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## ACADEMIC PREPARATION FOR COLLEGE EVIDENCE ON THE IMPORTANCE OF ACADEMIC RIGOR IN HIGH SCHOOL

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A college degree is more important than ever before for ensuring the economic prosperity of individuals and for society at large. Individuals with a bachelor's degree who worked full time, year-round in 2008 had median earnings of \$55,700, compared to the \$21,900 earned by their peers with only a high school diploma (Baum, Ma, and Payea 2010). Despite the many additional benefits associated with college completion, including better health, improved job security, and stronger families and communities, too few college students complete their postsecondary schooling. While there are many determinants of college degree completion, arriving at college academically prepared to do college-level work is among the most predictive factors of collegiate success. The purpose of this brief is to review the evidence on the role of rigorous high school course-taking on students' subsequent college and labor market success.

Current policy discussions seek methods of improving the academic rigor of high school curricula in order to better align K–12 expectations with the demands of college and the workplace. Curricular reform in high school is not new; reports such as *A Nation at Risk* have long rallied policymakers to push for increases in the academic rigor of high school course work.<sup>1</sup> More recently, many states have focused their efforts on increasing college and workforce preparation through the development of Common Core State Standards.<sup>2</sup>

What constitutes a rigorous academic curriculum in high school? In principle, any academically stimulating environment may contribute to academic rigor. In practice, however, evaluating the learning environment for rigor can be difficult. It is common to use measures such as course titles and/or grades as proxies for rigor. Academically rigorous courses often have explicit content or skill development embedded in the curriculum and can serve as important signals to colleges about individuals' abilities and efforts. As a result, colleges often articulate a set of courses, usually in core subjects, as necessary for successful preparation for postsecondary work (e.g., four years of college-preparatory English, two years of mathematics, two years of a foreign

1. *A Nation at Risk* (U.S. Department of Education 1983) led to the curriculum, dubbed the "New Basics," that consisted primarily of four years of English, three years of math, three years of science, three years of social studies, and two years of foreign language for students to be college bound.

2. See more information at [www.corestandards.org](http://www.corestandards.org).

language). In particular, the highest mathematics course taken in high school is often utilized as a proxy for academic rigor because of the strong association it has with subsequent student outcomes (Adelman 2006; Murnane, Willett, and Levy 1995; Rose and Betts 2004). In addition, specific programs and types of courses offered in many high schools provide an important indication of academic rigor, particularly for college admission. For example, these might include International Baccalaureate (IB), Dual Enrollment (DE), or Advanced Placement Program® (AP®) courses, which many colleges accept for college credit.

## RIGOROUS COURSE-TAKING AND SUBSEQUENT STUDENT OUTCOMES

Over the last several decades, scholars have investigated the extent to which high school experiences influence later outcomes for students. These studies are possible because of detailed longitudinal data that permit students to be followed from their K–12 settings into postsecondary institutions and/or the workplace.

Some of the most influential research on high school academic rigor is found in the Department of Education analyses authored by Clifford Adelman, *Answers in the Tool Box* (1999) and *The Toolbox Revisited* (2006). These studies provide evidence that the intensity of a student’s high school curriculum is the single best predictor of college degree completion. Using the High School and Beyond (HS&B) cohort of 1982 high school graduates and the National Education Longitudinal Study (NELS) cohort of 1992 high school graduates, Adelman investigated the pathways that contribute to college completion. His findings describe how academic intensity in high school curricula (measured by course level Carnegie units<sup>3</sup>, highest math course taken, the need for remedial course work in English and math, and enrollment in Advanced Placement® courses) is a stronger predictor of students’ college degree attainment than student test scores or class rank. More specifically, Adelman (1999) finds that a student’s highest level of mathematics taken in high school has the strongest influence on college completion relative to any other predictor. “Finishing a course beyond the level of Algebra II (for example, trigonometry or pre-calculus) more than doubles the odds that a student who enters postsecondary education will complete a bachelor’s degree” (Adelman 1999:16–18).

Statistics from the Education Longitudinal Study (ELS) cohort of 2002 high school graduates, the most recently available nationally representative cohort of high school students who are tracked over time, reveal that students with higher math course-taking patterns in high school also have higher rates of both high school diploma receipt and college enrollment. According to Table 1, students with less than precalculus (and especially those with less than Algebra II) have significantly lower rates of both high school diploma receipt and postsecondary enrollment, and have very low rates of enrollment at highly selective postsecondary institutions, when compared to those with more rigorous high school math backgrounds.

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3. As cited in Adelman (2006): “[a] Carnegie unit is the basic credit system for U.S. secondary schools. It is generally recognized as representing a full year (36–40 weeks) in a specific class meeting four or five times per week for 40–50 minutes per class session.”

**Table 1:**

Percentage of Students Receiving a High School Diploma, Enrolling in College, and Enrolling in Highly Selective College by Highest Level of Math Enrollment in High School

	Received High School Diploma	Enrolled in College Within 4 Years of High School Graduation	Enrolled in a Highly Selective 4-Year College
No Math	51.6%	20.2%	
Basic Math or Pre-Algebra	61.3%	30.4%	0.2%
Algebra I, Geometry, or Algebra II	86.3%	61.5%	2.7%
Trigonometry, Statistics, or Precalculus	98.6%	89.3%	18.9%
Calculus	99.6%	97.3%	52.2%

SOURCE: U.S. Department of Education, National Center for Education Statistics, Education Longitudinal Study of 2002 (ELS: 2002).

It must be noted that it is difficult to establish a causal relationship between taking academically rigorous courses in high school and later outcomes because students self-select into rigorous courses. Students who take a more rigorous set of courses in high school likely have a host of other attributes that also lead to their success in college and in the workforce. For example, such students may have better academic skills, more motivation and a stronger work ethic, or perhaps more academic support and encouragement from their families or teachers. Thus, it is likely that these attributes contribute to students' enrollment in more rigorous courses in the first place, and not necessarily that the rigorous courses themselves *cause* students to succeed in college or later in life.

Many researchers have attempted to deal with the complexity of estimating the influence of curricular intensity on future success by using a variety of approaches. When researchers control for as many observable characteristics as are available, they find a consistent positive association between curricular intensity and the following: student test scores (Attewell and Domina 2008), high school graduation (Schneider, Swanson, and Riegle-Crumb 1998), college entry (Long et al. 2012), type of college entry (Attewell and Domina 2008), college grades (Klopfenstein and Thomas 2009), college graduation, (Adelman 2006; Attewell and Domina 2008), and wages (Altonji 1995; Rose and Betts 2004).

Using detailed information from students' high school transcripts, Long, Conger, and Iatarola (2012) find a 7–11 percentage point increase in the likelihood of high school graduation and four-year college entry between a student who takes no rigorous high school courses and a student taking just one rigorous course during high school. This study finds that the biggest differences in student outcomes are based on math and English course levels. Enrollment in rigorous courses in other subjects, however, also leads to improved outcomes. Long and colleagues also find that, although more rigorous courses are associated with better student outcomes, the differences were greatest between those taking no rigorous course and those taking only one.

This result suggests that “requiring or encouraging students to enroll in even one rigorous course in their first two years of high school can substantially improve graduation and four-year college enrollment rates” (Long et al. 2012, 315).

Enrolling in a rigorous course of study in high school is not only associated with higher educational attainment but also with improved labor market outcomes. Several studies find that enrolling in more advanced mathematics courses in high school leads to higher wages once in the workforce (Altonji 1995; Levine and Zimmerman 1995; Rose and Betts 2004). Utilizing a detailed longitudinal data set, Rose and Betts (2004) specifically look at the impact of high school courses on earnings 10 years after high school graduation. They find that, after controlling for a variety of characteristics that predict course placement in the first place, higher-level math course enrollment is associated with higher earnings. Moreover, this study identifies important differences by students’ background characteristics; type of math courses taken in high school explain 27 percent of the earnings gap between students from the lowest-income families when compared to middle-income families.

## **IDENTIFYING THE MECHANISMS**

There are several plausible mechanisms by which we would expect a more rigorous set of high school courses to lead to better postsecondary success.

1. A rigorous course of study in high school might provide richer curricula, exposing students to material they may face in college and improving their college readiness.
2. Rigorous courses in high school (such as honors and AP) are frequently taught by more skilled teachers (often with additional credentials, more experience, or specialized professional development), than less rigorous courses.
3. A rigorous course of study can serve as an important signal for college admission, particularly at more selective institutions, and enrollment at a more selective college is positively associated with student outcomes.
4. Rigorous courses attract particular students, often those most academically able and/or those most motivated, and engagement with higher-ability peers may positively influence student outcomes.<sup>4</sup>
5. The relationship between rigorous course-taking and student outcomes may not be causal at all, such that the observed positive correlation is driven by a third underlying set of traits shared by academically successful students, such as drive or motivation.

It is nearly impossible to disentangle these various explanations for why rigorous courses may lead to improved educational and occupational outcomes. Moreover, as suggested above, because students are not randomly placed into courses in high school, but rather self-select (often with the aid of parents, teachers, or counselors) into a rigorous course of study, it is difficult to separate out unobserved motivation, support, or other characteristics that may be associated with both rigorous course-taking in high school and better collegiate outcomes. Although it has been difficult for researchers to conclude whether there is a causal relationship between rigorous high school course-taking and improved educational outcomes, it is imperative for high schools to ensure that all students have access to an academically rigorous course of study (Tierney et al. 2009).

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4. See Sacerdote (2001) and Zimmerman (2003) for evidence of peer effects in education.

## ACCESS TO RIGOROUS COURSES AND DIFFERENTIAL EFFECTS BY RACE AND SOCIOECONOMIC STATUS

Efforts to increase the academic intensity of students' high school curricula have also been spurred by an equity agenda that seeks to ensure access to rigorous courses for students from all demographic backgrounds. Recent statistics from a nationally representative sample of high school students' course enrollment reveals that white and Asian students are much more likely to be enrolled in a more rigorous set of courses than are African American or Latino youth (see Table 2). Similarly, students from higher socioeconomic-status families have higher levels of participation in more rigorous academic course work than do their lower-socioeconomic status peers. This is consistent with research indicating that lower-SES students, in particular, continue to be underrepresented at more selective postsecondary institutions because they have not completed the appropriate course work (Carnevale and Rose 2004).

**Table 2:**

Percentage Enrolled in Types of Academically Rigorous Courses in High School by Race/Ethnicity and Socioeconomic Status

	Enrolled in AP or IB	Enrolled in Academic Track	Math Enrollment Past Algebra II	Calculus Enrollment
Total	30.0%	25.8%	36.1%	13.9%
<b>By Race/Ethnicity</b>				
American Indian or Alaskan Native	14.9%	13.3%	16.1%	5.6%
Asian or Pacific Islander	52.8%	39.5%	35.6%	33.4%
Black or African American	15.7%	17.2%	37.0%	4.7%
Hispanic or Latino	25.3%	15.8%	27.5%	6.8%
White	32.6%	29.1%	38.3%	16.0%
<b>By Socioeconomic Status</b>				
Low Quartile	16.3%	12.7%	25.6%	6.2%
Middle two Quartiles	24.2%	22.0%	35.6%	10.0%
High Quartile	50.9%	42.4%	44.9%	26.4%

SOURCE: U.S. Department of Education, National Center for Education Statistics, Education Longitudinal Study of 2002 (ELS: 2002), "High School Transcript Study." Adapted from: Planty, M., Bozick, R., and Ingels, S.J. (2006). *Academic Pathways, Preparation, and Performance — A Descriptive Overview of the Transcripts from the High School Graduating Class of 2003-04 (NCES 2007-316)*. U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Students do not enroll in a course of study by chance. There are a host of factors that contribute to students' sorting into various levels of courses in high school: availability of courses, knowledge of offerings at the school, academic ability, interest, motivation, familial involvement (or lack thereof), and the influences of teachers, counselors, and/or peers. As such, properly addressing racial/ethnic and socioeconomic differences in analysis of course enrollment patterns requires further inquiry into each of these possible sources of existing disparities.

Research suggests that schools serving high concentrations of low-income students often have fewer advanced curricular offerings than do schools serving a more affluent student population (Adelman, 1999; Conger et al. 2009). However, recent efforts by the federal government to ensure such opportunities are more equally distributed have attenuated the disparities in curricular offerings, particularly in courses such as Advanced Placement, between schools. Moreover, studies that account for school differences suggest that disparities in advanced course-taking by demographic characteristics are largely phenomena that exist within a school rather than across schools (Gamoran 1987). This suggests that curricular disparities are mainly due to tracking or to inequalities in access to more demanding courses *within* the school (Attewell and Domina 2008). The implications of such inequality suggests that schools need to investigate more closely the process that contributes to course sorting, particularly when it results in racial/ethnic or socioeconomic segregation.

Studies that parse out the effects of academic rigor by race/ethnicity and socioeconomic status find that the return to taking more advanced course work varies with the attributes of the student. Some of this variation is based on school attended. For example, Long et al. (2012) find that students attending high-poverty or academically lower-quality schools experienced larger increases in their high school graduation and college enrollment rates associated with taking more rigorous courses than students attending more affluent high schools. Some of this variation may be attributable to other individual differences in response to a rigorous curriculum, perhaps differential peer effects, or support for a college-going culture. Regardless of the mechanism at work, it is important to consider rigorous course-taking as one avenue for addressing inequality in educational attainment. Using data on students in Florida public postsecondary institutions, Long and colleagues (2009) find that 28–35 percent of the gaps (and over three-quarters of the Asian advantage) in college readiness among college-going black, Hispanic, and low-income students can be explained by the highest math course taken in high school.

## **IMPLICATIONS FOR POLICY AND PRACTICE**

Given the clear evidence that early academic skills beget later educational attainment and labor market success, it is critical for policymakers and practitioners at all levels of the education system to consider ways of improving the academic rigor of high school course-taking. Moreover, academic rigor is becoming an important marker for assessing college readiness among students in a school, district, or state. Wiley, Wyatt, and Camara (2010) develop an Academic Rigor Index (ARI) based on course-level enrollment in English, mathematics, science, and social studies each year of high school, with additional points allocated to the index for honors, AP, and/or dual enrollment course work. Similar efforts to measure the academic rigor of students' high school experience for use in assessing college readiness are widespread. As such, we conclude by offering several key principles for increasing the quantity and quality of rigorous course work among high school students.

### **1. Better alignment**

Many stakeholders (e.g., Achieve, Inc.) have argued for better alignment between high school and college and the labor market. In fact, the Common Core State Standards are

chiefly about developing standards at the secondary level that are aligned with career and college readiness. Perhaps missing from that discussion is the need to better align students' expectations for college and careers with their curricular offerings in high school. Students are often misinformed about what it takes to succeed in college and in the various careers they might consider. Better alignment between the content they face in high school and what they will likely encounter in college and in many jobs would fill the information gap and may improve students' postsecondary outcomes.

## **2. Raising standards for all students**

Even if some students do not intend to go to college, high schools need to provide more rigorous academic course work offerings. It is clear that college-bound high school students require such course work in order to arrive at college better prepared. In addition, the payoffs from such rigorous courses in the workplace are clear even for those entering the labor market directly, so additional rigorous course work should not be reserved for only those who are college bound.

## **3. More is not necessarily better**

Simply taking more courses in high school does not necessarily yield better outcomes. Several researchers have posited a "credentialist" theory suggesting that the national trend toward more rigorous course enrollment has been largely in name and, as a result, has not resulted in improvements in college readiness (Geiser and Santelices 2004). Having all students enroll in courses that are merely labeled at a higher level, but with instruction or content that is unchanged, or offering more sections of calculus when there are no qualified teachers to staff these sections is unlikely to bring about desired improvements in student outcomes.

## **4. Monitoring Access and Equity**

Given persistent racial/ethnic, gender, and socioeconomic disparities in course enrollment and in educational attainment, educational leaders and policymakers need to monitor the extent to which opportunities for enrolling in rigorous academic courses are distributed equitably. Several studies have emphasized that availability of such course work can go a long way to reducing the educational attainment gap between different racial/ethnic and socioeconomic status students (Conger et al. 2009; Klopfenstein 2004).

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