

Center for the Study of Higher and Postsecondary Education

Are Contextualized Measures of High School Performance Associated with Success in College Engineering Programs?

Engineering schools may be less likely to employ contextual measures, even though their students may be just as likely to succeed in engineering.

Since the 1970s, growth among low-income students and students of color at selective higher education institutions has remained stagnant. Due to the manner in which school funding is allocated, lower-SES and underrepresented students of color are more likely to attend schools that do not have the funds to provide advanced courses, highly trained teachers, and smaller class sizes. These disparities put lower-SES and underrepresented students of color at a disadvantage when it comes to the college admissions process, when they are expected to compete with more advantaged students who often have higher standardized test scores, high school GPA, and more rigorous STEM courses in high school. One area of higher education where this disparity is especially salient is engineering, where the percentage of women, low-SES students, and underrepresented students of color is disproportionately low.

In an effort to make the admissions process more equitable, many higher education institutions have begun to adjust the way they review applications. There has been a shift towards holistic review, which endeavors to contextualize student performance in light of their high school, family, and neighborhood. In response to COVID-19, a large majority of colleges and universities have adopted test-optional or test-free policies, which deemphasize or ignore test scores and focus on other measures of high school achievement, particularly high school GPA and coursetaking. A number of institutions have also shifted from looking at raw measures of success to contextual measures of success, which include factors such as the number of advanced courses an applicant's high school offers or how the applicant's GPA and test scores compare to their school peers.

Recent evidence suggests that contextualized measures of high school performance offer a promising way to more accurately ascertain the academic potential of college applicants. Institutions that utilize contextual measures are also more likely to accept female students, low-income students, and underrepresented students of color. At the same time, departments in the STEM fields may be less likely to employ contextual measures due to concerns that students with lower raw scores and GPAs might struggle to keep up with rigorous science- and math-based curricula.

The aim of our study is to investigate whether contextualized measures of high school performance may aid college engineering programs in both selecting students who are more likely to succeed in the program and in increasing the diversity of students accepted into engineering programs.

The Study

Our data are drawn from a medium-sized Midwestern state's Department of Education database (DOE). The data contains information from all public high schools within the state, the state's ACT test database, and the state's fifteen public universities. The high school dataset, comprising over 2.3 million high school students, includes information such as courses and associated instructors, grades, credits, course type, and demographics. The database also includes ACT test score information for all students and transcripts for all attendees of the public universities. The university data are similar to the high school data, additionally including enrollment status, choice of major, and Pell Grant eligibility as a proxy for low-income status.

This state was chosen because the DOE not only collected all high school transcripts for students graduating from public high schools from 2010 to 2015, but also mandated the ACT for all high school juniors during this time period. This allowed us to construct contextualized high school performance measures otherwise unavailable in any national dataset and match the state transcript data with public college records. Public universities within the state range in selectivity, location, and size, but only one university is highly selective. Each of the public universities has at least one ABET-accredited engineering program.

In the final dataset, we used the first three years of transcript data from the high school database to calculate raw high school GPA (unweighted for more advanced coursework such as honors and AP courses). Our aim in constructing this GPA variable was to mimic the GPA most admissions counselors see when reviewing applications, typically the GPA acquired after junior year. We restricted our sample to in-state public university students, which accounted for 75% of college students in the state, because the DOE dataset does not include private schools. Our additional analyses comparing student demographics (i.e. race,

HIGHLIGHTS

- Based on a dataset from a Midwestern state, which provided information on students' high school and college transcripts, standardized test scores, and sociodemographic data, we find both raw and contextualized measures of high school performance have strong, statistically significant relationships with engineering students' college success.
- GPA appears to have the most consistent and strongest relationship with all three measures of college success: college GPA, retention, and graduation.
- Subgroup analysis suggests that contextualized measures of high school performance are consistently with college success outcomes for underrepresented students, and for some measures have a stronger relationship.
- Using contextualized test scores when making admissions decisions may be particularly useful for identifying women who are likely to succeed in four-year engineering programs, particularly as raw scores consistently underpredict the achievement of college women.

“Contextualized assessment can help identify underrepresented talent in engineering, while expanding access to a broader, more diverse population of engineering students.”

gender, Pell status) between our final analytical sample and true in-state freshman at each institution revealed that students who are missing from the DOE dataset did not significantly change the demographic makeup of our sample. Only students who majored in engineering during their undergraduate career were included in the sample.

We used first-year college GPA, first-year retention within an engineering major, and four-year graduation rates within an engineering program to assess college outcomes. First-year GPA is the grade point average of a student prior to beginning their second year of college, while first-year retention indicates whether a student was enrolled during the beginning of their second year of college.

To measure high school performance, we used high school GPA, ACT composite scores, and curriculum (course selection and rigor). For each of these raw performance metrics (GPA, ACT, curriculum), we created a contextualized score using a formula that accounts for how far a student's scores are from the average score of peers at their high school. Contextualized measures were also created for math and science course selection measures, respectively: these measures show how far (in standard deviations) a student progressed in math and science courses offered by their school. The contextualized score for math curriculum rigor, for example, takes a student's maximum value for math course level, divides this by the maximum value of math course level offered within the student's school, and then standardizes this value.

Results

Our findings show that GPA and ACT scores have strong, statistically significant relationships with three measures of college success for engineering students -- first-year college GPA, first-year retention, and four-year graduation. High school GPA is most strongly associated with each of the three measures of college success.

Across all universities in our dataset, measures of high school GPA and ACT composite scores (raw and contextualized) are significantly associated with first-year college GPA. Our findings suggest that raw high school GPA is most strongly associated with first-year college GPA, while the effect size is somewhat smaller for contextualized high school GPA and smaller still for raw and contextualized ACT scores (as illustrated by the figure). Our data also showed that high school curriculum rigor (raw and contextualized) displays a significant relationship with first-year college GPA, but the effect size is smaller than those of either high school GPA or ACT scores, and the association between science rigor and college GPA is particularly weak. Our findings suggest that high school GPA (raw and contextualized) is significantly associated with first-year retention, but interestingly, ACT scores (raw and contextualized) are not significantly associated with first-year retention.

Across the institutions included in this sample, we observed that high school GPA (raw and contextualized) is significantly associated with four-year graduation from an engineering program. In approximately half of the institutions, contextualized high school GPA is more strongly associated with four-year graduation than raw high school GPA. ACT scores (raw and contextualized) are significantly associated with four-year graduation, but once again the effect size is smaller than when looking at high school GPA.

Lastly, our findings suggest that the relationship between high school measures of success and college measures of success change somewhat when examining underrepresented students. For Pell recipients, underrepresented students of color, and women, high school GPA is a stronger predictor of all three measures of college success than ACT score. For all three groups, contextualized ACT score is significantly associated with first-year college GPA and four-year graduation, but is not significantly associated with first-year retention for Pell recipients.

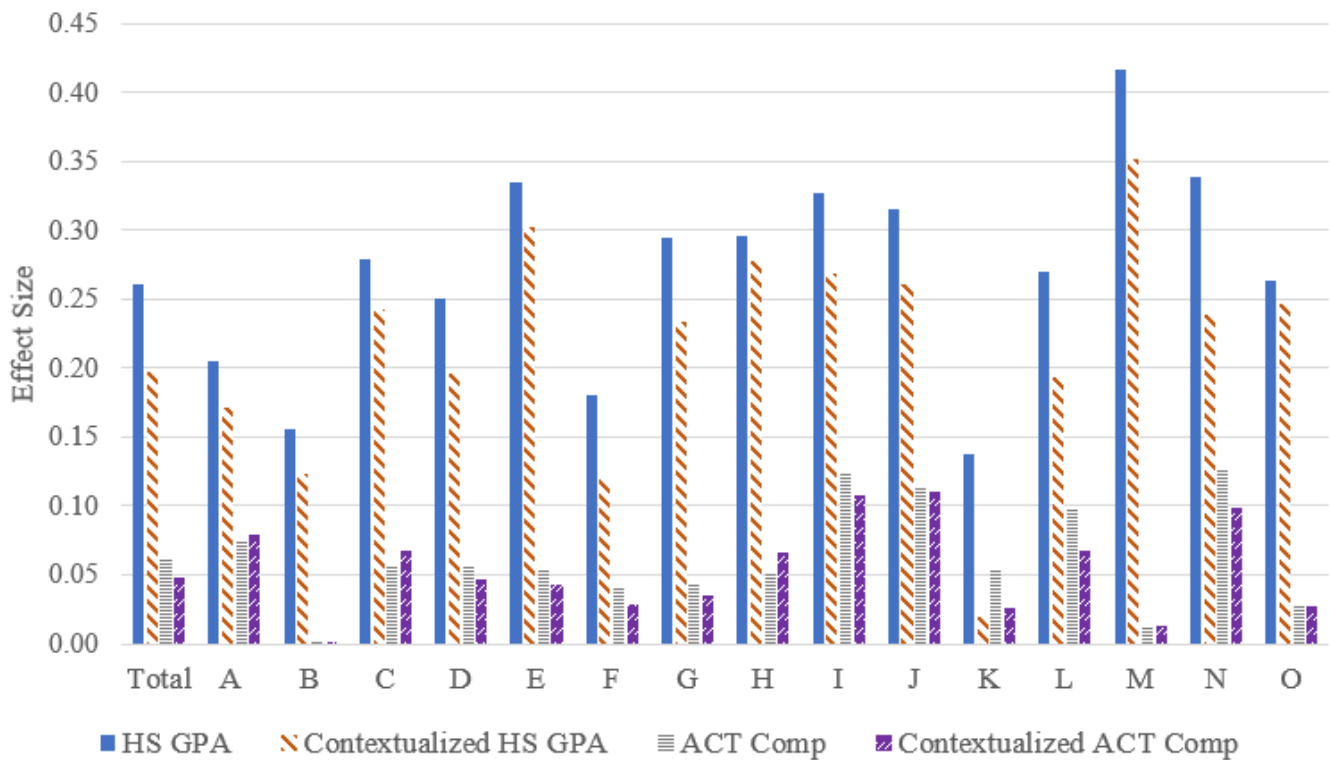


Figure 1. Effect sizes for high school GPA and ACT composite scores on first-year college GPA

Policy and Practice Implications

This study highlights several strategies and implications for developing holistic review practices that broaden student participation in college engineering programs.

Contextualized measures may draw more highly qualified women, as well as a racially and socioeconomically diverse pipeline into engineering programs

Our findings suggest that contextualized data can be particularly useful in assessing the potential of applicants who have traditionally been underrepresented in the engineering field. For example, our results indicate that contextualized ACT scores may more accurately identify women who are likely to succeed in engineering programs than raw ACT scores, and that contextualized high school GPA is a good predictor of college success for women, Pell recipients, and underrepresented students of color. This may be particularly crucial in light of the forthcoming Supreme Court rulings on race-conscious admissions.

Context is critical when looking at curriculum rigor and AP/IB participation.

Schools with less resources - in which students are disproportionately low-SES and underrepresented students of color - generally provide less advanced courses, disadvantaging students who attend these schools when they apply to college. Our research suggests that raw and contextualized curriculum rigor scores are nearly equally associated with college measures of success in engineering programs. Evaluating an applicant's high school course background in the context of what courses were available to them, rather than focusing on raw curriculum scores, may remove a barrier to admission and allow institutions to more accurately evaluate the potential of students from underrepresented communities.

Contextualized measures of high school performance may be crucial at the growing number of test-optional institutions.

As a growing number of institutions amend their admission policies to remove standardized test score requirements, shifting toward a holistic review process, it is useful to consider what measures might replace or supplement test scores. Our research suggests that high school GPA is more strongly associated with college retention, four-year graduation and college GPA than ACT score, and is a valuable tool in assessing an applicant's potential to succeed in engineering programs. This finding aligns with recommendations from The Standards for Educational and Psychological Testing, which advocates considering multiple variables of applicant potential instead of focusing solely on raw test scores.

AUTHORS

Michael Bastedo is a professor of education in the Center for the Study of Higher and Postsecondary Education at the University of Michigan, where he also serves as Associate Dean for Research and Graduate Studies in the School of Education. He is also the founding director of the Michigan Admissions Collaboratory.

Mark Umbricht is the Director of Data Analysis and Research for the University of North Carolina System. He holds a Ph.D. in higher education from Pennsylvania State University.

Emma Bausch is a doctoral candidate in the Center for the Study of Higher and Postsecondary Education at the University of Michigan. Her dissertation considers how prospective college students and their families interpret financial aid offers, think about paying for college, and eventually choose a college.

This research was funded by the National Science Foundation, Research on the Formation of Engineers (Grant No. 1947114). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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CSHPE POLICY BRIEF NO.6

Bo-Kyung Byun is a doctoral student in the Center for the Study of Higher and Postsecondary Education. Her research interests revolve around issues of access and equity in college admissions, with a particular focus on holistic admissions practices—both in the U.S. and Korean context.

Yiping Bai is a doctoral candidate in the Center for the Study of Higher and Postsecondary Education. Her research interests involve studying the education inequality among race/ethnicity, socioeconomic status, and urbanicity, as well as evaluating the effects of education policies along these lines, to more equitably serve different student populations.

Joy Richardson is a master's student in the Center for the Study of Higher and Postsecondary Education. Her research interests are centered on fortifying the P-20 education pipeline, improving college accessibility in rural, first-generation, and minoritized racial groups, and increasing Black representation in international education programs.

Abbi Crowder is a master's student in the University of Michigan's School of Education. Her research interests include creating assessments, evaluations, and admissions policies that are rooted in culturally responsive and strengths-based practices, and improving access to higher education among lower-socioeconomic and minoritized communities.



CENTER FOR THE STUDY OF HIGHER
AND POSTSECONDARY EDUCATION
UNIVERSITY OF MICHIGAN

CSHPE

*Center for the Study of Higher
and Postsecondary Education*

University of Michigan | Marsal Family School of Education

610 E. University Avenue | Ann Arbor, MI 48109-1259

734-647-1981 | Fax: 734-764-2510

cshpe.info@umich.edu