Research Report

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How Has the Predictive Validity of HSGPA and ACT Composite Score on Cumulative First-Year Hours Earned Changed Between 2018 and 2022?

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Conclusions

The study by Sanchez (2024a & 2024b) reveals evidence of grade inflation in high school GPA (HSGPA) from 2018 to 2022 despite stable or slightly decreased ACT scores. This study demonstrated that the predicted cumulative first-year hours earned at 2- and 4-year colleges decreased when the predictions were based on HSGPA alone, but predicted hours remained stable when based on ACT Composite score alone. Combining HSGPA with ACT scores mitigated but did not eliminate the decline in HSGPA's predictive validity. The study underscores the need to use multiple measures of academic achievement in college admissions to accurately assess student readiness.

So What?

This study has important implications for postsecondary institutions and policymakers. Given the evidence of grade inflation in HSGPA from 2018 to 2022, we can conclude that HSGPA as the sole measure of academic achievement may misrepresent students' readiness for college-level coursework, particularly under test-optional or test-blind admissions policies. The study highlights the impact of the COVID-19 pandemic on educational delivery and assessment, which likely contributed to shifts in HSGPA's predictive validity.

Now What?

To ensure accurate assessment of academic readiness, the study recommends using multiple measures, such as HSGPA and ACT scores together. This provides a more stable and valid prediction of academic outcomes. This approach can help institutions develop more effective educational strategies and assessment methods to help their incoming cohorts succeed in college.

About the Author

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Dr. Sanchez is a lead research scientist at ACT, where he studies postsecondary admissions, national testing programs, test preparation efficacy, and intervention effectiveness. Throughout his career, Dr. Sanchez has focused on studying the transition between high school and college and supporting the decision-making capacity of students, their families, and college administrators. His research has been widely cited in academic literature and by the media, including *The Wall Street Journal*, *The Washington Post*, *USA Today*, and the education trade press.

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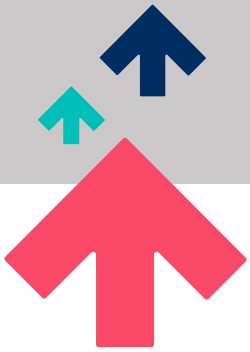


Introduction

Understanding which factors are important in predicting academic success in college is pivotal for higher education institutions as they strive to enhance student outcomes. Among these factors, high school GPA (HSGPA) and ACT scores are considered significant predictors of college performance and are commonly used in admissions (Allen, 2013; Allen & Sconing, 2005; Camara et al., 2019; Geiser & Santelices, 2007; Kobrin et al., 2008; Mattern & Patterson, 2014; Radunzel & Mattern, 2020; Radunzel & Noble, 2012; Radunzel & Noble, 2013; Sanchez, 2013; University of California Academic Senate, 2020; Westrick et al., 2015). Both metrics are indicators of students' overall academic preparedness and ability to handle college-level coursework.

Westrick et al. (2015) highlighted the relationship between ACT Composite scores, HSGPA, socioeconomic status, and college success in the first year of college and in persistence to the second year of college. While this study did not directly examine the predictive validity of these metrics on cumulative hours earned, success in the first year of college is related to the accumulation of more credit hours. Davidson and Blankenship (2017) demonstrated the important link between the number of credit hours earned in the first year of college and the subsequent academic performance of students in both 2- and 4-year institutions. Furthermore, Adelman (2006) illustrated that completing at least twenty credit hours toward a degree was a significant benchmark in student graduation. Radunzel and Noble (2012) also documented the important ways that HSGPA and ACT Composite scores relate to progress to degrees (defined as credit hours earned) and long-term college success, such as graduation. Collectively, these studies demonstrate the importance of early and sustained academic performance in postsecondary education.

Recent research has shown that the predictive validity of HSGPA has changed in recent years. For example, Sanchez (2024a) studied the predictive validity of HSGPA and ACT Composite scores on first-year college GPA (FYGPA) from 2017 to 2021. This study period, which encompasses significant shifts in education due to the COVID-19 pandemic, found that HSGPA had increased from 3.44 in 2017 to 3.59 in 2021, while the average ACT Composite score decreased from 22.51 in 2018 to 21.9 in 2021. The study also found that HSGPA has become a less consistent predictor of FYGPA, while ACT Composite scores have maintained relative stability in their predictive power. Despite the slight decline in ACT Composite scores, these scores reliably predicted FYGPA; reliability was notable at higher FYGPA levels, where Composite scores were able to predict a FYGPA of 4.0 for some students, which was not mirrored by HSGPA.[1] The study underscores the benefit of using both HSGPA and ACT Composite scores to enhance the prediction of FYGPA.

Another recent study, Sanchez (2024b), explores the relationship between HSGPA, ACT Composite scores, and developmental course placement, emphasizing how these relationships have evolved since the onset of the COVID-19 pandemic. This study found that the predictive relationship between HSGPA and developmental course placement has fluctuated across cohorts of students; this fluctuation may be due to institutions adjusting their interpretation of HSGPA because of grade inflation. ACT Composite scores, on the other hand, were found to

have shown a more consistent relationship with developmental course placement across cohorts. This study also highlights the importance of using multiple measures in combination to make more equitable and effective placement decisions.

It is in the context of the recognition that HSGPA and ACT Composite scores are important predictors of both early and later college success, along with the evidence that the relationships between HSGPA and college outcomes have changed in recent years, that the present study endeavors to expand our understanding. Specifically, the present study looks at how the predictive validity of HSGPA and ACT Composite scores has changed in relation to college cumulative first-year hours earned. This study addresses the following research questions:

1. In what ways has the relationship between cumulative first-year hours earned and HSGPA changed since the onset of the pandemic?

2. In what ways has the relationship between cumulative first-year hours earned and ACT Composite scores changed since the onset of the pandemic?

3. In what ways has the relationship between cumulative first-year hours earned and the combined college readiness measures HSGPA and ACT Composite score changed since the onset of the pandemic?

Methods

Analytical Sample

The present study used data from public high school graduates who took the ACT test between 2017 and 2021 as part of a school-day testing program, hereafter referred to as the 2018 to 2022 cohorts. I used ACT-tested students from a single state that uses the ACT test for statewide school-day testing; because of this statewide adoption, nearly all public high school graduates in this state had taken the ACT. The study included students who enrolled at public 2- and 4-year institutions in the state in the fall immediately after graduation. The outcome of interest was cumulative college hours earned by the end of their freshman year, hereafter referred to as cumulative first-year hours earned. The analytical sample included 20,916 students enrolled at 2-year institutions and 40,194 students enrolled at 4-year institutions, for a total of 61,110 students from 32 institutions in the state. This particular state was chosen because of the availability of data on postsecondary outcomes.

Measures

ACT Composite Score

Official ACT Composite scores were obtained from the graduating class record for the state in the analysis. Each student's ACT Composite score was attained during either school-day testing or a national test administration. For students who took the ACT more than once, the last score they earned prior to high school graduation was used.

Cumulative High School GPA (HSGPA)

Self-reported grades in up to 23 courses in English, mathematics, social studies, and natural science were averaged to calculate each student's cumulative HSGPA. Prior research indicates that students' self-reported HSGPAs are highly correlated with their transcript GPAs, and previous studies support the use of self-reported data for research purposes (Camara et al., 2003; Kuncel et al., 2005; Sanchez & Buddin, 2016; Shaw & Mattern, 2009).

Cumulative Hours Earned

For each student, the number of official cumulative first-year hours earned was obtained from the student's postsecondary transcript.

Data Analysis

In the study, students were nested within institutions. The intraclass correlation coefficient (ICC) for the study data was 0.103, which suggests that a notable portion of the variability in cumulative first-year hours earned was due to differences across institutions. In order to account for this type of nested relationship, researchers can employ methods such as hierarchical linear modeling or cluster-robust standard errors. In this study, I used hierarchical linear modeling. Three separate regression models were estimated. In all three models, cumulative first-year hours earned was the outcome of interest, and the predictors were cohort year, institution type (2- or 4-year), and either HSGPA or ACT Composite score or both. Additionally, each model allowed for both random slopes and random intercepts. This was done because it was determined that models with randomly varying slopes and intercepts fit the data better than models with only randomly varying intercepts. For the HSGPA model, a random intercept term was implemented in addition to a random slope for HSGPA. For the ACT Composite score model, a random intercept term was implemented in addition to a random slope for ACT Composite score. Finally, for the combined model, a random intercept term and random slopes were implemented for both HSGPA and ACT Composite score for institutions. The study did not account for either school- or institution-level characteristics. In all three models, HSGPA and ACT Composite score were standardized.

The Akaike information criterion (AIC) and Bayesian information criterion (BIC), along with a pseudo-R^2 measure, were examined to evaluate model fit. Both marginal and conditional R^2 were presented. Marginal R^2 represents the variance explained by the fixed effects and is defined as $R_m^2 = \frac{\sigma_f^2}{\sigma_f^2 + \sigma_\alpha^2 + \sigma_\varepsilon^2}$. Conditional R^2 reflects the variance of the entire model, including both fixed and random effects, and is defined as $R_c^2 = \frac{\sigma_f^2 + \sigma_\alpha^2}{\sigma_f^2 + \sigma_\alpha^2 + \sigma_\varepsilon^2}$. In these equations, σ_f^2 is the variance of the fixed effects components, σ_α^2 is the variance of the random effects, and σ_ε^2 is the "observation level" variance. These statistics are based on those outlined in Nakagawa et al. (2017).

In addition to these metrics, the reduction in residual variance (i.e., variance within an institution) was used to evaluate model fit. In order to calculate the reduction in residual variance, a null model was first fit to assess the amount of residual variance not explained by institution nesting. In subsequent models, the percentage of reduction in this residual variance was assessed and can be interpreted as the percentage of residual variance explained by the HSGPA, ACT Composite score, and combined models.

Results

Descriptive Statistics

Table 1 displays the sample size, average ACT Composite score, average HSGPA, and average cumulative first-year hours earned for the five cohorts, examined by institution type. Within each institution type and across cohorts, a similar number of students were enrolled. For students enrolled at 2-year institutions, the average ACT Composite score varied slightly from 2018 to 2022. For students enrolled at 4-year institutions, the average ACT Composite score decreased from 22.51 in 2018 to 21.90 in 2022. For students at both types of institutions, HSGPA increased from 2018 to 2022. For students enrolled at 2-year institutions, average HSGPA increased from 3.09 in 2018 to 3.32 in 2022. For students enrolled at 4-year institutions, HSGPA increased from 3.48 in 2018 to 3.59 in 2022. For students enrolled at 2-year institutions, cumulative first-year hours earned increased from 21.34 in 2018 to 23.16 in 2022; for students enrolled at 4-year institutions, hours decreased slightly, from 32.37 in 2018 to 31.56 in 2022.

Table 1. Sample Size and Achievement by Institution Type and Cohort

Institution type	Cohort	*n*	ACT Composite score (*SD*)	HSGPA (*SD*)	Cumulative hours earned (*SD*)
2-year	2018	4,056	18.66 (3.72)	3.09 (0.56)	21.34 (14.68)
	2019	4,079	18.58 (3.84)	3.15 (0.54)	20.70 (14.40)
	2020	4,532	18.40 (3.80)	3.17 (0.56)	21.32 (14.51)
	2021	4,239	18.42 (3.84)	3.30 (0.52)	22.57 (15.77)
	2022	4,010	18.51 (3.96)	3.32 (0.51)	23.16 (15.82)
4-year	2018	8,598	22.51 (4.80)	3.48 (0.47)	32.37 (15.76)
	2019	7,810	22.47 (4.86)	3.51 (0.46)	31.49 (15.46)
	2020	8,738	22.34 (4.67)	3.44 (0.49)	32.23 (15.65)
	2021	7,764	22.27 (5.00)	3.56 (0.43)	30.83 (17.30)
	2022	7,284	21.90 (5.12)	3.59 (0.42)	31.56 (16.93)

Figure 1 illustrates the distribution of HSGPA for students enrolled at 2- and 4-year institutions, most of whom had a HSGPA above about 3.0. Among students at 2-year institutions, there was a relative plateau in the distribution of HSGPA above approximately 3.0. Among students at 4-year institutions, the distribution of HSGPA was highly skewed, with most students reporting a score near 4.0. The overall average HSGPA was 3.20 for students at 2-year institutions and 3.51 for students at 4-year institutions. Scores for students at 4-year institutions displayed less variability (i.e., had smaller standard deviations) than scores for students at 2-year institutions.

Figure 1. HSGPA for Students Enrolled at 2-Year and 4-Year Institutions

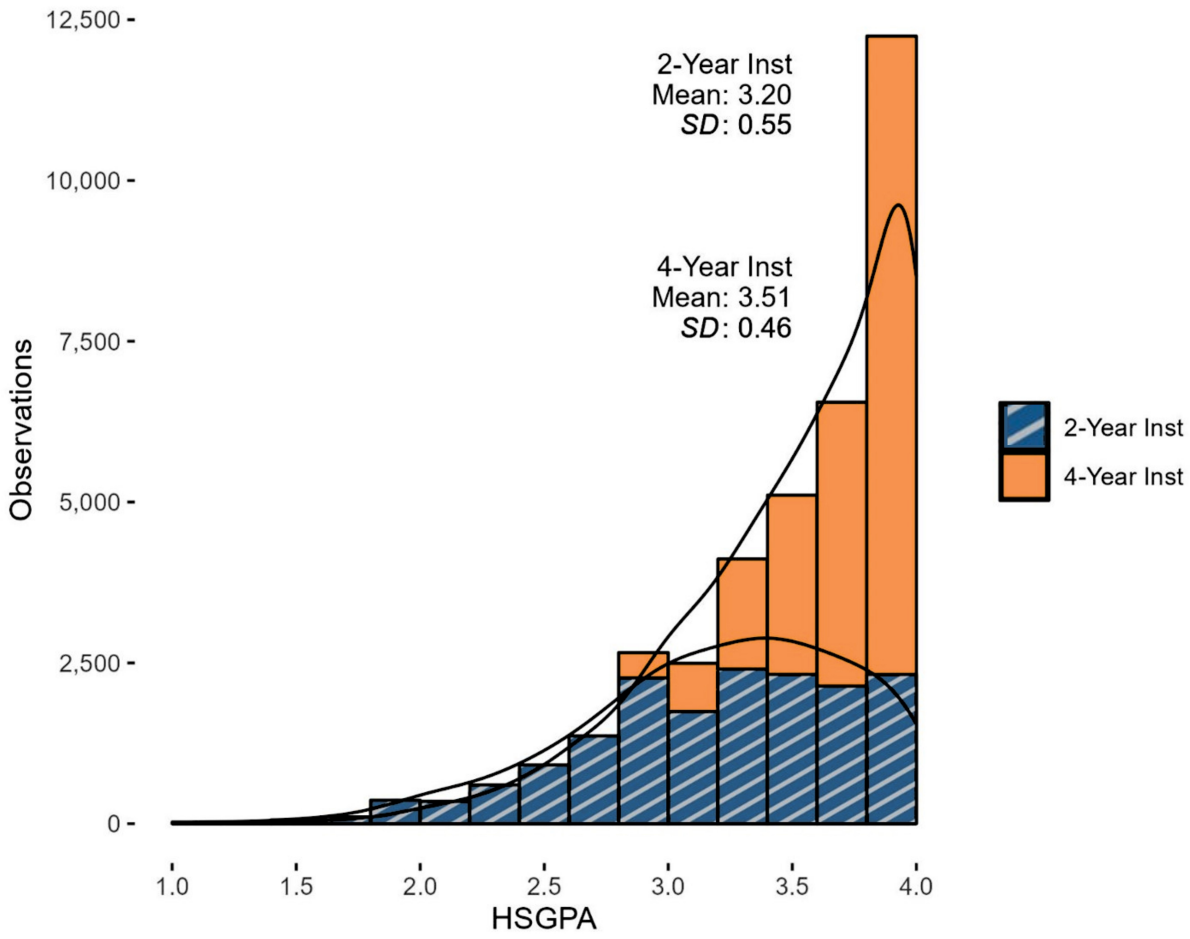


Figure 2 illustrates the distribution of ACT Composite scores for students enrolled at 2-year and 4-year institutions. In general, students who enrolled at 2-year institutions had lower ACT Composite scores than students who enrolled at 4-year institutions. At both institution types, ACT Composite scores were more normally distributed than HSGPA. The average ACT Composite score was 18.51 for students at 2-year institutions and 22.31 for students at 4-year institutions. Students at 2-year institutions had less variability in the distribution of their scores, as indicated by lower standard deviations, than students at 4-year institutions.

Figure 2. ACT Composite Scores for Students Enrolled at 2-Year and 4-Year Institutions

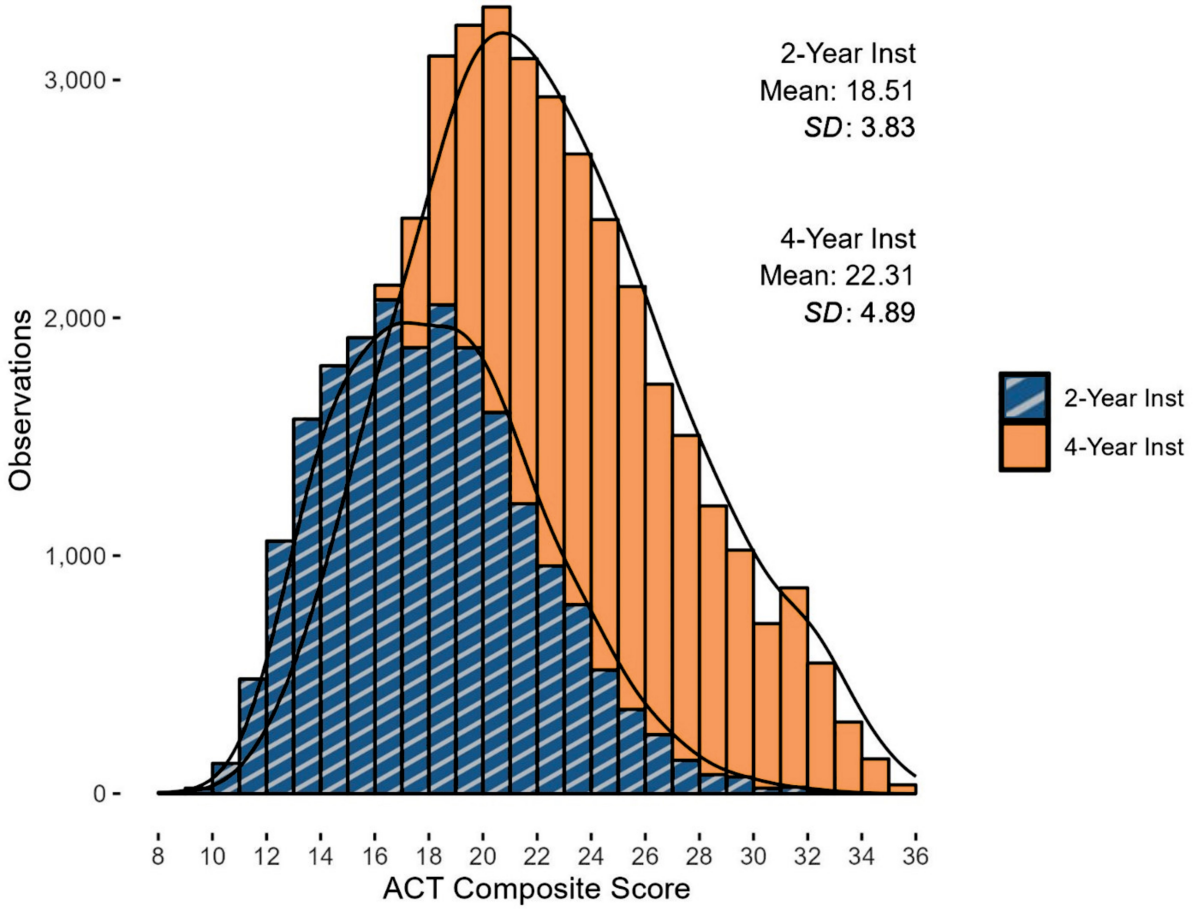
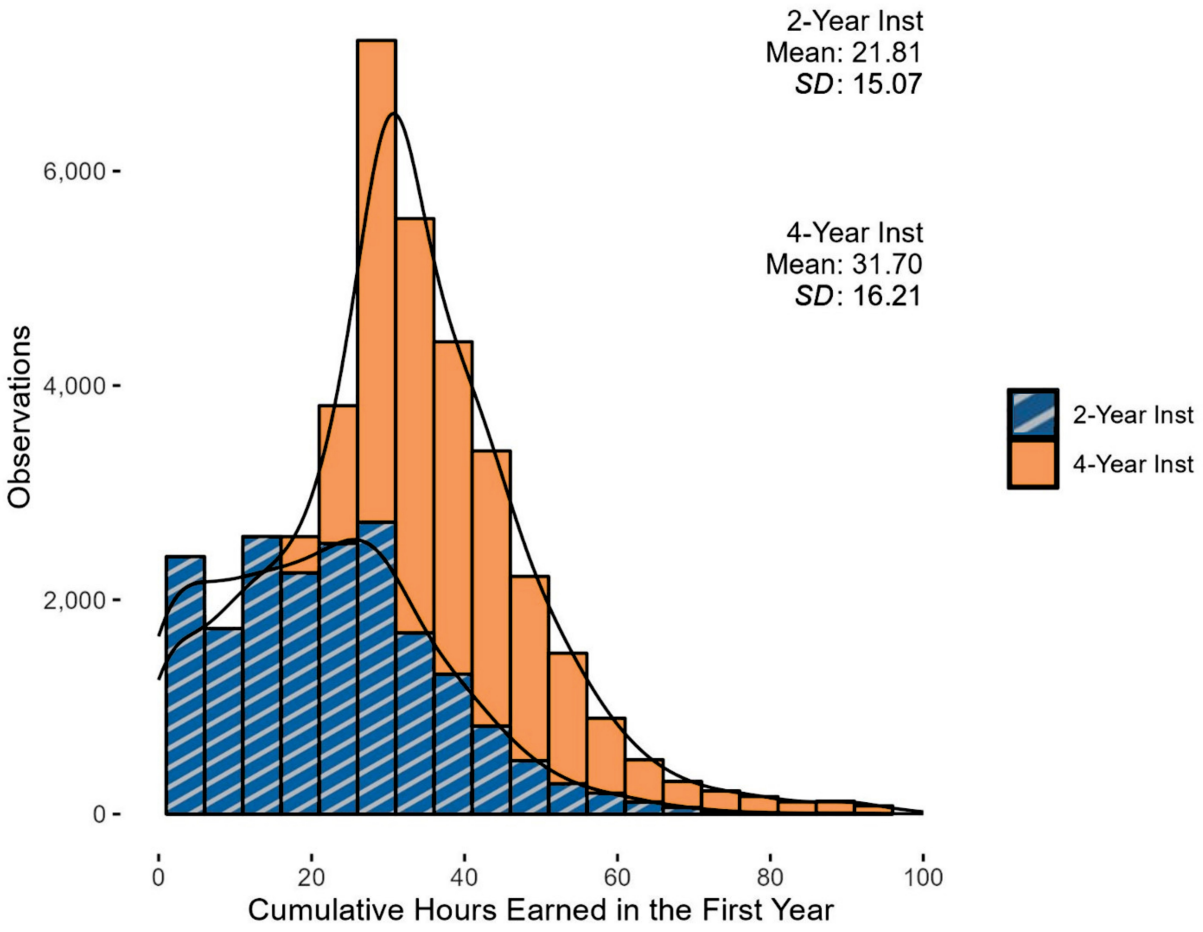


Figure 3 shows the distribution of cumulative first-year hours earned for students enrolled in 2- and 4-year institutions. Most students who enroll in 2-year institutions complete 30 hours or less in their first year. The distribution of cumulative first-year hours earned for students enrolled in 2-year institutions is skewed.[2] The average cumulative first-year hours earned was 21.81 for students enrolled in 2-year institutions and 31.70 for students enrolled in 4-year institutions. The distribution of cumulative first-year hours earned translates to higher variability (i.e., a higher standard deviation) among students enrolled in 4-year institutions than students enrolled in 2-year institutions.

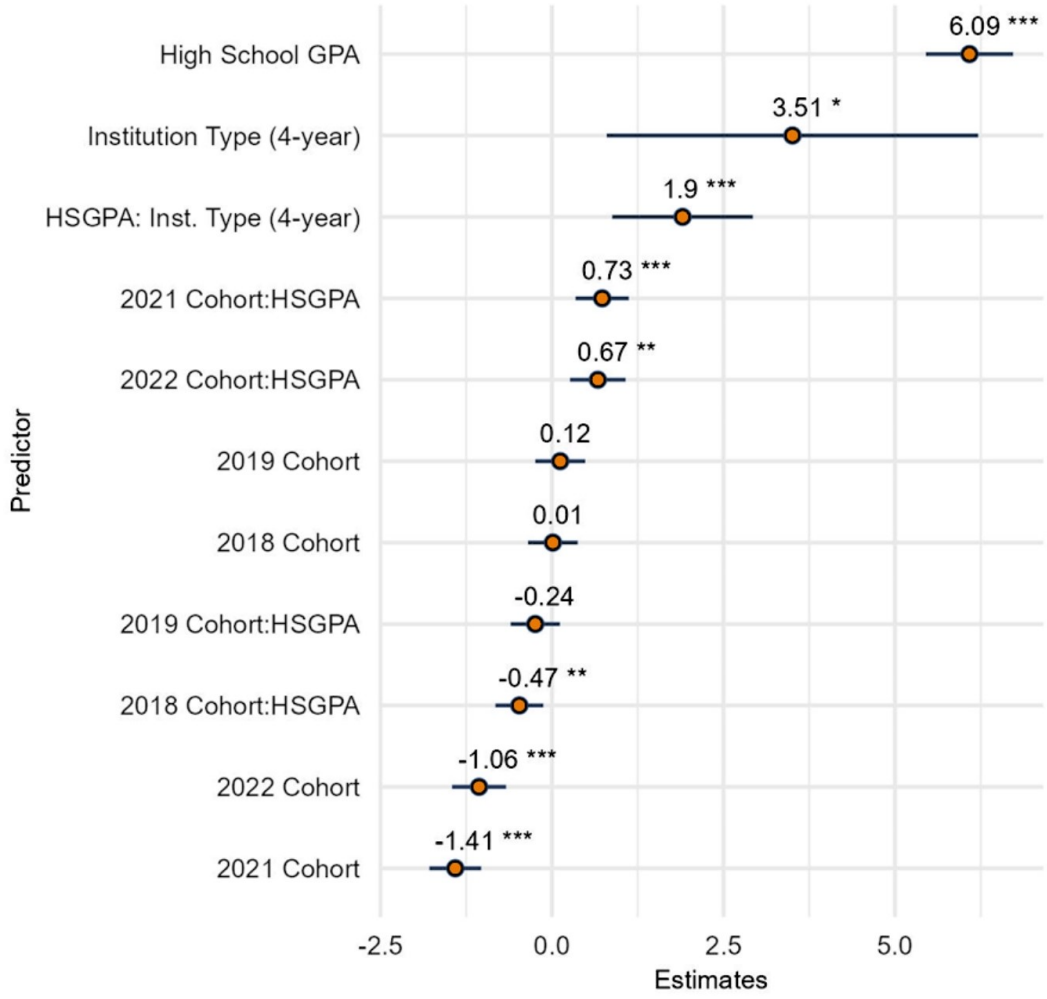
Figure 3. Cumulative First-Year Hours Earned for Students Enrolled at 2-Year and 4-Year Institutions



In what ways has the relationship between cumulative first-year hours earned and HSGPA changed since the onset of the pandemic?

As indicated by the coefficients from the hierarchical model, which included HSGPA alone, there were significant positive interaction effects between cohort and HSGPA for the 2021 and 2022 cohorts relative to the 2020 cohort (Figure 4). Conversely, there was a significant negative interaction effect between cohort and HSGPA for the 2018 cohort relative to the 2020 cohort. There were also significant negative main effects for the 2022 and 2021 cohorts relative to the 2020 cohort. Additionally, there were significant positive interaction effects between institution type and HSGPA and a positive main effect for institution type.

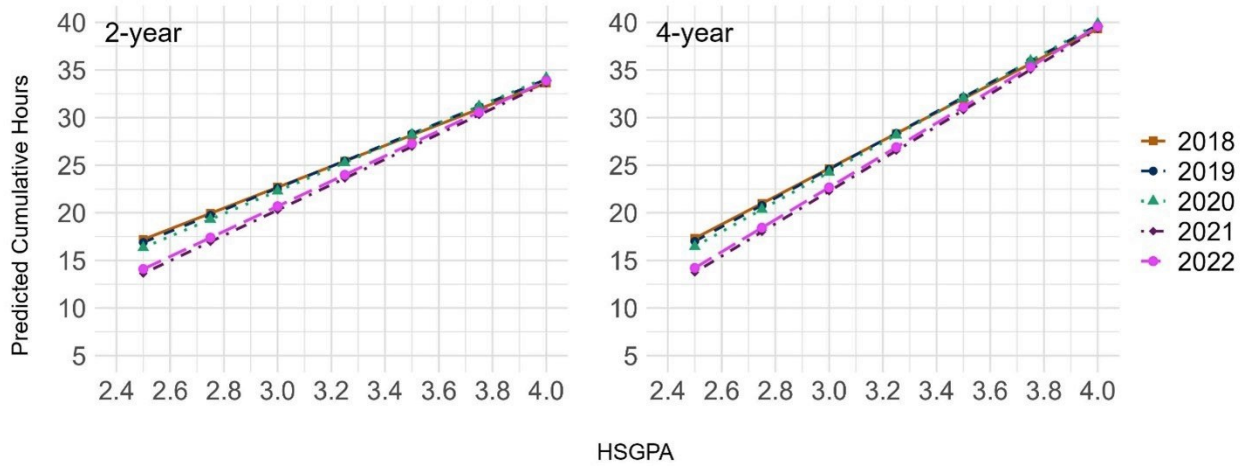
Figure 4. HSGPA Model Coefficients



Note. *p < 0.1; **p < 0.05; ***p < 0.01

Furthermore, when we examine the predicted cumulative first-year hours earned (PHE) for students at 2-year and 4-year institutions, we see that over much of the HSGPA distribution, PHE was lower for the 2022 and 2021 cohorts than for the 2018, 2019, and 2020 cohorts (Figure 5); there was a consistent negative shift in PHE after 2020. Finally, we can see that as HSGPA increased, the difference between the 2018–2020 cohorts and the 2021 and 2022 cohorts decreased. Only students with very high HSGPAs (above 3.8) had similar PHE before and after 2020.

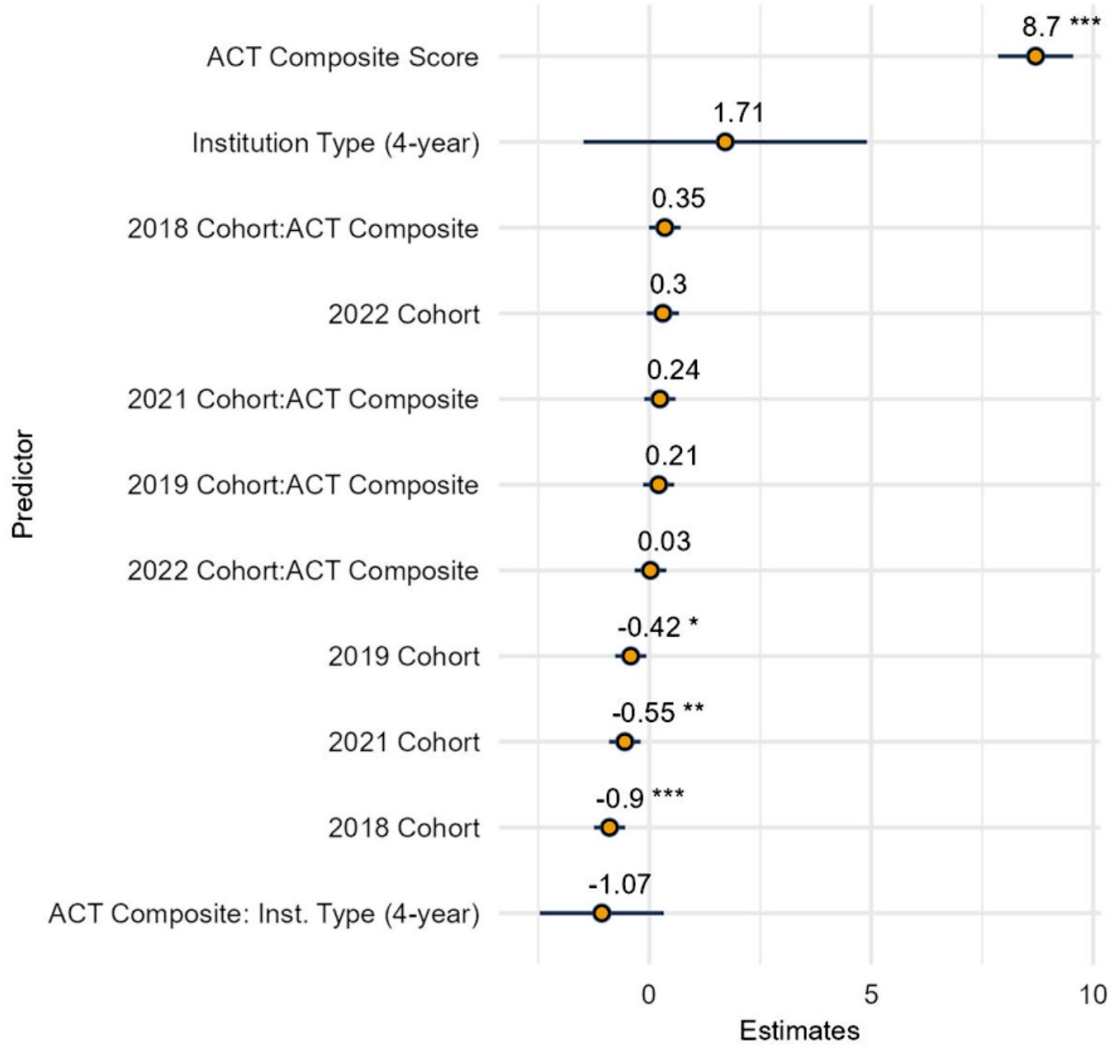
Figure 5. Predicted Cumulative First-Year Hours Earned According to the HSGPA Model by Institution Type



In what ways has the relationship between cumulative first-year hours earned and ACT Composite scores changed since the onset of the pandemic?

In the model for ACT Composite score only, we did not see significant interaction effects between cohort and ACT Composite score across the cohorts examined (Figure 6). There were, however, significant negative main effects for the 2018, 2019, and 2021 cohorts relative to the 2020 cohort. Unlike the HSGPA model, the Composite model showed no significant interaction effect between ACT Composite score and institution type and no significant main effect for institution type.

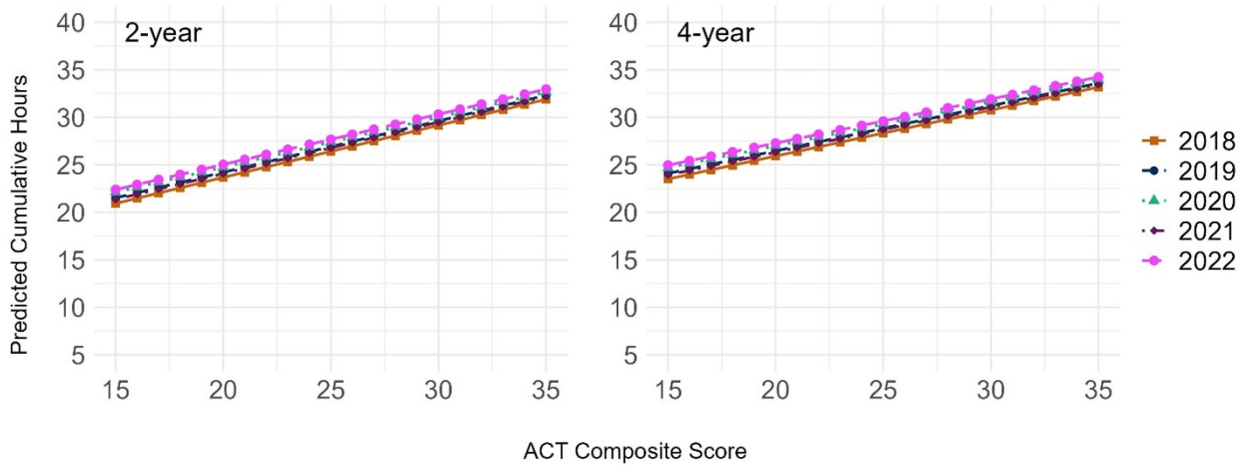
Figure 6. ACT Composite Score Model Coefficients



Note. *p < 0.1; **p < 0.05; ***p < 0.01

Using this model, we see a small but consistent increase in PHE for students entering both 2-year and 4-year institutions between 2018 and 2022 (Figure 7). Additionally, students at 2-year institutions had lower PHE across the ACT Composite score scale than students at 4-year institutions.

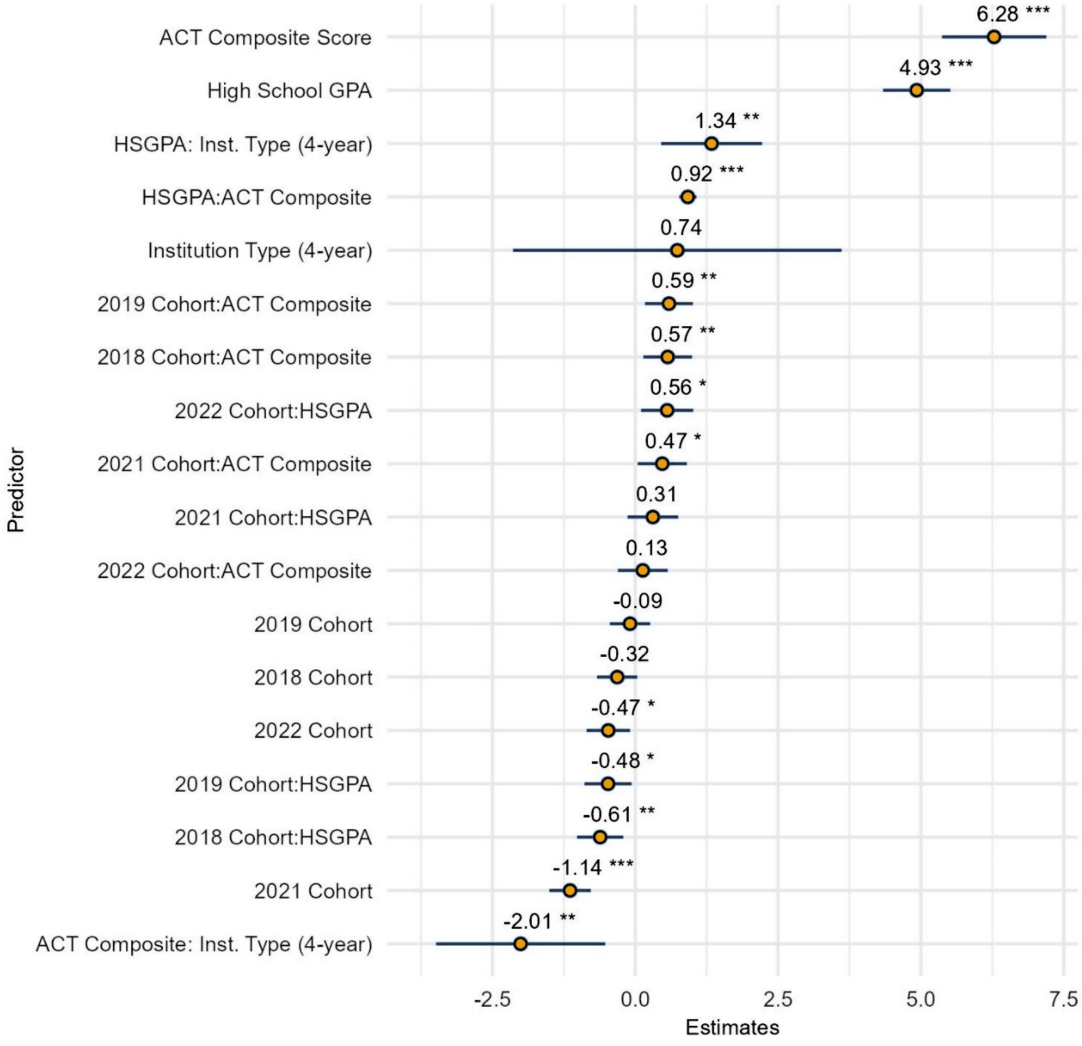
Figure 7. Predicted Cumulative First-Year Hours Earned According to the ACT Composite Score Model by Institution Type



In what ways has the relationship between cumulative first-year hours earned and the combined college readiness measures HSGPA and ACT Composite score changed since the onset of the pandemic?

In Figure 8, we can see that there are significant interaction effects between cohort and both HSGPA and ACT Composite score. The coefficients for the interaction between cohort and ACT Composite score were significant and positive for 2018, 2019, and 2021, while the coefficients for the interaction between cohort and HSGPA were significant and positive for the 2022 cohort. Additionally, the coefficients for the interaction effect between HSGPA and cohort were significant and negative for the 2018 and 2019 cohorts. The main effects for the 2021 and 2022 cohorts were also significant and negative.

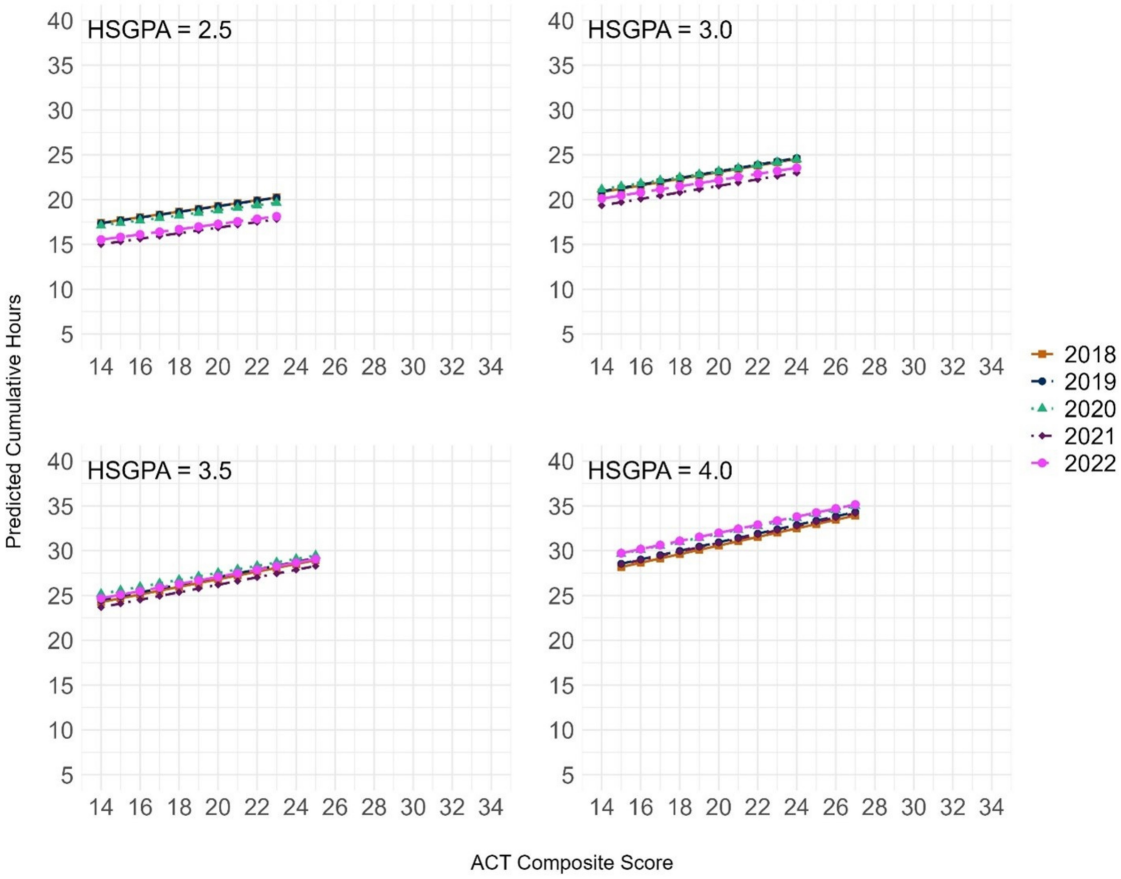
Figure 8. HSGPA and ACT Composite Score Model Coefficients



Note. *p < 0.1; **p < 0.05; ***p < 0.01

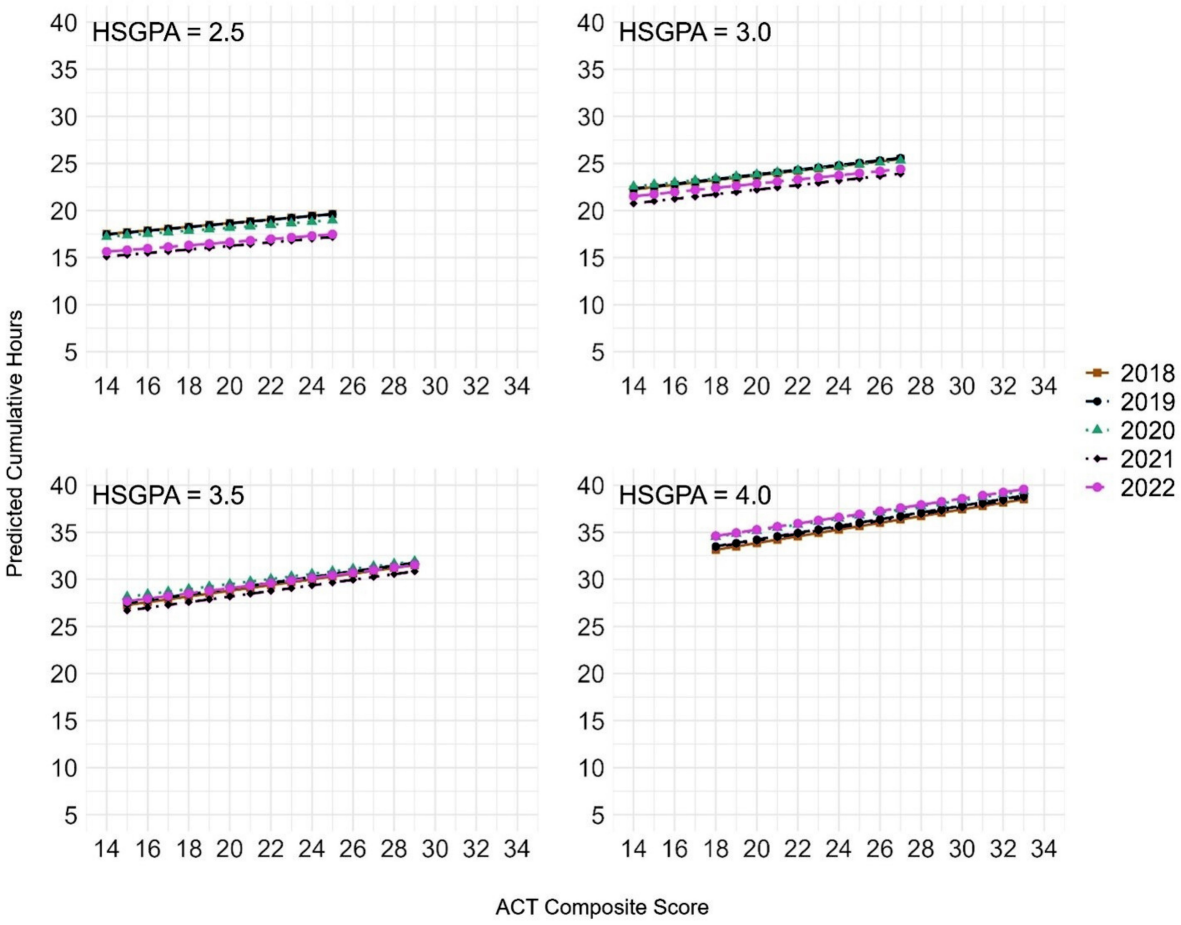
This model reveals that as HSGPA increased from 2.5 to 4.0, PHE also increased for students enrolled at 2-year institutions (Figure 9). PHE also increased as ACT Composite score increased. Among students with a 2.5 HSGPA, there was a clear distinction between the probabilities for the 2018–2020 cohorts and those for the 2021 and 2022 cohorts such that students in the latter two cohorts had notably lower predicted cumulative hours earned. As HSGPA increased, PHE for the 2022 cohort rose. For students with a 3.0 HSGPA, PHE was highest for the 2018, 2019, and 2020 cohorts, followed by hours for the 2022 cohort and finally by those for the 2021 cohort. For students with a 3.5 HSGPA, PHE was lowest for the 2021 cohort, and predicted hours earned were similar for other cohorts. Among students with a 4.0 HSGPA, predicted hours earned were similar for the 2022 and 2020 cohorts and higher than those for other cohorts.

Figure 9. Predicted Cumulative First-Year Hours Earned According to the HSGPA and ACT Composite Score Model for 2-Year Institutions



The trend observed at 2-year institutions was observed at 4-year institutions as well: as HSGPA or ACT Composite score increased, PHE increased. For students who were enrolled in 4-year institutions and had a HSGPA of 2.5, there was a clear distinction between the 2021 and 2022 cohorts and previous cohorts, with the former two cohorts having notably lower predicted cumulative hours earned. As HSGPA increased from 2.5 to 4.0, PHE for the 2022 cohort increased. For students with a 3.0 GPA, the 2021 cohort had the lowest predicted cumulative hours, followed by the 2022 cohort and then the 2018–2020 cohorts. For students with a 3.5 HSGPA, the 2021 cohort had the lowest PHE, and the remaining four cohorts had very similar predicted cumulative hours earned. Finally, for students with a 4.0 HSGPA, students in the 2022 and 2020 cohorts had higher PHE than students in the 2018, 2019, and 2021 cohorts. Notably, as indicated by Figures 9 and 10, students with a lower HSGPA had similar predicted hours earned at both 2-year and 4-year institutions, whereas students with a higher HSGPA had higher predicted hours earned at 4-year institutions than at 2-year institutions.

Figure 10. Predicted Cumulative First-Year Hours Earned According to the HSGPA and ACT Composite Score Model for 4-Year Institutions



Model Fit

As shown in the appendix, the model that included both HSGPA and ACT Composite score resulted in the greatest percentage reduction in residual variance, followed by the HSGPA-alone model and finally the Composite-alone model (approximately 25%, 20%, and 16% respectively). A similar pattern was observed in the marginal and conditional R^2 for the models. For example, the combined model, Composite-alone model, and HSGPA-alone model explained approximately 32%, 25%, and 23% (respectively) of the fixed effects variance. In terms of the Akaike and Bayesian information criteria, the model that included both HSGPA and ACT Composite score demonstrated the best fit among the three models, followed by the HSGPA-alone model and finally the Composite-alone model. Based on these statistics, we can see that using both HSGPA and ACT Composite score resulted in the best model fit and the greatest percentage of marginal and conditional variance explained. It is noteworthy that the Akaike and Bayesian information criteria suggest that the HSGPA-alone model fits the data better than the Composite-alone model; however, the Composite-alone model explained more marginal and conditional variance than the HSGPA-alone model. A model might be considered “better”

depending on the researcher's ultimate goals. For my purposes, the explanation of variance is more important, and as such, the combined model demonstrated better model fit.

Discussion

In Sanchez (2024a & 2024b), evidence of grade inflation in HSGPA from 2018 to 2022 was found. This study showed that HSGPA rose 0.23 points for students enrolled in 2-year institutions and 0.11 points for students enrolled in 4-year institutions. At the same time, average ACT Composite scores remained stable for students enrolled in 2-year institutions (18.66 in 2018 and 18.51 in 2022) and decreased slightly for students enrolled in 4-year institutions (22.51 in 2018 and 21.90 in 2022). This suggests an issue of grade inflation: Although students' grades are increasing, they are not able to demonstrate content mastery on other measures of achievement.

Sanchez (2024a & 2024b) documented a shift in the predictive validity of HSGPA after the onset of the COVID-19 pandemic in 2020. This study also documents a shift in the predictive validity of HSGPA in predicting cumulative hours earned during the first year of college. For example, at the 25th, 50th, and 75th percentiles of HSGPA for students at 2-year institutions, PHE were approximately 23, 27, and 30 (respectively) for the 2018–2020 cohorts but 21, 25, and 29 (respectively) for the 2021 and 2022 cohorts. We can see that there was a decrease in the predicted cumulative hours earned. For students enrolled at 4-year institutions, a similar pattern emerged at the 25th, 50th, and 75th percentiles: Students in the 2018–2020 cohorts had PHE of approximately 26, 30, and 35 (respectively), while students in the 2021 and 2022 cohorts had PHE of approximately 23, 29, and 34 (respectively).

This differentiation was not observed in the ACT Composite score model for students across all cohorts. At the 25th, 50th, and 75th percentiles of ACT Composite score, students at 2-year institutions had PHE of approximately 25, 27, and 30 (respectively), and students at 4-year institutions had PHE of approximately 27, 29, and 31 (respectively). Together, these two findings demonstrate that while the predictive validity of HSGPA on cumulative first-year hours earned was impacted by the educational landscape after the onset of the COVID-19 pandemic, the predictive validity of ACT Composite score remained relatively stable.

When we look at the findings for the model that included both HSGPA and ACT Composite score, we can see that using both achievement measures mitigated but did not eliminate the shift in predictive validity for HSGPA after the onset of the COVID-19 pandemic. This was particularly true at lower levels of HSGPA, where a notable shift was seen between the 2018–2020 cohorts and the 2021 and 2022 cohorts. In regard to HSGPA predicting cumulative hours earned, it would appear that students at the lower end of HSGPA were most significantly impacted after the onset of the COVID-19 pandemic.

The findings from this study, supported by Sanchez's research (2024a & 2024b), provide strong evidence of grade inflation for the 2018 to 2022 cohorts. This raises concerns about the reliability and significance of HSGPA as a standalone predictor of academic preparation for college, particularly as it may misrepresent students' readiness for college-level coursework.

This has serious implications for postsecondary institutions using test-optional or test-blind policies, since these institutions may be entirely reliant on HSGPA as the sole measure of academic achievement.

Additionally, this research demonstrates the impact on HSGPA of the significant changes that occurred in education due to the COVID-19 pandemic. The changes in educational delivery and assessment that occurred during the pandemic likely contributed to the predictive validity of HSGPA and to the shifts revealed by this study. As a result, it is important for postsecondary institutions and policymakers to consider these findings when exploring future educational strategies and assessment methods that will ensure that HSGPA is a valid measure of academic achievement and preparation. The use of multiple measures (e.g., HSGPA and ACT Composite score together) offers a more stable and valid approach to predicting academic outcomes such as cumulative hours earned, first-year college GPA (Sanchez 2024a), and placement in developmental education courses (Sanchez 2024b).

Limitations

This study used ACT-tested students from a single state that uses the ACT test for statewide school-day testing. The sample was also limited to students from public high schools and public colleges in the state. This may limit the generalizability of these findings across states to students who have not tested as part of a statewide adoption contract or to students attending private high schools or private colleges. The study also used self-reported HSGPA. Although there is evidence to support the use of a self-reported HSGPA measure, it is possible that this measure included a degree of inaccuracy or bias. Additionally, in order to observe overall trends between the achievement measures examined and cumulative hours earned in the first year of college, I omitted contextual factors such as socioeconomic status, demographic characteristics, and high school and college characteristics. The inclusion of these contextual factors in future research would undoubtedly provide a more nuanced perspective on the relationship between HSGPA, ACT Composite score, and cumulative hours earned.

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Notes

[1] The standard deviation for high school GPA and ACT Composite score varies slightly across cohorts. For example, the standard deviation for high school GPA changes from 0.62 in 2017 to 0.59 in 2021, and the standard deviation for ACT Composite score changes from 5.63 in 2017 to 6.03 in 2021. While small, these changes could have impacted the predictive model.

[2] The skewness and kurtosis were 0.67 and 3.97, respectively, for 2-year institutions and 0.46 and 4.01, respectively, for 4-year institutions. Both institution types show positive skewness, indicating longer right tails. Additionally, their kurtosis values indicate that both distributions have heavier tails and sharper peaks compared to those in a normal distribution.

Appendix

Table A1. Model Coefficients

Predictor	Dependent variable		
	First-year cumulative hours earned		
	HSGPA model	ACT Composite score model	HSGPA & ACT Composite score model
Cohort 2018	0.014	−0.896***	−0.316*
	(0.185)	(0.179)	(0.180)
Cohort 2019	0.121	−0.419**	−0.091
	(0.186)	(0.180)	(0.180)
Cohort 2021	−1.408***	−0.550***	−1.141***
	(0.193)	(0.182)	(0.186)
Cohort 2022	−1.062***	0.304	−0.472**
	(0.201)	(0.186)	(0.195)
HSGPA	6.085***	—	4.927***
	(0.314)	—	(0.294)
ACT Composite	—	8.703***	6.283***
	—	(0.419)	(0.452)
4-year institution	3.506***	1.711	0.736
	(1.321)	(1.562)	(1.406)
HSGPA for cohort 2018	−0.475***	—	−0.614***
	(0.178)	—	(0.207)
HSGPA for cohort 2019	−0.243	—	−0.476**
	(0.183)	—	(0.211)
HSGPA for cohort 2021	0.733***	—	0.309
	(0.198)	—	(0.226)
HSGPA for cohort 2022	0.669***	—	0.559**
	(0.207)	—	(0.234)
HSGPA: Inst. type (4-year)	1.904***	—	1.337***
	(0.498)	—	(0.428)
ACT Composite for cohort 2018	—	0.349*	0.568***
	—	(0.182)	(0.218)
ACT Composite for cohort 2019	—	0.211	0.591***
	—	(0.180)	(0.215)
ACT Composite for cohort 2021	—	0.239	0.473**
	—	(0.180)	(0.220)

Predictor	Dependent variable		
	First-year cumulative hours earned		
	HSGPA model	ACT Composite score model	HSGPA & ACT Composite score model
ACT Composite for cohort 2022	—	0.025	0.133
	—	(0.183)	(0.223)
HSGPA and ACT Composite	—	—	0.921***
	—	—	(0.078)
ACT Composite: Inst. type (4-year)	—	−1.070	−2.006***
	—	(0.683)	(0.721)
Intercept	27.177***	29.124***	29.915***
	(0.757)	(0.891)	(0.806)

Note. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Table A2. Model Fit Statistics

Random effects	Dependent variable		
	First-year cumulative hours earned		
	HSGPA model	ACT Composite score model	HSGPA & ACT Composite score model
Number of institutions	32	32	32
SD (intercept slope)	3.433	4.061	3.645
SD (ACT Composite score slope)	—	1.712	1.027
SD (HSGPA slope)	1.236	—	1.785
σ^2 (residual variance)	191.082	199.027	177.776
τ_{00} (intercept variance)	11.783	16.49	13.289
τ_{11} (ACT Composite score slope variance)	—	2.932	3.186
τ_{11} (HSGPA slope variance)	1.528	—	1.055
% reduction in residual variance (null model)	19.734	16.397	25.324
Marginal R^2 (fixed effects only)	0.232	0.247	0.32
Conditional R^2 (random effects included)	0.282	0.314	0.379
Observations	53,378	61,110	53,378
Log likelihood	−216,026.000	−248,560.300	−214,135.600
Akaike inf. crit.	432,084.000	497,152.700	428,323.300
Bayesian inf. crit.	432,226.100	497,297.000	428,554.300

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