fall 2002, spring 2003, or summer 2003 semester and enrolled in one of the six sequent courses (Biology 325, Rhetoric and Composition 309K, English 322, History 317L, Math 408D, or Math 408M) during that same time period. Students were classified by how they earned credit for the prerequisite biology, rhetoric, English, history, or mathematics course(s). These classifications included in-residence, dual enrollment, transfer, AP, IB, CLEP, SAT II, or university created credit-by-examination. An ANOVA was conducted with sequent course grade point average (GPA) as the dependent variable and mode of earning prerequisite course credit as the independent factor. Additionally, correlations between credit-by-examination score and sequent course GPA were calculated for each possible CBE test type. Cross-tabulations were calculated for grade earned in the prerequisite and sequent courses.

## Results

### *Biology*

Students who earned Advanced Placement CBE credit in Biology 211 did significantly better in the sequent course, Biology 325, than students who took the prerequisite course in-residence. Other forms of credit did not statistically differ from one another with respect to performance in Biology 325. Tables 1-3 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 211. The correlation between students' grade in Biology 325 and their performance on the Advanced Placement exam was 0.289,  $p < .01$ . The university credit-by-exam sample size was too small to calculate a correlation. Refer to Table 4 for correlation analysis.

Table 1  
*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 211*

| Source          | Type III sum of squares | df   | Mean square | F       | Sig. |
|-----------------|-------------------------|------|-------------|---------|------|
| Corrected Model | 20.378 <sup>a</sup>     | 3    | 6.793       | 6.354   | .000 |
| Intercept       | 371.418                 | 1    | 371.418     | 347.427 | .000 |
| Bio 211 Method  | 20.378                  | 3    | 6.793       | 6.354   | .000 |
| Error           | 1402.598                | 1312 | 1.069       |         |      |
| Total           | 11480.000               | 1316 |             |         |      |
| Corrected Total | 1422.976                | 1315 |             |         |      |

<sup>a</sup>R Squared = .014 (Adjusted R Squared = .012).

Table 2

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 211*

| Method earned credit for BIO 211 | Mean  | N     | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|-------|------------|-------------------------|-------------|
|                                  |       |       |            | Lower bound             | Upper bound |
| Advanced Placement               | 3.075 | 161   | .081       | 2.915                   | 3.234       |
| University credit-by-exam        | 3.667 | 3     | .597       | 2.496                   | 4.838       |
| Transfer                         | 2.667 | 18    | .244       | 2.189                   | 3.145       |
| In-residence course              | 2.720 | 1,134 | .031       | 2.659                   | 2.780       |

Table 3

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 211*

| (I) Method earned credit for BIO 211 | (J) Method earned credit for BIO 211 | Mean difference (I-J) | Std. Error | Sig. | 95% Confidence Interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                      |                                      |                       |            |      | Lower bound             | Upper bound |
| Advanced Placement                   | University credit-by-exam            | -.5921                | .60249     | .759 | -2.1419                 | .9577       |
|                                      | Transfer                             | .4079                 | .25697     | .386 | -.2531                  | 1.0689      |
|                                      | In-residence course                  | .3550*                | .08708     | .000 | .1310                   | .5790       |
| University credit-by-exam            | Advanced Placement                   | .5921                 | .60249     | .759 | -.9577                  | 2.1419      |
|                                      | Transfer                             | 1.0000                | .64478     | .407 | -.6586                  | 2.6586      |
|                                      | In-residence course                  | .9471                 | .59774     | .388 | -.5905                  | 2.4847      |
| Transfer                             | Advanced Placement                   | -.4079                | .25697     | .386 | -1.0689                 | .2531       |
|                                      | University credit-by-exam            | -1.0000               | .64478     | .407 | -2.6586                 | .6586       |
|                                      | In-residence course                  | -.0529                | .24563     | .996 | -.6848                  | .5789       |
| In-residence course                  | Advanced Placement                   | -.3550*               | .08708     | .000 | -.5790                  | -.1310      |
|                                      | University credit-by-exam            | -.9471                | .59774     | .388 | -2.4847                 | .5905       |
|                                      | Transfer                             | .0529                 | .24563     | .996 | -.5789                  | .6848       |

\*  $p < .05$ .

Table 4

*Correlation Between Biology 325 Grade and Score on the Advanced Placement Exam in Biology*

|               |                     | BIO 211 CBE test score <sup>a</sup> |
|---------------|---------------------|-------------------------------------|
| BIO 325 Grade | Pearson Correlation | .289**                              |
|               | Sig. (2-tailed)     | .000                                |
|               | N                   | 162                                 |

\*\*  $p < .01$ .<sup>a</sup> Bio 211 CBE test = CB Advanced Placement Exam in Biology.

Students who earned Advanced Placement CBE credit in Biology 212 did significantly better in the sequent course, Biology 325, than students who took the prerequisite course in-residence. Other forms of credit did not statistically differ from one another with respect to performance in Biology 325. Tables 5-7 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 212. The correlation between students' grade in Biology 325 and their performance on the Advanced Placement exam was 0.279,  $p < .01$ . The university credit-by-exam sample size was too small to calculate a correlation. Refer to Table 8 for correlation analysis.

Table 5

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 212*

| Source          | Type III sum of squares | df   | Mean square | F       | Sig. |
|-----------------|-------------------------|------|-------------|---------|------|
| Corrected Model | 20.646 <sup>a</sup>     | 2    | 10.323      | 9.500   | .000 |
| Intercept       | 261.231                 | 1    | 261.231     | 240.394 | .000 |
| Bio 212 Method  | 20.646                  | 2    | 10.323      | 9.500   | .000 |
| Error           | 1483.318                | 1365 | 1.087       |         |      |
| Total           | 11811.000               | 1368 |             |         |      |
| Corrected Total | 1503.964                | 1367 |             |         |      |

<sup>a</sup> R Squared = .014 (Adjusted R Squared = .012).

Table 6

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 212*

| Method earned credit for BIO 212 | Mean  | N     | Std. error | 95% Confidence Interval |             |
|----------------------------------|-------|-------|------------|-------------------------|-------------|
|                                  |       |       |            | Lower bound             | Upper bound |
| Advanced Placement               | 3.065 | 155   | .084       | 2.900                   | 3.229       |
| University credit-by-exam        | 3.667 | 3     | .602       | 2.486                   | 4.847       |
| In-residence course              | 2.702 | 1,210 | .030       | 2.643                   | 2.760       |

Table 7  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 212*

| (I) Method earned credit for BIO 212 | (J) Method earned credit for BIO 212 | Mean difference (I-J) | Std. error | Sig. | 95% Confidence Interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                      |                                      |                       |            |      | Lower bound             | Upper bound |
| Advanced Placement                   | University credit-by-exam            | -.6022                | .60765     | .583 | -2.0279                 | .8236       |
|                                      | In-residence course                  | .3629*                | .08893     | .000 | .1542                   | .5715       |
| University credit-by-exam            | Advanced Placement                   | .6022                 | .60765     | .583 | -.8236                  | 2.0279      |
|                                      | In-residence course                  | .9650                 | .60260     | .245 | -.4488                  | 2.3789      |
| In-residence course                  | Advanced Placement                   | -.3629*               | .08893     | .000 | -.5715                  | -.1542      |
|                                      | University credit-by-exam            | -.9650                | .60260     | .245 | -2.3789                 | .4488       |

\*  $p < .05$ .

Table 8  
*Correlation Between Biology 325 Grade and Score on the Advanced Placement Exam in Biology*

|               |                     | BIO 212 CBE test score <sup>a</sup> |
|---------------|---------------------|-------------------------------------|
| BIO 325 Grade | Pearson Correlation | .279**                              |
|               | Sig. (2-tailed)     | .000                                |
|               | N                   | 156                                 |

\*\*  $p < .01$

<sup>a</sup> Bio 212 CBE test = CB Advanced Placement Exam in Biology.

Students who earned Advanced Placement CBE credit in Biology 213 did significantly better in the sequent course, Biology 325, than students who took the prerequisite course in-residence. Other forms of credit did not statistically differ from one another with respect to performance in Biology 325. Tables 9-11 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 213. The correlation between students' grade in Biology 325 and their performance on the Advanced Placement exam was 0.264,  $p < .01$ . The International Baccalaureate and university credit-by-exam sample sizes were too small to calculate correlations. Refer to Table 12 for correlation analysis.

Table 9

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 213*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 34.835 <sup>a</sup>     | 3   | 11.612      | 10.007  | .000 |
| Intercept       | 268.423                 | 1   | 268.423     | 231.328 | .000 |
| Bio 213 Method  | 34.835                  | 3   | 11.612      | 10.007  | .000 |
| Error           | 1025.759                | 884 | 1.160       |         |      |
| Total           | 7477.000                | 888 |             |         |      |
| Corrected Total | 1060.593                | 887 |             |         |      |

<sup>a</sup> R Squared = .033 (Adjusted R Squared = .030).

Table 10

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 213*

| Method earned credit for BIO 213 | Mean  | N   | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|-----|------------|-------------------------|-------------|
|                                  |       |     |            | Lower bound             | Upper bound |
| Advanced Placement               | 3.080 | 174 | .082       | 2.920                   | 3.241       |
| International Baccalaureate      | 3.000 | 3   | .622       | 1.779                   | 4.221       |
| Transfer                         | 3.000 | 6   | .440       | 2.137                   | 3.863       |
| In-residence course              | 2.587 | 705 | .041       | 2.508                   | 2.667       |

Table 11  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 213*

| (I) Method earned credit for BIO 213 | (J) Method earned credit for BIO 213 | Mean difference (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|-------|-------------------------|-------------|
|                                      |                                      |                       |            |       | Lower bound             | Upper bound |
| Advanced Placement                   | International Baccalaureate          | .0805                 | .62726     | .999  | -1.5341                 | 1.6950      |
|                                      | Transfer                             | .0805                 | .44728     | .998  | -1.0708                 | 1.2317      |
|                                      | In-residence course                  | .4932*                | .09118     | .000  | .2585                   | .7279       |
| International Baccalaureate          | Advanced Placement                   | -.0805                | .62726     | .999  | -1.6950                 | 1.5341      |
|                                      | Transfer                             | .0000                 | .76170     | 1.000 | -1.9605                 | 1.9605      |
|                                      | In-residence course                  | .4128                 | .62324     | .911  | -1.1914                 | 2.0169      |
| Transfer                             | Advanced Placement                   | -.0805                | .44728     | .998  | -1.2317                 | 1.0708      |
|                                      | International Baccalaureate          | .0000                 | .76170     | 1.000 | -1.9605                 | 1.9605      |
|                                      | In-residence course                  | .4128                 | .44163     | .786  | -.7240                  | 1.5495      |
| In-residence course                  | Advanced Placement                   | -.4932*               | .09118     | .000  | -.7279                  | -.2585      |
|                                      | International Baccalaureate          | -.4128                | .62324     | .911  | -2.0169                 | 1.1914      |
|                                      | Transfer                             | -.4128                | .44163     | .786  | -1.5495                 | .7240       |

\*  $p < .05$ .

Table 12  
*Correlation Between Biology 325 Grade and Score on the Advanced Placement Exam in Biology*

|               |                     | BIO 213 CBE test score <sup>a</sup> |
|---------------|---------------------|-------------------------------------|
| BIO 325 Grade | Pearson Correlation | .264**                              |
|               | Sig. (2-tailed)     | .000                                |
|               | N                   | 177                                 |

\*\*  $p < .01$ .

<sup>a</sup> Bio 213 CBE test = CB Advanced Placement Exam in Biology.

Students who earned Advanced Placement CBE credit in Biology 214 did significantly better in the sequent course, Biology 325, than students who earned credit for the prerequisite course through transfer, university extension, or in-residence coursework. Tables 13-15 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 214. The correlation between students' grade in Biology 325 and their performance on the Advanced Placement exam was 0.286,  $p < .01$ . The International Baccalaureate and university credit-by-exam sample sizes were too small to calculate correlations. Refer to Table 16 for correlation analysis.

Table 13

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 214*

| Source          | Type III sum of squares | df   | Mean square | F       | Sig. |
|-----------------|-------------------------|------|-------------|---------|------|
| Corrected Model | 26.008 <sup>a</sup>     | 4    | 6.502       | 6.032   | .000 |
| Intercept       | 370.638                 | 1    | 370.638     | 343.874 | .000 |
| Bio 214 Method  | 26.008                  | 4    | 6.502       | 6.032   | .000 |
| Error           | 1461.538                | 1356 | 1.078       |         |      |
| Total           | 11754.000               | 1361 |             |         |      |
| Corrected Total | 1487.546                | 1360 |             |         |      |

<sup>a</sup> R Squared = .017 (Adjusted R Squared = .015).

Table 14

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 214*

| Method earned credit for BIO 214 | Mean  | N     | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|-------|------------|-------------------------|-------------|
|                                  |       |       |            | Lower bound             | Upper bound |
| Advanced Placement               | 3.081 | 160   | .082       | 2.920                   | 3.242       |
| International Baccalaureate      | 3.000 | 3     | .599       | 1.824                   | 4.176       |
| Transfer                         | 2.313 | 16    | .260       | 1.803                   | 2.822       |
| University extension             | 2.231 | 13    | .288       | 1.666                   | 2.796       |
| In-residence course              | 2.712 | 1,169 | .030       | 2.652                   | 2.771       |

Table 15  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 214*

| (I) Method earned credit for BIO 214 | (J) Method earned credit for BIO 214 | Mean difference (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|-------|-------------------------|-------------|
|                                      |                                      |                       |            |       | Lower bound             | Upper bound |
| Advanced Placement                   | International Baccalaureate          | .0812                 | .60499     | 1.000 | -1.5713                 | 1.7338      |
|                                      | Transfer                             | .7687*                | .27221     | .039  | .0252                   | 1.5123      |
|                                      | University extension                 | .8505*                | .29941     | .037  | .0327                   | 1.6683      |
|                                      | In-residence course                  | .3695*                | .08751     | .000  | .1305                   | .6086       |
| International Baccalaureate          | Advanced Placement                   | -.0812                | .60499     | 1.000 | -1.7338                 | 1.5713      |
|                                      | Transfer                             | .6875                 | .65318     | .831  | -1.0966                 | 2.4716      |
|                                      | University extension                 | .7692                 | .66497     | .776  | -1.0471                 | 2.5856      |
|                                      | In-residence course                  | .2883                 | .60017     | .989  | -1.3510                 | 1.9276      |
| Transfer                             | Advanced Placement                   | -.7687*               | .27221     | .039  | -1.5123                 | -.0252      |
|                                      | International Baccalaureate          | -.6875                | .65318     | .831  | -2.4716                 | 1.0966      |
|                                      | University extension                 | .0817                 | .38765     | 1.000 | -.9771                  | 1.1406      |
|                                      | In-residence course                  | -.3992                | .26132     | .545  | -1.1130                 | .3146       |
| University extension                 | Advanced Placement                   | -.8505*               | .29941     | .037  | -1.6683                 | -.0327      |
|                                      | International Baccalaureate          | -.7692                | .66497     | .776  | -2.5856                 | 1.0471      |
|                                      | Transfer                             | -.0817                | .38765     | 1.000 | -1.1406                 | .9771       |
|                                      | In-residence course                  | -.4810                | .28954     | .459  | -1.2718                 | .3099       |
| In-residence course                  | Advanced Placement                   | -.3695*               | .08751     | .000  | -.6086                  | -.1305      |
|                                      | International Baccalaureate          | -.2883                | .60017     | .989  | -1.9276                 | 1.3510      |
|                                      | Transfer                             | .3992                 | .26132     | .545  | -.3146                  | 1.1130      |
|                                      | University extension                 | .4810                 | .28954     | .459  | -.3099                  | 1.2718      |

\*  $p < .05$ .

Table 16  
*Correlation Between Biology 325 Grade and Score on the Advanced Placement Exam in Biology*

|               |                     | BIO 214 CBE test score <sup>a</sup> |
|---------------|---------------------|-------------------------------------|
| BIO 325 Grade | Pearson Correlation | .286**                              |
|               | Sig. (2-tailed)     | .000                                |
|               | N                   | 164                                 |

\*\*  $p < .01$ .

<sup>a</sup> Bio 214 CBE test = CB Advanced Placement Exam in Biology.

Students who earned dual enrollment credit in Biology 302 did significantly better in the sequent course, Biology 325, than students who took the prerequisite course in-residence. Other forms of credit did not statistically differ from one another with respect to performance in Biology 325. Tables 17-19 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 302. The Advanced Placement credit-by-exam sample size was too small to calculate a correlation.

Table 17

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 302*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 15.149 <sup>a</sup>     | 3   | 5.050       | 3.812   | .011 |
| Intercept       | 648.957                 | 1   | 648.957     | 489.913 | .000 |
| Bio 302 Method  | 15.149                  | 3   | 5.050       | 3.812   | .011 |
| Error           | 317.913                 | 240 | 1.325       |         |      |
| Total           | 1707.000                | 244 |             |         |      |
| Corrected Total | 333.061                 | 243 |             |         |      |

<sup>a</sup> R Squared = .045 (Adjusted R Squared = .034).

Table 18

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 302*

| Method earned credit for BIO 302 | Mean  | N   | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|-----|------------|-------------------------|-------------|
|                                  |       |     |            | Lower bound             | Upper bound |
| Advanced Placement               | 2.400 | 10  | .364       | 1.683                   | 3.117       |
| Dual enrollment                  | 2.765 | 51  | .161       | 2.447                   | 3.082       |
| Transfer                         | 2.396 | 111 | .109       | 2.181                   | 2.612       |
| In-residence course              | 2.056 | 72  | .136       | 1.788                   | 2.323       |

Table 19  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 302*

| (I) Method earned credit for BIO 302 | (J) Method earned credit for BIO 302 | Mean difference (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|-------|-------------------------|-------------|
|                                      |                                      |                       |            |       | Lower bound             | Upper bound |
| Advanced Placement                   | Dual enrollment                      | -.3647                | .39804     | .796  | -1.3945                 | .6651       |
|                                      | Transfer                             | .0036                 | .38000     | 1.000 | -.9795                  | .9867       |
|                                      | In-residence course                  | .3444                 | .38841     | .812  | -.6604                  | 1.3493      |
| Dual enrollment                      | Advanced Placement                   | .3647                 | .39804     | .796  | -.6651                  | 1.3945      |
|                                      | Transfer                             | .3683                 | .19470     | .234  | -.1354                  | .8720       |
|                                      | In-residence course                  | .7092*                | .21064     | .005  | .1642                   | 1.2541      |
| Transfer                             | Advanced Placement                   | -.0036                | .38000     | 1.000 | -.9867                  | .9795       |
|                                      | Dual enrollment                      | -.3683                | .19470     | .234  | -.8720                  | .1354       |
|                                      | In-residence course                  | .3408                 | .17416     | .207  | -.1097                  | .7914       |
| In-residence course                  | Advanced Placement                   | -.3444                | .38841     | .812  | -1.3493                 | .6604       |
|                                      | Dual enrollment                      | -.7092*               | .21064     | .005  | -1.2541                 | -.1642      |
|                                      | Transfer                             | -.3408                | .17416     | .207  | -.7914                  | .1097       |

\*  $p < .05$ .

Students who earned dual enrollment credit in Biology 303 did significantly better in the sequent course, Biology 325, than students who took the prerequisite course in-residence. Other forms of credit did not statistically differ from one another with respect to performance in Biology 325. Tables 20-22 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 303. The Advanced Placement credit-by-exam sample size was too small to calculate a correlation.

Table 20

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 303*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 13.676 <sup>a</sup>     | 3   | 4.559       | 3.373   | .020 |
| Intercept       | 316.852                 | 1   | 316.852     | 234.423 | .000 |
| Bio 303 Method  | 13.676                  | 3   | 4.559       | 3.373   | .020 |
| Error           | 241.941                 | 179 | 1.352       |         |      |
| Total           | 1266.000                | 183 |             |         |      |
| Corrected Total | 255.617                 | 182 |             |         |      |

<sup>a</sup> R Squared = .054 (Adjusted R Squared = .038).

Table 21

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 303*

| Method earned credit for BIO 303 | Mean  | N  | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|----|------------|-------------------------|-------------|
|                                  |       |    |            | Lower bound             | Upper bound |
| Advanced Placement               | 2.750 | 4  | .581       | 1.603                   | 3.897       |
| Dual enrollment transfer         | 2.721 | 43 | .177       | 2.371                   | 3.071       |
| Transfer                         | 2.369 | 84 | .127       | 2.119                   | 2.619       |
| In-residence course              | 1.981 | 52 | .161       | 1.663                   | 2.299       |

Table 22

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 303*

| (I) Method earned credit for BIO 303 | (J) Method earned credit for BIO 303 | Mean difference (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|-------|-------------------------|-------------|
|                                      |                                      |                       |            |       | Lower bound             | Upper bound |
| Advanced Placement                   | Dual enrollment                      | .0291                 | .60773     | 1.000 | -1.5470                 | 1.6051      |
|                                      | Transfer                             | .3810                 | .59498     | .919  | -1.1620                 | 1.9239      |
|                                      | In-residence course                  | .7692                 | .60324     | .580  | -.7952                  | 2.3336      |
| Dual enrollment                      | Advanced Placement                   | -.0291                | .60773     | 1.000 | -1.6051                 | 1.5470      |
|                                      | Transfer                             | .3519                 | .21800     | .373  | -.2135                  | .9172       |
|                                      | In-residence course                  | .7402*                | .23964     | .012  | .1187                   | 1.3616      |
| Transfer                             | Advanced Placement                   | -.3810                | .59498     | .919  | -1.9239                 | 1.1620      |
|                                      | Dual enrollment                      | -.3519                | .21800     | .373  | -.9172                  | .2135       |
|                                      | In-residence course                  | .3883                 | .20514     | .235  | -.1437                  | .9203       |
| In-residence course                  | Advanced Placement                   | -.7692                | .60324     | .580  | -2.3336                 | .7952       |
|                                      | Dual enrollment                      | -.7402*               | .23964     | .012  | -1.3616                 | -.1187      |
|                                      | Transfer                             | -.3883                | .20514     | .235  | -.9203                  | .1437       |

\*  $p < .05$ .

Students did not differ in their performance in Biology 325 based on how they earned credit in Biology 304. Tables 23-25 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Biology 304. The Advanced Placement credit-by-exam sample size was too small to calculate a correlation.

Table 23

*ANOVA Results for Performance in Biology 325 by How Students Earned Credit in Biology 304*

| Source          | Type III sum of squares | df | Mean square | F       | Sig. |
|-----------------|-------------------------|----|-------------|---------|------|
| Corrected Model | 9.633 <sup>a</sup>      | 2  | 4.817       | 3.709   | .030 |
| Intercept       | 191.137                 | 1  | 191.137     | 147.166 | .000 |
| BIO 304 Method  | 9.633                   | 2  | 4.817       | 3.709   | .030 |
| Error           | 79.226                  | 61 | 1.299       |         |      |
| Total           | 333.000                 | 64 |             |         |      |
| Corrected Total | 88.859                  | 63 |             |         |      |

<sup>a</sup> R Squared = .108 (Adjusted R Squared = .079).

Table 24

*Estimated Marginal Means in Biology 325 by How Students Earned Credit in Biology 304*

| Method earned credit for BIO 304 | Mean  | N  | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|----|------------|-------------------------|-------------|
|                                  |       |    |            | Lower bound             | Upper bound |
| Advanced Placement               | 2.400 | 10 | .360       | 1.679                   | 3.121       |
| Transfer                         | 2.750 | 8  | .403       | 1.944                   | 3.556       |
| In-residence course              | 1.717 | 46 | .168       | 1.381                   | 2.053       |

Table 25

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Biology 325 by How Students Earned Credit in Biology 304*

| (I) Method earned credit for BIO 304 | (J) Method earned credit for BIO 304 | Mean difference (I-J) | Std. error | Sig. | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                      |                                      |                       |            |      | Lower bound             | Upper bound |
| Advanced Placement                   | Transfer                             | -.3500                | .54058     | .795 | -1.6486                 | .9486       |
|                                      | In-residence course                  | .6826                 | .39763     | .207 | -.2726                  | 1.6378      |
| Transfer                             | Advanced Placement                   | .3500                 | .54058     | .795 | -.9486                  | 1.6486      |
|                                      | In-residence course                  | 1.0326                | .43656     | .055 | -.0161                  | 2.0813      |
| In-residence course                  | Advanced Placement                   | -.6826                | .39763     | .207 | -1.6378                 | .2726       |
|                                      | Transfer                             | -1.0326               | .43656     | .055 | -2.0813                 | .0161       |

*Rhetoric and Composition*

Students who earned Advanced Placement or SAT II: Subject Test in Writing CBE credit for the prerequisite course, Rhetoric 306, did significantly better in the sequent course, Rhetoric 309K, than students who took the prerequisite course in-residence. Tables 26-28 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Rhetoric 306. The correlation between students' grade in Rhetoric 309K and their performance on the Advanced Placement Exam in English Language & Composition was 0.285,  $p < .01$ . The correlation between students' grade in Rhetoric 309K and their performance on the SAT II: Subject Test in Writing was 0.095,  $p > .05$ . Refer to Tables 29-30 for correlation analyses.

Table 26

*ANOVA Results for Performance in Rhetoric 309K by How Students Earned Credit in Rhetoric 306*

| Source          | Type III sum of squares | df  | Mean square | F        | Sig. |
|-----------------|-------------------------|-----|-------------|----------|------|
| Corrected Model | 21.457 <sup>a</sup>     | 4   | 5.364       | 8.684    | .000 |
| Intercept       | 4634.058                | 1   | 4634.058    | 7501.700 | .000 |
| RHE 306 Method  | 21.457                  | 4   | 5.364       | 8.684    | .000 |
| Error           | 451.564                 | 731 | .618        |          |      |
| Total           | 8769.000                | 736 |             |          |      |
| Corrected Total | 473.020                 | 735 |             |          |      |

<sup>a</sup> R Squared = .045 (Adjusted R Squared = .040).

Table 27

*Estimated Marginal Means in Rhetoric 309K by How Students Earned Credit in Rhetoric 306*

| Method earned credit for RHE 306 | Mean  | N   | Std. error | 95% Confidence interval |             |
|----------------------------------|-------|-----|------------|-------------------------|-------------|
|                                  |       |     |            | Lower bound             | Upper bound |
| Advanced Placement               | 3.556 | 153 | .064       | 3.431                   | 3.680       |
| Dual enrollment                  | 3.316 | 38  | .127       | 3.065                   | 3.566       |
| SAT II subject test              | 3.554 | 157 | .063       | 3.431                   | 3.677       |
| Transfer                         | 3.250 | 52  | .109       | 3.036                   | 3.464       |
| In-residence course              | 3.196 | 336 | .043       | 3.112                   | 3.281       |

Table 28  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Rhetoric 309K by How Students Earned credit in Rhetoric 306*

| (I) Method earned credit for RHE 306 | (J) Method earned credit for RHE 306 | Mean difference (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|--------------------------------------|--------------------------------------|-----------------------|------------|-------|-------------------------|-------------|
|                                      |                                      |                       |            |       | Lower bound             | Upper bound |
| Advanced Placement                   | Dual enrollment                      | .2398                 | .14246     | .445  | -.1498                  | .6293       |
|                                      | SAT II subject test                  | .0014                 | .08929     | 1.000 | -.2427                  | .2456       |
|                                      | Transfer                             | .3056                 | .12616     | .111  | -.0394                  | .6506       |
|                                      | In-residence course                  | .3591*                | .07665     | .000  | .1495                   | .5687       |
| Dual enrollment                      | Advanced Placement                   | -.2398                | .14246     | .445  | -.6293                  | .1498       |
|                                      | SAT II subject test                  | -.2384                | .14209     | .449  | -.6269                  | .1502       |
|                                      | Transfer                             | .0658                 | .16774     | .995  | -.3929                  | .5245       |
|                                      | In-residence course                  | .1194                 | .13452     | .902  | -.2485                  | .4872       |
| SAT II subject test                  | Advanced Placement                   | -.0014                | .08929     | 1.000 | -.2456                  | .2427       |
|                                      | Dual enrollment                      | .2384                 | .14209     | .449  | -.1502                  | .6269       |
|                                      | Transfer                             | .3041                 | .12575     | .111  | -.0397                  | .6480       |
|                                      | In-residence course                  | .3577*                | .07598     | .000  | .1499                   | .5655       |
| Transfer                             | Advanced Placement                   | -.3056                | .12616     | .111  | -.6506                  | .0394       |
|                                      | Dual enrollment                      | -.0658                | .16774     | .995  | -.5245                  | .3929       |
|                                      | SAT II subject test                  | -.3041                | .12575     | .111  | -.6480                  | .0397       |
|                                      | In-residence course                  | .0536                 | .11712     | .991  | -.2667                  | .3739       |
| In-residence course                  | Advanced Placement                   | -.3591*               | .07665     | .000  | -.5687                  | -.1495      |
|                                      | Dual enrollment                      | -.1194                | .13452     | .902  | -.4872                  | .2485       |
|                                      | SAT II subject test                  | -.3577*               | .07598     | .000  | -.5655                  | -.1499      |
|                                      | Transfer                             | -.0536                | .11712     | .991  | -.3739                  | .2667       |

\*  $p < .05$ .

Table 29

*Correlation Between Rhetoric 309K Grade and Score on the Advanced Placement Exam in English Language and Composition*

|                |                     | RHE 306 CBE<br>test score <sup>a</sup> |
|----------------|---------------------|--|
| RHE 309K Grade | Pearson Correlation | .285**                                 |
|                | Sig. (2-tailed)     | .000                                   |
|                | N                   | 154                                    |

\*\*  $p < .01$ .

<sup>a</sup> RHE 306 CBE test = CB Advanced Placement Exam in English Language & Composition.

Table 30

*Correlation Between Rhetoric 309K Grade and Score on the SAT II: Subject Test in Writing*

|                |                     | RHE 306 CBE<br>test score <sup>a</sup> |
|----------------|---------------------|--|
| RHE 309K Grade | Pearson Correlation | .095                                   |
|                | Sig. (2-tailed)     | .239                                   |
|                | N                   | 155                                    |

<sup>a</sup> RHE 306 CBE test = SAT II: Subject Test in Writing.

### *English*

Students who earned Advanced Placement CBE credit for the prerequisite course, English 316K, did significantly better in the sequent course, English 322, than students who took the prerequisite course in-residence. Tables 31-33 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in English 316K. The correlation between students' grade in English 322 and their performance on the Advanced Placement Exam in English Literature and Composition was 0.070,  $p > .05$ . The International Baccalaureate and College Level Examination Program (CLEP) sample sizes were too small to calculate correlations. Refer to Table 34 for the correlation analysis.

Table 31

*ANOVA Results for Performance in English 322 by How Students Earned Credit in English 316K*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 27.126 <sup>a</sup>     | 4   | 6.782       | 5.979   | .000 |
| Intercept       | 634.590                 | 1   | 634.590     | 559.513 | .000 |
| E 316K Method   | 27.126                  | 4   | 6.782       | 5.979   | .000 |
| Error           | 301.693                 | 266 | 1.134       |         |      |
| Total           | 2810.000                | 271 |             |         |      |
| Corrected Total | 328.819                 | 270 |             |         |      |

<sup>a</sup> R Squared = .082 (Adjusted R Squared = .069).

Table 32

*Estimated Marginal Means in English 322 by How Students Earned Credit in English 316K*

| Method earned credit<br>for E 316K | Mean  | N   | Std.<br>error | 95% Confidence interval |                |
|------------------------------------|-------|-----|---------------|-------------------------|----------------|
|                                    |       |     |               | Lower<br>bound          | Upper<br>bound |
| Advanced Placement                 | 3.360 | 100 | .106          | 3.150                   | 3.570          |
| Dual enrollment                    | 2.857 | 7   | .403          | 2.065                   | 3.650          |
| International<br>Baccalaureate     | 3.600 | 5   | .476          | 2.662                   | 4.538          |
| Transfer                           | 3.150 | 40  | .168          | 2.818                   | 3.482          |
| In-residence course                | 2.689 | 119 | .098          | 2.497                   | 2.881          |

Table 33

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Rhetoric English 322 by How Students Earned Credit in English 316K*

| (I) Method earned credit for E 316K | (J) Method earned credit for E 316K | Mean difference (I-J) | Std. error | Sig. | 95% Confidence interval |             |
|-------------------------------------|-------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                     |                                     |                       |            |      | Lower bound             | Upper bound |
| Advanced Placement                  | Dual enrollment                     | .5029                 | .41637     | .747 | -.6408                  | 1.6465      |
|                                     | International Baccalaureate         | -.2400                | .48804     | .988 | -1.5804                 | 1.1004      |
|                                     | Transfer                            | .2100                 | .19924     | .830 | -.3372                  | .7572       |
|                                     | In-residence course                 | .6709*                | .14447     | .000 | .2741                   | 1.0677      |
| Dual enrollment                     | Advanced Placement                  | -.5029                | .41637     | .747 | -1.6465                 | .6408       |
|                                     | International Baccalaureate         | -.7429                | .62359     | .756 | -2.4556                 | .9699       |
|                                     | Transfer                            | -.2929                | .43633     | .962 | -1.4913                 | .9055       |
|                                     | In-residence course                 | .1681                 | .41419     | .994 | -.9696                  | 1.3057      |
| International Baccalaureate         | Advanced Placement                  | .2400                 | .48804     | .988 | -1.1004                 | 1.5804      |
|                                     | Dual enrollment                     | .7429                 | .62359     | .756 | -.9699                  | 2.4556      |
|                                     | Transfer                            | .4500                 | .50516     | .900 | -.9375                  | 1.8375      |
|                                     | In-residence course                 | .9109                 | .48618     | .334 | -.4244                  | 2.2462      |
| Transfer                            | Advanced Placement                  | -.2100                | .19924     | .830 | -.7572                  | .3372       |
|                                     | Dual enrollment                     | .2929                 | .43633     | .962 | -.9055                  | 1.4913      |
|                                     | International Baccalaureate         | -.4500                | .50516     | .900 | -1.8375                 | .9375       |
|                                     | In-residence course                 | .4609                 | .19464     | .127 | -.0737                  | .9955       |
| In-residence course                 | Advanced Placement                  | -.6709*               | .14447     | .000 | -1.0677                 | -.2741      |
|                                     | Dual enrollment                     | -.1681                | .41419     | .994 | -1.3057                 | .9696       |
|                                     | International Baccalaureate         | -.9109                | .48618     | .334 | -2.2462                 | .4244       |
|                                     | Transfer                            | -.4609                | .19464     | .127 | -.9955                  | .0737       |

\*  $p < .05$ .

Table 34

*Correlation Between English 322 Grade and Score on the Advanced Placement Exam in English Language and Composition*

|             |                     | E 316K CBE test score <sup>a</sup> |
|-------------|---------------------|------------------------------------|
| E 222 Grade | Pearson Correlation | .070                               |
|             | Sig. (2-tailed)     | .489                               |
|             | N                   | 100                                |

<sup>a</sup> E 316K CBE test = CB Advanced Placement Exam in English Literature & Composition.

### *History*

There are no significant differences among students based on how they earned credit for History 315K on performance in the sequent course, History 317L. Tables 35-36 show ANOVA results and estimated marginal means for how credit was earned in History 315K. The Advanced Placement sample size was too small to calculate a correlation.

Table 35

*ANOVA Results for Performance in History 317L by How Students Earned Credit in History 315K*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 1.899 <sup>a</sup>      | 2   | .950        | .994    | .373 |
| Intercept       | 423.692                 | 1   | 423.692     | 443.397 | .000 |
| HIS 315K Method | 1.899                   | 2   | .950        | .994    | .373 |
| Error           | 107.023                 | 112 | .956        |         |      |
| Total           | 1126.000                | 115 |             |         |      |
| Corrected Total | 108.922                 | 114 |             |         |      |

<sup>a</sup> R Squared = .017 (Adjusted R Squared = .000).

Table 36

*Estimated Marginal Means in History 317L by How Students Earned Credit in History 315K*

| Method earned credit for HIS 315K | Mean  | N  | Std. error | 95% Confidence interval |             |
|-----------------------------------|-------|----|------------|-------------------------|-------------|
|                                   |       |    |            | Lower bound             | Upper bound |
| Advanced Placement                | 3.500 | 6  | .399       | 2.709                   | 4.291       |
| Transfer                          | 2.895 | 38 | .159       | 2.581                   | 3.209       |
| In-residence course               | 2.972 | 71 | .116       | 2.742                   | 3.202       |

There are no significant differences among students based on how they earned credit for History 315L on performance in the sequent course, History 317L. Tables 37-38 show ANOVA results and estimated marginal means for how credit was earned in History 315L. The Advanced Placement sample size was too small to calculate a correlation.

Table 37

*ANOVA Results for Performance in History 317L by How Students Earned Credit in History 315L*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 1.798 <sup>a</sup>      | 2   | .899        | .897    | .411 |
| Intercept       | 418.299                 | 1   | 418.299     | 417.606 | .000 |
| HIS 315L Method | 1.798                   | 2   | .899        | .897    | .411 |
| Error           | 98.163                  | 98  | 1.002       |         |      |
| Total           | 1021.000                | 101 |             |         |      |
| Corrected Total | 99.960                  | 100 |             |         |      |

<sup>a</sup> R Squared = .018 (Adjusted R Squared = -.002).

Table 38

*Estimated Marginal Means in History 317L by How Students Earned Credit in History 315L*

| Method earned credit for HIS 315L | Mean  | N  | Std. error | 95% Confidence Interval |             |
|-----------------------------------|-------|----|------------|-------------------------|-------------|
|                                   |       |    |            | Lower bound             | Upper bound |
| Advanced Placement                | 3.500 | 6  | .409       | 2.689                   | 4.311       |
| Transfer                          | 2.909 | 33 | .174       | 2.563                   | 3.255       |
| In-residence course               | 3.032 | 62 | .127       | 2.780                   | 3.284       |

### *Mathematics*

Students who earned Advanced Placement or CLEP credit for the prerequisite course, Mathematics 408C, did significantly better in the sequent course, Mathematics 408D, than students who took the prerequisite course in-residence. Tables 39-41 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Math 408D. The correlation between students' grade in Math 408D and their performance on the Advanced Placement Exam in Calculus BC was 0.329,  $p < .01$ . The correlation between students' grade in Math 408D and their performance on the Advanced Placement Exam in Calculus AB was 0.228,  $p < .01$ . The International Baccalaureate and College Level Examination Program (CLEP) sample sizes were too small to calculate correlations. Refer to Tables 42-43 for correlation analyses.

Table 39

*ANOVA Results for Performance in Math 408D by How Students Earned Credit in Math 408C*

| Source          | Type III sum of squares | df   | Mean square | F       | Sig. |
|-----------------|-------------------------|------|-------------|---------|------|
| Corrected Model | 309.09 <sup>a</sup>     | 6    | 51.515      | 34.974  | .000 |
| Intercept       | 320.056                 | 1    | 320.056     | 217.290 | .000 |
| M 408C Method   | 309.090                 | 6    | 51.515      | 34.974  | .000 |
| Error           | 3697.084                | 2510 | 1.473       |         |      |
| Total           | 22194.000               | 2517 |             |         |      |
| Corrected Total | 4006.175                | 2516 |             |         |      |

<sup>a</sup> R Squared = .077 (Adjusted R Squared = .075).

Table 40

*Estimated Marginal Means in Math 408D by How Students Earned Credit in Math 408C*

| Method earned credit for M 408C | Mean  | N     | Std. error | 95% Confidence interval |             |
|---------------------------------|-------|-------|------------|-------------------------|-------------|
|                                 |       |       |            | Lower bound             | Upper bound |
| Advanced Placement              | 3.149 | 881   | .041       | 3.069                   | 3.229       |
| CLEP                            | 3.467 | 15    | .313       | 2.852                   | 4.081       |
| Correspondence                  | 3.500 | 2     | .858       | 1.817                   | 5.183       |
| International Baccalaureate     | 3.167 | 6     | .495       | 2.195                   | 4.138       |
| Transfer                        | 2.500 | 4     | .607       | 1.310                   | 3.690       |
| University extension            | 2.333 | 3     | .701       | .959                    | 3.707       |
| In-residence course             | 2.427 | 1,606 | .030       | 2.367                   | 2.486       |

Table 41  
*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Math 408D by How Students Earned Credit in Math 408C*

| (I) Method earned credit for M 408C | (J) Method earned credit for M 408C | Mean diff (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|-------------------------------------|-------------------------------------|-----------------|------------|-------|-------------------------|-------------|
|                                     |                                     |                 |            |       | Lower bound             | Upper bound |
| Advanced Placement                  | CLEP                                | -.3180          | .31602     | .953  | -1.2505                 | .6145       |
|                                     | Correspondence                      | -.3513          | .85915     | 1.000 | -2.8864                 | 2.1838      |
|                                     | International Baccalaureate         | -.0180          | .49715     | 1.000 | -1.4849                 | 1.4490      |
|                                     | Transfer                            | .6487           | .60820     | .938  | -1.1459                 | 2.4433      |
|                                     | University extension                | .8154           | .70189     | .908  | -1.2557                 | 2.8864      |
|                                     | In-residence course                 | .7222*          | .05088     | .000  | .5720                   | .8723       |
| CLEP                                | Advanced Placement                  | .3180           | .31602     | .953  | -.6145                  | 1.2505      |
|                                     | Correspondence                      | -.0333          | .91360     | 1.000 | -2.7291                 | 2.6624      |
|                                     | International Baccalaureate         | .3000           | .58625     | .999  | -1.4299                 | 2.0299      |
|                                     | Transfer                            | .9667           | .68296     | .794  | -1.0486                 | 2.9819      |
|                                     | University extension                | 1.1333          | .76758     | .759  | -1.1316                 | 3.3982      |
|                                     | In-residence course                 | 1.0401*         | .31482     | .017  | .1112                   | 1.9691      |
| Correspondence                      | Advanced Placement                  | .3513           | .85915     | 1.000 | -2.1838                 | 2.8864      |
|                                     | CLEP                                | .0333           | .91360     | 1.000 | -2.6624                 | 2.7291      |
|                                     | International Baccalaureate         | .3333           | .99094     | 1.000 | -2.5907                 | 3.2573      |
|                                     | Transfer                            | 1.0000          | 1.05105    | .964  | -2.1014                 | 4.1014      |
|                                     | University extension                | 1.1667          | 1.10790    | .941  | -2.1024                 | 4.4358      |
|                                     | In-residence course                 | 1.0735          | .85871     | .874  | -1.4603                 | 3.6073      |
| International Baccalaureate         | Advanced Placement                  | .0180           | .49715     | 1.000 | -1.4490                 | 1.4849      |
|                                     | CLEP                                | -.3000          | .58625     | .999  | -2.0299                 | 1.4299      |
|                                     | Correspondence                      | -.3333          | .99094     | 1.000 | -3.2573                 | 2.5907      |
|                                     | Transfer                            | .6667           | .78341     | .979  | -1.6449                 | 2.9783      |
|                                     | University extension                | .8333           | .85818     | .960  | -1.6989                 | 3.3656      |
|                                     | In-residence course                 | .7401           | .49639     | .750  | -.7246                  | 2.2049      |
| Transfer                            | Advanced Placement                  | -.6487          | .60820     | .938  | -2.4433                 | 1.1459      |
|                                     | CLEP                                | -.9667          | .68296     | .794  | -2.9819                 | 1.0486      |
|                                     | Correspondence                      | -1.0000         | 1.05105    | .964  | -4.1014                 | 2.1014      |
|                                     | International Baccalaureate         | -.6667          | .78341     | .979  | -2.9783                 | 1.6449      |
|                                     | University extension                | .1667           | .92694     | 1.000 | -2.5685                 | 2.9018      |
|                                     | In-residence course                 | .0735           | .60758     | 1.000 | -1.7193                 | 1.8663      |
| University extension                | Advanced Placement                  | -.8154          | .70189     | .908  | -2.8864                 | 1.2557      |
|                                     | CLEP                                | -1.1333         | .76758     | .759  | -3.3982                 | 1.1316      |
|                                     | Correspondence                      | -1.1667         | 1.10790    | .941  | -4.4358                 | 2.1024      |
|                                     | International Baccalaureate         | -.8333          | .85818     | .960  | -3.3656                 | 1.6989      |
|                                     | Transfer                            | -.1667          | .92694     | 1.000 | -2.9018                 | 2.5685      |
|                                     | In-residence course                 | -.0932          | .70135     | 1.000 | -2.1627                 | 1.9763      |

Table 41 continued

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Math 408D by How Students Earned Credit in Math 408C*

| (I) Method earned credit for M 408C | (J) Method earned credit for M 408C | Mean diff (I-J) | Std. error | Sig.  | 95% Confidence interval |             |
|-------------------------------------|-------------------------------------|-----------------|------------|-------|-------------------------|-------------|
|                                     |                                     |                 |            |       | Lower bound             | Upper bound |
| In-residence course                 | Advanced Placement                  | -.7222*         | .05088     | .000  | -.8723                  | -.5720      |
|                                     | CLEP                                | -1.0401*        | .31482     | .017  | -1.9691                 | -.1112      |
|                                     | Correspondence                      | -1.0735         | .85871     | .874  | -3.6073                 | 1.4603      |
|                                     | International Baccalaureate         | -.7401          | .49639     | .750  | -2.2049                 | .7246       |
|                                     | Transfer                            | -.0735          | .60758     | 1.000 | -1.8663                 | 1.7193      |
|                                     | University extension                | .0932           | .70135     | 1.000 | -1.9763                 | 2.1627      |

\*  $p < .05$ .

Table 43

*Correlation Between Math 408D Grade and Score on the Advanced Placement Exam in Calculus BC*

|              |                     | M 408C CBE test score <sup>a</sup> |
|--------------|---------------------|------------------------------------|
| M 408D Grade | Pearson Correlation | .329**                             |
|              | Sig. (2-tailed)     | .000                               |
|              | N                   | 333                                |

\*\*  $p < .01$ .

<sup>a</sup> M 408C CBE test = CB Advanced Placement Exam in Calculus BC.

Table 43

*Correlation Between Math 408D Grade and Score on the Advanced Placement Exam in Calculus AB*

|             |                     | M 408C CBE test score <sup>a</sup> |
|-------------|---------------------|------------------------------------|
| M408D Grade | Pearson Correlation | .228**                             |
|             | Sig. (2-tailed)     | .000                               |
|             | N                   | 548                                |

\*\*  $p < .01$ .

<sup>a</sup> M 408C CBE test = CB Advanced Placement Exam in Calculus AB.

Students who earned Advanced Placement CBE credit for the prerequisite course, Mathematics 408K, did significantly better in the sequent course, Mathematics 408M, than students who earned credit for the prerequisite course through dual enrollment or transfer credit. Tables 44-46 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Math 408M. The correlation between students' grade in Math 408M and their performance on the Advanced Placement Exam in Calculus BC was 0.560,  $p < .01$ . Refer to Table 47 for the correlation analysis.

Table 44

*ANOVA Results for Performance in Math 408M by How Students Earned Credit in Math 408K*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 45.173 <sup>a</sup>     | 2   | 22.587      | 17.975  | .000 |
| Intercept       | 740.787                 | 1   | 740.787     | 589.540 | .000 |
| M 408K Method   | 45.173                  | 2   | 22.587      | 17.975  | .000 |
| Error           | 157.069                 | 125 | 1.257       |         |      |
| Total           | 1079.000                | 128 |             |         |      |
| Corrected Total | 202.242                 | 127 |             |         |      |

<sup>a</sup> R Squared = .223 (Adjusted R Squared = .211).

Table 45

*Estimated Marginal Means in Math 408M by How Students Earned Credit in Math 408K*

| Method earned credit for M 408K | Mean  | N  | Std. error | 95% Confidence interval |             |
|---------------------------------|-------|----|------------|-------------------------|-------------|
|                                 |       |    |            | Lower bound             | Upper bound |
| Advanced Placement              | 3.645 | 31 | .201       | 3.247                   | 4.044       |
| Dual enrollment                 | 2.042 | 24 | .229       | 1.589                   | 2.495       |
| Transfer                        | 2.370 | 73 | .131       | 2.110                   | 2.630       |

Table 46

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Math 408M by How Students Earned Credit in Math 408K*

| (I) Method earned credit for M 408K | (J) Method earned credit for M 408K | Mean difference (I-J) | Std. error | Sig. | 95% Confidence interval |             |
|-------------------------------------|-------------------------------------|-----------------------|------------|------|-------------------------|-------------|
|                                     |                                     |                       |            |      | Lower bound             | Upper bound |
| Advanced Placement                  | Dual enrollment                     | 1.6035*               | .30478     | .000 | .8806                   | 2.3264      |
|                                     | Transfer                            | 1.2753*               | .24031     | .000 | .7053                   | 1.8453      |
| Dual enrollment                     | Advanced Placement                  | -1.6035*              | .30478     | .000 | -2.3264                 | -.8806      |
|                                     | Transfer                            | -.3282                | .26376     | .430 | -.9538                  | .2974       |
| Transfer                            | Advanced Placement                  | -1.2753*              | .24031     | .000 | -1.8453                 | -.7053      |
|                                     | Dual enrollment                     | .3282                 | .26376     | .430 | -.2974                  | .9538       |

\*  $p < .05$ .

Table 47

*Correlation Between Math 408M Grade and Score on the Advanced Placement Exam in Calculus BC*

|              |                     | M 408K CBE test score <sup>a</sup> |
|--------------|---------------------|------------------------------------|
| M 408M Grade | Pearson Correlation | .560**                             |
|              | Sig. (2-tailed)     | .001                               |
|              | N                   | 31                                 |

\*\*  $p < .01$ .

<sup>a</sup> M 408K CBE test = CB Advanced Placement Exam in Calculus BC.

Students who earned Advanced Placement CBE credit for the prerequisite course, Mathematics 408L, did significantly better in the sequent course, Mathematics 408M, than students who took the prerequisite course in-residence or earned dual enrollment or transfer credit. Tables 48-50 show ANOVA results, estimated marginal means, and multiple comparison results for how credit was earned in Math 408M. The correlation between students' grade in Math 408M and their performance on the Advanced Placement Exam in Calculus BC was 0.539,  $p < .01$ . Refer to Table 51 for the correlation analysis.

Table 48

*ANOVA Results for Performance in Math 408M by How Students Earned Credit in Math 408L*

| Source          | Type III sum of squares | df  | Mean square | F       | Sig. |
|-----------------|-------------------------|-----|-------------|---------|------|
| Corrected Model | 46.713 <sup>a</sup>     | 3   | 15.571      | 11.922  | .000 |
| Intercept       | 640.559                 | 1   | 640.559     | 490.459 | .000 |
| M 408L Method   | 46.713                  | 3   | 15.571      | 11.922  | .000 |
| Error           | 172.397                 | 132 | 1.306       |         |      |
| Total           | 1125.000                | 136 |             |         |      |
| Corrected Total | 219.110                 | 135 |             |         |      |

<sup>a</sup> R Squared = .213 (Adjusted R Squared = .195).

Table 49

*Estimated Marginal Means in Math 408M by How Students Earned Credit in Math 408L*

| Method earned credit for M 408L | Mean  | N  | Std. error | 95% Confidence interval |             |
|---------------------------------|-------|----|------------|-------------------------|-------------|
|                                 |       |    |            | Lower bound             | Upper bound |
| Advanced Placement              | 3.667 | 30 | .209       | 3.254                   | 4.079       |
| Dual enrollment                 | 2.100 | 20 | .256       | 1.595                   | 2.605       |
| Transfer                        | 2.352 | 71 | .136       | 2.084                   | 2.620       |
| In-residence course             | 2.133 | 15 | .295       | 1.550                   | 2.717       |

Table 50

*Multiple Comparisons (Tukey HSD) of Observed Mean Differences in Math 408M by How Students Earned Credit in Math 408L*

| (I) Method<br>earned credit for<br>M 408L | (J) Method<br>earned credit for<br>M 408L | Mean<br>difference<br>(I-J) | Std.<br>error | Sig.  | 95% Confidence<br>interval |                |
|---|---|-----------------------------|---------------|-------|----------------------------|----------------|
|   |   |                             |               |       | Lower<br>bound             | Upper<br>bound |
| Advanced<br>Placement                     | Dual enrollment                           | 1.5667*                     | .32990        | .000  | .7082                      | 2.4251         |
|   | Transfer                                  | 1.3146*                     | .24886        | .000  | .6670                      | 1.9621         |
|   | In-residence<br>course                    | 1.5333*                     | .36139        | .000  | .5930                      | 2.4737         |
| Dual enrollment                           | Advanced<br>Placement                     | -1.5667*                    | .32990        | .000  | -2.4251                    | -.7082         |
|   | Transfer                                  | -.2521                      | .28930        | .820  | -1.0049                    | .5007          |
|   | In-residence<br>course                    | -.0333                      | .39035        | 1.000 | -1.0490                    | .9824          |
| Transfer                                  | Advanced<br>Placement                     | -1.3146*                    | .24886        | .000  | -1.9621                    | -.6670         |
|   | Dual enrollment                           | .2521                       | .28930        | .820  | -.5007                     | 1.0049         |
|   | In-residence<br>course                    | .2188                       | .32475        | .907  | -.6262                     | 1.0638         |
| In-residence<br>course                    | Advanced<br>Placement                     | -1.5333*                    | .36139        | .000  | -2.4737                    | -.5930         |
|   | Dual enrollment                           | .0333                       | .39035        | 1.000 | -.9824                     | 1.0490         |
|   | Transfer                                  | -.2188                      | .32475        | .907  | -1.0638                    | .6262          |

\*  $p < .05$ .

Table 51

*Correlation Between Math 408M Grade and Score on the Advanced Placement Exam in Calculus BC*

|              |                     | M 408L CBE<br>test score <sup>a</sup> |
|--------------|---------------------|---------------------------------------|
| M 408M Grade | Pearson Correlation | .539**                                |
|              | Sig. (2-tailed)     | .002                                  |
|              | N                   | 30                                    |

\*\*  $p < .01$ .

<sup>a</sup> M 408L CBE test = CB Advanced Placement Exam in Calculus BC.

*Summary*

Results indicate that students who earned prerequisite course credit in biology, rhetoric, English, and mathematics through qualifying Advanced Placement examinations performed better in sequent courses than students who earned credit for the prerequisite course by taking the course in-residence. Except in a few cases students earning other forms of credit (dual enrollment, transfer, AP, IB, CLEP, SAT II, or university created credit-by-examination) did not perform better in sequent courses. Refer to Table 52 for a summary cross-tabulation of sequent course grade point average by how credit was earned in the prerequisite course.

Table 52

Average Sequent Course GPA Based on How Credit Was Earned in the Prerequisite Course(s)

| Sequent Course                               |                         | Biology 325                |                            |                          |                            |                         |                         | Rhe<br>309K | English<br>322           | History 317L             |             | Math<br>408D | Math 408M                  |                         |                         |
|--|-------------------------|----------------------------|----------------------------|--------------------------|----------------------------|-------------------------|-------------------------|-------------|--------------------------|--------------------------|-------------|--------------|----------------------------|-------------------------|-------------------------|
| Prerequisite Course<br>GPA<br>N              |                         | BIO<br>211                 | BIO<br>212                 | BIO<br>213               | BIO<br>214                 | BIO<br>302              | BIO<br>303              | BIO<br>304  | RHE<br>306               | E<br>316K                | HIS<br>315K | HIS<br>315L  | M<br>408C                  | M<br>408K               | M<br>408L               |
| How Earned Credit for<br>Prerequisite course |                         |                            |                            |                          |                            |                         |                         |             |                          |                          |             |              |                            |                         |                         |
| Forms<br>of<br>CBE                           | In-residence            | 2.72 <sup>b</sup><br>1,134 | 2.70 <sup>b</sup><br>1,210 | 2.59 <sup>b</sup><br>705 | 2.71 <sup>b</sup><br>1,169 | 2.06 <sup>b</sup><br>72 | 1.98 <sup>b</sup><br>52 | 1.72<br>46  | 3.20 <sup>b</sup><br>336 | 2.69 <sup>b</sup><br>119 | 2.97<br>71  | 3.03<br>62   | 2.43 <sup>b</sup><br>1,606 |                         | 2.13 <sup>b</sup><br>15 |
|  | Advanced<br>Placement   | 3.08 <sup>a</sup><br>161   | 3.07 <sup>a</sup><br>155   | 3.08 <sup>a</sup><br>174 | 3.08 <sup>a</sup><br>160   | 2.40<br>10              | 2.75<br>4               | 2.40<br>10  | 3.56 <sup>a</sup><br>153 | 3.36 <sup>a</sup><br>100 | 3.50<br>6   | 3.50<br>6    | 3.15 <sup>a</sup><br>881   | 3.65 <sup>a</sup><br>31 | 3.67 <sup>a</sup><br>30 |
|  | CLEP                    |                            |                            |                          |                            |                         |                         |             |                          |                          |             |              | 3.47 <sup>a</sup><br>15    |                         |                         |
|  | IB                      |                            |                            | 3.00<br>3                | 3.00<br>3                  |                         |                         |             |                          | 3.60<br>5                |             |              | 3.17<br>6                  |                         |                         |
|  | SAT II subject          |                            |                            |                          |                            |                         |                         |             | 3.55 <sup>a</sup><br>157 |                          |             |              |                            |                         |                         |
|  | University CBE          | 3.67<br>3                  | 3.67<br>3                  |                          |                            |                         |                         |             |                          |                          |             |              |                            |                         |                         |
| School<br>-based                             | Dual<br>Enrollment      |                            |                            |                          |                            | 2.77 <sup>a</sup><br>51 | 2.72 <sup>a</sup><br>43 |             | 3.32<br>38               | 2.86<br>7                |             |              |                            | 2.04 <sup>b</sup><br>24 | 2.10 <sup>b</sup><br>20 |
| College<br>-based                            | Correspondence          |                            |                            |                          |                            |                         |                         |             |                          |                          |             |              | 3.50<br>2                  |                         |                         |
|  | Transfer                | 2.67<br>18                 |                            | 3.00<br>6                | 2.31 <sup>b</sup><br>16    | 2.40<br>111             | 2.37<br>84              | 2.75<br>8   | 3.25<br>52               | 3.15<br>40               | 2.90<br>38  | 2.91<br>33   | 2.50<br>4                  | 2.37 <sup>b</sup><br>73 | 2.35 <sup>b</sup><br>71 |
|  | University<br>Extension |                            |                            |                          | 2.23 <sup>b</sup><br>13    |                         |                         |             |                          |                          |             |              | 2.33<br>3                  |                         |                         |

<sup>a</sup> Prerequisite category that has a statistically higher mean GPA in the sequent course at the  $p < .05$  level.<sup>b</sup> Prerequisite category that has a statistically lower mean GPA in the sequent course at the  $p < .05$  level.

## Discussion

Students who earned Advanced Placement CBE credit for any of the current prerequisite courses, Biology 211-214, did significantly better in the sequent course, Biology 325, than students who took any of the prerequisite courses in-residence. A small, but significant correlation exists between students' score on the Advanced Placement exam and their grade in the sequent biology course. While students did earn credit through university developed credit-by-examinations, transfer, International Baccalaurate, or university extension programs, the number of students in these categories was eighteen or fewer. Given the small sample sizes it is not surprising that no differences were found.

Students who earned dual enrollment credit for Biology 302 and 303 (the previous prerequisite courses) did significantly better in the sequent course, Biology 325, than students who took either of these prerequisite courses in-residence. In this case there were approximately fifty students who earned dual enrollment credit, a sample size large enough to determine if students in this category outperform their in-residence counterparts. Unfortunately, the number of Advanced Placement scores available is too small to make viable comparisons. While dual enrollment students did do better than students who took the course in-residence, these students did not differ from traditional transfer students.

For both sets of biology prerequisite courses, it appears that students who enter with either Advanced Placement or dual enrollment credit have better overall grades in the biology sequent course compared to students who earn credit for the prerequisite courses in-residence. At this particular university, the introductory biology courses are taught in large, multi-section lecture halls with smaller lab sections taught by graduate students once a week. Students in Advanced Placement or dual enrollment programs may be benefiting from smaller class sizes and more personal, experienced instruction in the high school setting than they receive in-residence at the university. These differences may contribute to student performance disparity in the sequent biology course.

Students who earned credit for the introductory rhetoric and composition course, RHE 306, through the Advanced Placement or SAT II: Subject Test in Writing, have higher grades in the sequent course, RHE 309K, than students who earn credit in-residence. A small, but significant correlation exists between students' score on the Advanced Placement exam and their grade in the sequent rhetoric course. The correlation between students' scores on the SAT II: Subject Test in Writing and their grade in the sequent course was not significant. The university has a policy that all students who do are not eligible for credit through some type of credit-by-examination (AP, IB, SAT II) or other transfer work must take a locally administered SAT II: Subject Test in Writing examination. This examination is used for both granting credit and placement purposes. So, students who take the course in-residence did not bring any CBE or transfer work and did not have high enough qualifying scores on the locally administered placement exam to receive credit. Therefore, it is not surprising that students with Advanced Placement and SAT II scores outperform the students who took the course in-residence as these are the students who have been intentionally screened out to enroll in the course because of poor skills in this area.

Students who earned Advanced Placement credit for the introductory English course, E 316K, did better in the sequent course, E 322, than students who took the prerequisite course in-residence. Except for transfer credit, the number of students in the other categories was too small to make comparisons. Similar to biology, the prerequisite English course is taught in a large, multi-section lecture course with smaller graduate student led discussion section meetings once a week. The smaller enrollment found in the Advanced Placement course at the high school level taught by experienced teachers may better prepare students to do well in a literature-based sequent course than the current university format. The correlation between scores on the Advanced Placement exam and the grade in the sequent course was not significant. This may have been due to restriction in range in the sequent course grade distribution as the grade point averages across all categories varied from 3.20 – 3.56.

The number of students having any type of credit for the history prerequisite courses was too small to make any conclusions about how students perform in the history sequent course. The university has a history requirement for all students and the credit awarded for the credit-by-examination or other types of transfer credit are history elective courses and do not fulfill the university requirement. Therefore, this subject area is one where students choose to take the required history courses in-residence.

Students who earned Advanced Placement or CLEP credit for the prerequisite math course, M 408C, did better in the sequent course, M 408D, than students who took the prerequisite course in-residence. The other forms of earning credit had sample sizes that were too small to make comparisons. Additionally, the number of students with a CLEP score was also small so those findings should be interpreted with caution. The Advanced Placement students outperformed their in-residence counterparts by three-quarters of a letter grade (0.72) in the sequent course. Small but significant correlations occurred between the Advanced Placement exams (Calculus BC or AB) and grade in the sequent course. During the time the study data was taken mathematics courses for M 408C were taught in mid-sized lectures (about 100 students) with graduate student led discussion sections meeting once a week. Calculus is a requirement for many majors and a large number of students who do not have credit-by-examination or other forms of credit must enroll in the course.

In addition to the traditional Math 408C/408D sequence students may elect to take Math 408K/408L/408M, a three-semester sequence that is equivalent, but slower-paced, than the Math 408C/408D sequence. Students who earned Advanced Placement credit for Math 408K outperformed students who earned dual enrollment or transfer credit in the sequent math course (no in-residence students were available for comparison). Students who earned Advanced Placement credit for Math 408L did better than students who earned dual enrollment, transfer, or in-residence credit for the sequent course. There was a moderate and significant correlation between Advanced Placement score and grade in the sequent course for these students. This suggests that Advanced Placement students are adequately prepared for the sequent course and may benefit from taking the slower-paced sequent course. However, the number of students in all categories that elected to take the Math 408K/408L/408M sequence is small so results should be interpreted with caution. Most students are required to take Math 408D as the sequent course so the group of students that take M 408M may differ from those that take Math 408D.

### *Limitations and areas for future research*

The small sample sizes for some subject areas and forms of credit often made it impossible to make comparisons or conclusions. A larger sample of students across multiple academic years should be drawn to better determine how students perform in sequent courses based on how they earn credit in the prerequisite course. Prior knowledge or skills were not controlled for in this study and another possible limitation is that students who choose to take Advanced Placement courses in high school may be better students to begin with which could explain their higher grades in sequent courses.

The prerequisite courses taught at the university and included in this study are all structured as medium to large enrollment courses (one hundred to several hundred students) with a smaller enrollment discussion section. Typically, students who take Advanced Placement, dual enrollment, or transfer coursework are doing so in high school courses with smaller enrollments. It may be that students in smaller courses benefit more from earning credit in prerequisite courses outside the university. Future research should explore the possible impact class size has on performance.

Additionally, the large enrollment university level courses are usually taught by full-time faculty with the smaller discussion sections led by graduate students. The graduate student instructors may have little or no teaching experience and are the primary contact for small group or one-on-one instruction with students. In contrast, Advanced Placement courses are often taught by experienced high school teachers. Therefore, students in Advanced Placement courses may benefit from having more experienced teachers than students who take large enrollment courses in-residence. The impact of teaching experience in prerequisite courses should be explored further.

### *Implications*

It is clear that students earning Advanced Placement credit for prerequisite courses in biology, rhetoric, English, and mathematics performed better in sequent courses than students who earned credit for the prerequisite course by taking the course in-residence. Additionally, significant correlations exist between Advanced Placement exam scores and grade in the sequent course, suggesting the higher the score the better students do in the sequent course. In cases where dual enrollment data was available, these students did as well or better than the in-residence students, although no statistically significant differences existed with similar students who earned transfer credit.

College-level learning has major implications for high-school curriculum reform, college admissions, and college success. It may also impact students' opportunity to take more higher level courses, time-to-graduation, and early placement in future job markets. Determining whether students are prepared for upper-level college coursework after earning college-level credit in high school is a first step toward shedding light on some of these issues.

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## Appendix

## Key to Prerequisite and Sequent Courses

| Prerequisite Course Eligible for Credit   | Sequent Course Selected for Study                      |
|---|--|
| BIO 211 – Introductory Biology: Cell Biology<br>(prior to fall 2002 was first half of BIO 302 course)<br>BIO 212 – Introductory Biology: Genetics and Evolution<br>(prior to fall 2002 was second half of BIO 302 course)<br>BIO 213 – Introductory Biology: Diversity and Ecology<br>(prior to fall 2002 was BIO 304 course)<br>BIO 214 – Introductory Biology: Structure and Function of Organisms<br>(prior to fall 2002 was BIO 303 course) | BIO 325 - Genetics                                     |
| RHE 306 – Rhetoric and Composition  | RHE 309K – Topics in Writing                           |
| E 316K – Masterworks of Literature: World, British, or American versions  | E 322 – Literature in Translation                      |
| HIS 315K – The United States 1492 - 1865<br>HIS 315L – The United States since 1865   | HIS 317 L – Topics in United States History            |
| M 408C - Differential and Integral Calculus   | M 408D - Sequences, Series, and Multivariable Calculus |
| M 408K – Differential Calculus<br>M 408L – Integral Calculus  | M 408M – Multivariable Calculus                        |