

The Relationship between High School Math Courses, High School GPA, and Retention of Honors Scholarships

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This research examined the high school transcripts of honors scholarship recipients to identify a better criterion for awarding scholarships than high school grade point average (GPA) alone. Specifically, this study compared the honors scholarship retention rate when the scholarship was awarded based on completed advanced high school math classes to the retention rate when the scholarship was based solely on GPA. The research, conducted at a community college in New Mexico, used a calculated MathScore variable and a dichotomous HighMath variable. The HighMath variable was counted if the student completed a class in trigonometry, pre-calculus, or calculus. The results indicated that awarding the scholarship based on grades earned in high school math classes would not increase retention rates. However, the retention rate was 10% higher if the scholarships were awarded based on a high GPA and on completing an advanced math class than when scholarships were based on GPA alone. While using this combination of advanced math and high GPA might limit access to scholarship funds, access to scholarships cannot be the sole consideration. Students' success in retaining scholarships and remaining in college is paramount.

The general public, as well as state and federal governments, has placed increasing demands for accountability on institutions of higher education (National Center for Postsecondary Improvement, 2002). Frequently, institutional graduation rates have been used as a measure of accountability (Adelman, 1999; New Mexico Association of Community Colleges [NMACC], n.d.). As a result, numerous studies have taken on the task of establishing the best predictors of success in higher education (Adelman; California State Legislature, 1999). The predictive validity of commonly used predictors such as Scholastic Assessment Test (SAT) scores and American College Test (ACT) scores has been scrutinized and found failing (California State Legislature, 1999; Langland, 1999). However, since the National Commission on Excellence in Education released its 1983 report, *A Nation at Risk*, studies have found one common predictor that seems to supercede other factors: a rigorous high school course of study. In addition, several studies have noted the importance of completing high school mathematics courses at or above the algebra II level (Adelman; Yoo & Bragg, 2001). Adelman concluded that, as a subset of academic rigor, mathematics might be the key to predicting college readiness and success.

This concept of college success extends to the retention of scholarships. Each fall semester, 40% to 45% of newly graduated high school honors students do not maintain the academic standards needed to retain their honors scholarships at New Mexico Junior College (NMJC). The scholarships are awarded to high school graduates based on a 3.2 high school grade point average (GPA) and full-time enrollment status. In order to keep the scholarships, awardees must maintain a college GPA of 3.0 and full-time enrollment of at least 12 credit hours per semester (New Mexico Junior College, n.d.).

This study focused on the selection of honors students at New Mexico Junior College and argued that the selection of honors students should be based on the number, rigor, and grades achieved in high school advanced mathematics courses, or the highest math class completed in high school rather than, or in conjunction with, high school GPA.

Related Research

There are several potential outcomes of successful community college attendance, including receiving a certificate or attaining an associate's degree, achieving a specified GPA to continue studies, transferring to a four-year institution of higher education, or maintaining a scholarship. Many scholarships require that recipients maintain a specified GPA to renew or retain the award. Community colleges as well as four-year colleges and universities are concerned with choosing students who will be successful at their institutions. This concern relates to the impact on the individual student as well as institutional accountability. Therefore, many studies have been conducted to identify the best predictor of college academic success.

Researchers have come to varying conclusions concerning high school GPA as a predictor variable. For example, the Maryland State Commission on Higher Education (1997) found that secondary school GPA is an excellent predictor of college success. Conversely, Adelman (1999) disregarded high school GPA and class rank as indicators of college degree attainment because of the inconsistencies in the curriculum of different high schools.

Through extensive research, Adelman (1999) found that students who completed a class in high school mathematics above the algebra II level were twice as likely to complete a bachelor's degree (Adelman). In addition, Adelman's research suggests that racial, ethnic, and socioeconomic barriers pertaining to education can be overcome by studying advanced mathematics in high school.

In 2001, the Association of American Colleges and Universities confirmed Adelman's (1999) conclusion that completing a rigorous curriculum in high school is a stronger predictor of college success than standardized test scores or other measures of high school academic performance. Holton (1998) and the National Center for Education Statistics (2001) are consis-

tent with Adelman's findings. However, evaluating the entire curriculum quality of many secondary schools would prove to be a tedious and difficult process for a selection committee (R. Evans, personal communication, July 10, 2003). Therefore, this study concentrated on factors that can be managed or changed without complex evaluations or complicated calculations.

Adelman's (1999) conclusion that the number and intensity of mathematics courses completed in high school are excellent indicators of success in higher education was supported by Yoo and Bragg (2001), Holton (1998), and Sadler and Tai (1997). Based primarily on the results of these researchers, this study used the number, rigor, and grades achieved in high school mathematics classes as potential indicators of college success. Examining the predictive validity of the highest level of high school mathematics was an extension of the research design.

Methodology

Applying Adelman's (1999) findings that math may be a key to college success, this study addressed the issue of why students fail to retain their honors scholarships at New Mexico Junior College (NMJC). The office of financial aid at New Mexico Junior College recorded data for an eight-year period from 1995 to 2002. Each fall semester, 40% to 45% of newly graduated high school honors students fail to retain their New Mexico Junior College honors scholarships after one semester (L. Neel, personal communication, February 4, 2003). These scholarships are awarded to New Mexico high school graduates based on a minimum high school GPA of 3.2 and New Mexico residency status (New Mexico Junior College, n.d.). In order to retain their scholarships, awardees must maintain a 3.0 GPA and full-time enrollment status. Full-time enrollment status consists of a minimum of 12 credit hours per semester (New Mexico Junior College). Interestingly, the NMJC Office of Financial Aid records for the period of 1999-2002 indicated that the full-time status requirement is at the root of the problem. These records show that honors students, who are used to maintaining a high grade point average in high school, drop classes in which they are doing poorly to avoid low grades.

To determine if completion of advanced math classes in high school better indicates successful retention of honors scholarships, this study examined the high school and college transcripts of 675 students. The participants were newly-graduated from high school and first-time students at New Mexico Junior College (NMJC) during the fall semesters of 1998-2002. GPAs and the grades received in algebra II, geometry, trigonometry, pre-calculus, and calculus were extracted from the high school transcripts. College GPAs after the first semester, the number of hours attempted, and number of hours completed were collected from NMJC transcripts.

A “MathScore” was calculated for each student based on the number, rigor, and grades received in high school math classes above the algebra I level. The rigor of the math classes was weighted as follows: algebra II and geometry classes had weights of two points each, and all classes above the algebra II and geometry level had weights of three points each. Grades in the advanced math classes were weighted by the standard four-point grading scale. Four points were awarded for an “A,” three points for a “B,” two points for a “C,” and one point for a “D.” Grades of “F” earned no points. Grade pluses and minuses were disregarded because not all schools use the plus-minus grading system.

To establish the student’s MathScore, the rigor points were multiplied by the grade points for each class. For example, consider a fictitious student who completed four advanced math classes in high school. The student earned a grade of “A” in algebra II; a “B” in trigonometry; a “C” in pre-calculus; and a “D” in calculus. The student’s total math score would be 26 as illustrated in Table 1.

Table 1
An Example of the Weighting Scale of Mathematics
Classes Used for Selecting Honors Scholarship Recipients

| Math Class | Rigor of Class | Grade Earned | Total Points for the Class |
|------------------------------|-----------------------|---------------------|-----------------------------------|
| Algebra II | 2 | 4 | 8 |
| Trigonometry | 3 | 3 | 9 |
| Pre-calculus | 3 | 2 | 6 |
| Calculus | 3 | 1 | 3 |
| Total points for the student | | | 26 |

Note. The rigor of the class is based on two points for algebra II and geometry; and three points for all classes above the algebra II/geometry level. The grade earned in the class is weighted as four points for a grade of “A,” three points for a “B,” two points for a “C,” and one point for a “D.”

High school transcripts were also evaluated to determine if students took a high school math course above the algebra II level. While course offerings are not identical at all feeder schools of this community college, most offer several classes above the algebra II level. Specifically, the classes considered for the “HighMath” variable were trigonometry, pre-calculus, and calculus. The HighMath variable was dichotomous: either the students took advanced math or they did not. The counts of students were divided into six categories for the HighMath variable as well as the MathScore variable.

These categories were based on the student’s high school GPA, whether or not the student completed an advanced math course, and whether or not the student would have retained an honors scholarship based on their college GPA and full-time

enrollment status. For example, using the HighMath variable, the counts of students who would retain and those who would not retain the scholarship were separated into two groups based on how the student would have retained the scholarship: HighMath and not GPA, or HighMath and GPA. These four counts were then compared to the number of students who would or would not have retained the scholarship based on GPA but not HighMath (see Table 2).

Table 2
Results of Chi Square Analysis of HighMath
for All Cohorts

| Qualified By | Retained or Would Have Retained the Honors Scholarship | | Total |
|------------------------------------|---|----------|-------|
| | Yes | No | |
| HighMath Not GPA | | | |
| HighMath not GPA | 13 (35%) | 24 (65%) | 37 |
| GPA not HighMath | 107 (58%) | 78 (42%) | 185 |
| $\chi^2(1, N=222) = 6.40, p=.99$ | | | |
| HighMath and GPA | | | |
| HighMath and GPA | 77 (73%) | 28 (27%) | 105 |
| GPA not HighMath | 107 (58%) | 78 (42%) | 185 |
| $\chi^2(1, N=290) = 6.93, p=.0042$ | | | |

To establish the relationship or no relationship status, directional chi-square tests for homogeneity of proportions were performed for students in each of the five semesters to determine if the calculated MathScore was a better indicator for retaining honor scholarships than high school GPA. Additionally, chi-square tests were performed to establish if those students who would have qualified on the basis of the HighMath variable were more likely to retain their scholarship than were those who would have qualified based on high school GPA alone. Retention of scholarships was based on the student maintaining a 3.0 GPA and full-time enrollment status (12 credit hours).

Records of students who qualified by either HighMath or GPA exclusively, or MathScore or GPA exclusively, were examined. The results were compared to records of students who qualified by GPA but not HighMath or MathScore. In addition, the records of students who qualified by MathScore regardless of their GPA, were compared to those who qualified by GPA regardless of the MathScore or HighMath variables.

Results

The study failed to identify a strong high school mathematics background that would be justified as the main criteria for scholarship selection. However, three of the results of the analyses on all cohorts using advanced math along with GPA were

significant. First, when HighMath was used in conjunction with GPA, more students retained their scholarships (77 out of 105, or 73%) than when GPA was used alone [(107 out of 185, or 58%) $\chi^2 (1, N = 290) = 6.93, p = .0042$]. Second, when MathScore was used in conjunction with GPA (158 out of 236, or 67%) more students retained their scholarship than when GPA was used alone [(26 out of 54, or 48%) $\chi^2 (1, N = 290) = 6.70, p = .0048$]. The first and second analyses used students who qualified by GPA exclusive of MathScore or HighMath. The third analysis compared GPA regardless of HighMath, which should be most important to scholarship committees. In this analysis, more students who qualified by HighMath and GPA combined (77 out of 105, or 73%) retained their scholarships than when GPA was used regardless of any other score (184 out of 290, or 63%) $\chi^2 (1, N = 395) = 3.36, p = .033$.

Tables 3 and 4 provide further detail on retention of scholarships. The percentage of students who retained or would have retained the honors scholarship who qualified by MathScore (59%) was slightly lower than the percentage of those who qualified by GPA alone (63%). Also, the percentage of those who qualified by MathScore and GPA (67%) was higher than those who qualified by GPA alone (see Table 3).

Table 3
Students Who Qualified for Scholarships
by MathScore and GPA, 1998 to 2002 Averages

| Qualified By | Retained or Would Have Retained the Honors Scholarship | | Total |
|---------------------|---|-----------|--------------|
| | Yes | No | |
| GPA | 63% | 37% | 290 |
| MathScore | 59% | 41% | 327 |
| MathScore and GPA | 67% | 33% | 237 |

Students who qualified by HighMath (63%) were as likely to retain the scholarship as those who qualified by GPA alone (63%). Furthermore, the percentage of those who qualified by HighMath and GPA (73%) was 10% higher than those who qualified by GPA alone (see Table 4).

The research did not support advanced math classes as a sole indicator of retention of scholarships. However, a student's background in mathematics combined with high school GPA proved the hypothesis to be true for all the cohorts except one. Of the 10 analyses, four (40%) were significant. Furthermore, both HighMath and MathScore were significant when used in conjunction with GPA for all the cohorts combined. Additionally, the HighMath variable would be easier than the MathScore variable for financial aid departments and scholarship committees to incorporate with GPA because no calculations would be

Table 4
Students Who Qualified for Scholarships
by HighMath and GPA

| Qualified By | Retained or Would Have Retained the Honors Scholarship | | Total |
|---------------------|---|-----------|--------------|
| | Yes | No | |
| GPA | 63% ^a | 37% | 290 |
| HighMath | 63% | 37% | 142 |
| HighMath and GPA | 73% | 27% | 105 |

required. Conversely, substantial calculations are required for the MathScore variable.

Conclusions

Adelman (1999) found that completing a mathematics class in high school above the level of algebra II doubled the odds of a student’s achieving a bachelor’s degree. Furthermore, he found that learning advanced mathematics can supersede racial, ethnic, and socioeconomic factors in pursuing a college degree. This study extended that concept to retaining an honors scholarship at a community college and found that the combination of math classes taken in high school and GPA was a better indicator of retention of scholarships than GPA alone.

There were two major limitations to the study. The first limitation was that the records investigated were restricted to those students who indicated that they were seeking a degree or certificate. Some students may not have specified that they planned to complete an associate’s degree or a certificate while enrolling when they actually did continue their education for a number of years. The second limitation was the number of records that were not considered due to high school transcripts not filed with the registrar’s office at New Mexico Junior College. There were 293 out of 995 records, or 29%, that were not used in the study because of missing high school transcripts. In addition, there were 27 records not used because of home schooling, GEDs, and incomplete or illegible transcripts. These limitations may have had an impact on the results of the study.

This study provides evidence that at New Mexico Junior College (NMJC) the addition of advanced math classes to high school GPA in selecting honors scholarship recipients would improve their retention rate. Although this research followed the findings of Adelman and used advanced math as the additional criterion, it would not be surprising to some that adding advanced classes in any discipline to the criteria for receiving a scholarship would increase the scholarship retention rate. By making the requirements more stringent, the number of students who would qualify for the scholarship would decrease and most likely result in a higher percentage of retention. Conversely, this decrease in potential scholarship recipients questions ex-

panding access to higher education in addition to the more immediate concern to NMJC, the distribution of scholarship funds. New Mexico statutes require that the dollars for the 3% Scholarship Program, which are used for the honors scholarships, be awarded before New Mexico Lottery Success Scholarships funds, which are used for general scholarships, can be expended (L. Neel, personal communication, November 9, 2003). If there are not enough students who qualify for the honors scholarships, then other financial aid may be impeded.

An additional concern related to more stringent scholarship requirements is that it may increase the risk that the college would also be limiting the candidates to the upper achievers. These upper achievers may not choose to attend the local community college because they are so highly recruited by other institutions; therefore, the scholarship funds would stand an even greater risk of not being expended.

On the other hand, scholarship funds might simply be redistributed where more qualified students would receive and retain the honors scholarships. It is a matter of access versus retention. Perhaps college administrators should consider whether they want to support access to scholarships or retention of scholarships.

In addition, the New Mexico legislature might want to reconsider its 3% scholarship allocation. Perhaps the funds should be based on 5% of enrollment or 1.5% of enrollment. Or perhaps it is time to reconsider the legislature's mandate that the 3% scholarship funds be distributed before the Lottery Success funds? Furthermore, is it cost effective for the state to invest in scholarships for students who will not maintain the standards of the scholarship? Which is more important: access or retention? These are matters that should be considered by the New Mexico state legislature to ensure that state dollars are invested wisely.

The results of this study are particularly relevant for New Mexico Junior College and other community colleges in New Mexico. Community colleges in other states that offer similar scholarships may want to do a comparable study to determine if they can retain a higher proportion of scholarship recipients by considering these additional variables.

Further research should be conducted to examine other combinations of indicators for successful scholarship retention at New Mexico Junior College. The combinations might include a student's mathematics background with a rigorous high school curriculum, and the highest level of English completed in secondary school. Additionally, students should be tracked to establish if a rigorous background in mathematics indicates successful retention of an honors scholarship over a two-year period. Another issue that should be investigated is the reasons that students withdraw from courses and college as well as the economic impact that "dropping out" has on students, the col-

Is it cost effective for the state to invest in scholarships for students who will not maintain the standards of the scholarship? Which is more important: access or retention?

lege, and the community. Another consideration might be whether additional assistance at the college level offered to students who have not taken advanced mathematics would negate this effect, preserving access and retention. Finally, one goal for providing scholarship assistance, facilitating success by relieving financial strain, could be another basis for further study. Indeed, there are areas where the retention of the scholarship might actually be a contributor to success at least as much as the cause for such success.

The study failed to identify a strong high school mathematics background as the main criterion for scholarship selection. However, a 10% increase in scholarship retention should not be dismissed by college administrators (R. Bates, personal communication, June 2, 2004). College recruitment, retention, and financial aid administrators might be encouraged to consider advanced high school math classes in conjunction with high GPA when choosing scholarship recipients. Finally, the New Mexico legislature should consider whether it wants to use state scholarship dollars to support access to college or college success.

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