POLICY BRIEF

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Shifts in Advanced Science Course-Taking and Postsecondary and Career Pathways Following Texas House Bill 5

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Background

House Bill 5 (HB5) was passed by the Texas Legislature in 2013 which changed high school graduation requirements and defined endorsement options which allowed students more choice in coursework[1]. Focusing on science, the Foundation High School Program (FHSP) requires three science credits for graduation – Biology, IPC or an Advanced Science Course, and another Advanced Science Course[1]. Post-HB5 included the introduction of CTE courses which could satisfy the Advanced Science Course Credit which aligns to student interests such as Engineering, Biotechnology, and Animal Science[1].

The STEM endorsement requires Chemistry, Physics, and two other science electives above and beyond the FHSP[1]. Previous graduation requirements included Biology, Chemistry, Physics, and a lab based-based course[1-3] which align with admission requirements to both 4-year colleges and selective universities[2]. HB5 removed Algebra II, Chemistry, and Physics from graduation requirements keeping Biology under the FHSP as the only required science.

This policy brief focuses on science course taking and the effect of HB5 implementation on student selection of advanced science courses. Interest in STEM careers carries significant future economic implications and the potential for a robust STEM workforce in both Texas and the U.S[4-5], making science course-taking a policy priority.

KEY FINDINGS

- **Students are taking less foundational college science courses**
- **CTE courses for science credit are being taken at a higher rate.**
- **Students in Rural districts take significantly less AP/IB science courses (3%) and more advanced CTE science courses (19%) than any other urbanicity.**

3%

of 2020 Texas high school graduates in Rural Districts take an AP or IB science course.

POLICY RECOMMENDATIONS

- **Ensure that all students, regardless of district, have access to not only foundational science courses, but CTE and AP/IB Science as well.**
- **Providing funding to schools for CTE science coursework to create workforce pathways for students interested in science occupations outside of IHE graduation.**

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A Changing Science Landscape

For the purposes of this policy brief, cohorts of students were created based on the year that each student entered 9th grade with Cohort 4 as the first cohort after HB5 implementation and graduating May 2018. It must be noted that Cohorts prior to this group of students, if still in high school, were allowed to opt-in to HB 5 requirements rather than the prior program; therefore, in each study, there is some residual effect of HB 5 implementation in Cohorts 1, 2, and 3 with most transitional students in Cohorts 2 and 3.

This study was limited to students who graduated high school in Texas. Science course work was determined by TEA documentation for traditional science courses, science electives, and CTE courses for science course credit. Traditional college preparatory science courses above and beyond Biology include Chemistry, Physics, and Advanced Placement courses. There are several science courses offered in Texas that provide advanced placement college credit. These courses vary based on both district and school and include AP Biology, AP Environmental Science, AP Chemistry, AP Physics I and II, and AP Physics C. Prerequisites for each of these courses include at least one high school science course; yet other prerequisites vary. AP Biology and AP Environmental Science require only high school biology while AP Chemistry additionally requires Algebra II with AP Physics I, II, and C requiring Calculus.

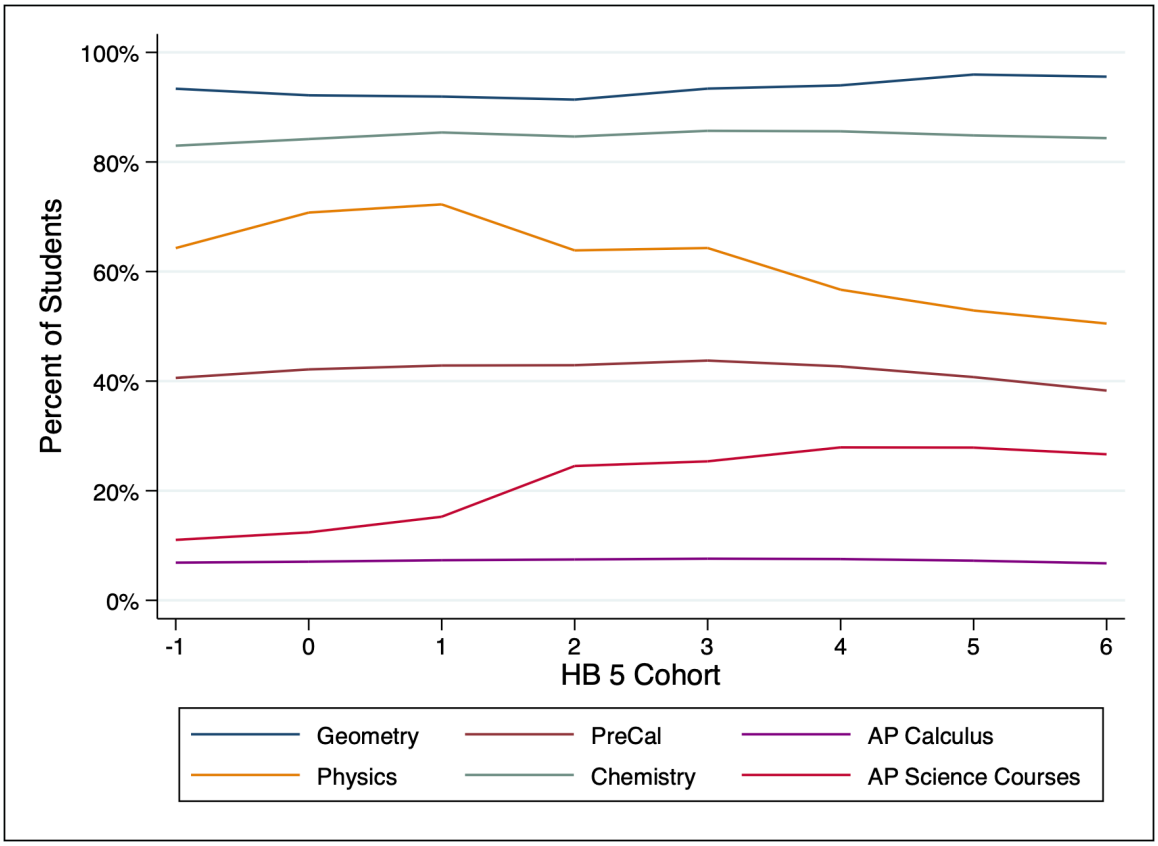
As noted, Chemistry and Physics are no longer required for most students to graduate high school following HB5 implementation. However, both courses associate with higher interest in STEM career[4]. Specific course offerings are determined at a campus level[1]. In our first analysis of science course taking, we sought to describe science courses taken by calculating student percentages of courses taken by cohort.

We found that the percentage of students taking Biology and Chemistry remained consistent between cohorts. There is a slight increase in students taking AP Science courses after HB5 implementation. The percentage of students taking Physics has the most drastic change with declining enrollment beginning with 2015 graduates. Initially, this decline can be explained by the introduction of AP Physics as a course recognized by TEA; yet both Physics courses decline throughout the sample. The 2015 graduating class was able to opt-in to FHSP which would allow them to take other courses, rather than Physics, and still graduate.

As expected, the percentage of students taking CTE science courses increased following HB5 implementation with the greatest increases in Food Science and Engineering. Additional research during the larger study examining the effects of HB5 on Texas high school student outcomes and workforce included identification of STEM deserts in which the percentage of students earning a STEM endorsement varies throughout the state suggesting disparities in access to math and science courses[6].

These disparities were linked to districts designated as rural or non-metropolitan as compared to suburban or urban districts. Indeed, a STEM workforce throughout a heterogeneous state should be adequately prepared in both math and science coursework; therefore, a comparison of college preparatory math and science course taking was completed showing a comparable decline between Physics and Precalculus after HB5 implementation.

Figure 1. Shifts in Traditional College Preparatory Math and Science Course Taking



This association can be explained by several factors including lowering the needed math and science credits to graduate from 4 credits to 3. Allowing students freedom to chose other course credits other than math and science may have encouraged students seeking enrollment in an IHE to pick an advanced placement course to obtain college credit rather than taking the traditional foundation course prior.

The introduction of CTE courses satisfying math credits above Geometry and science credits above Biology might also explain the decline in Precalculus and Physics. Both Precalculus and Physics are advanced courses and are now self-selected by students with higher academic motivation or an interest in a STEM field since neither are required for graduation under FHSP[1].

Is Biology Enough?

Prior to HB5, Texas graduates following the Recommended Graduation Plan or the Distinguished Achievement Program[1] were required to take Biology, Chemistry, and Physics as part of the four science credits required for graduation. HB5 not only reduced the number of science credits needed to graduate but removed Chemistry and Physics leaving only Biology as a named required course allowing students to fill additional science credits with CTE science credits or science electives[1]. Previous research on science course taking as a predictor of STEM college major[3,6], suggests that students taking chemistry and/or physics were more likely to declare a college major in a STEM field than students taking less rigorous or less credits of science coursework.

For our second analysis, we analyzed course taking affects on the likelihood of a Texas student declaring a STEM major and taking Biology, Chemistry, or Physics in high school. In Texas, Biology is recommended for students in grades 9, 10, or 11 and does not have any prerequisite course required[1]. Chemistry is recommended for students in grades 10, 11, or 12 and requires one unit of high school science and Algebra 1 as prerequisite courses[1]. Physics is recommended for grades 9, 10, 11, or 12 and recommends, but does not require, Algebra 1 as a prerequisite[1]. Our analysis of Texas graduates concluded similar results to previous literature. Taking Biology or Chemistry as a high school student resulted in a negative correlation to declaring a STEM major while taking Physics resulted in a positive correlation suggesting similar results to previous literature[3,6].

Since Biology is a graduation requirement for all students, this result is not surprising. All students do not declare a STEM major in college; yet the fact that taking a Physics course has a positive correlation to declaring a STEM major suggests that additional exposure to Physics concepts above middle school science curriculum may increase STEM career interest in Texas graduates.

Earning a STEM endorsement provides student's access to admission to technical colleges, community colleges. 4-year colleges, and selective universities[4] since it requires students to take Chemistry and Physics. An absence of these two credits creates additional consequences with Texas high school students either taking the minimum 3 credits each to graduate under the FHSP or a CTE credit satisfying the 4th needed credit in science. While a graduate can access technical college and community college admission with a high school diploma under FHSP, additional course work is needed to access most 4-year colleges with many citing a lab science high school credit.

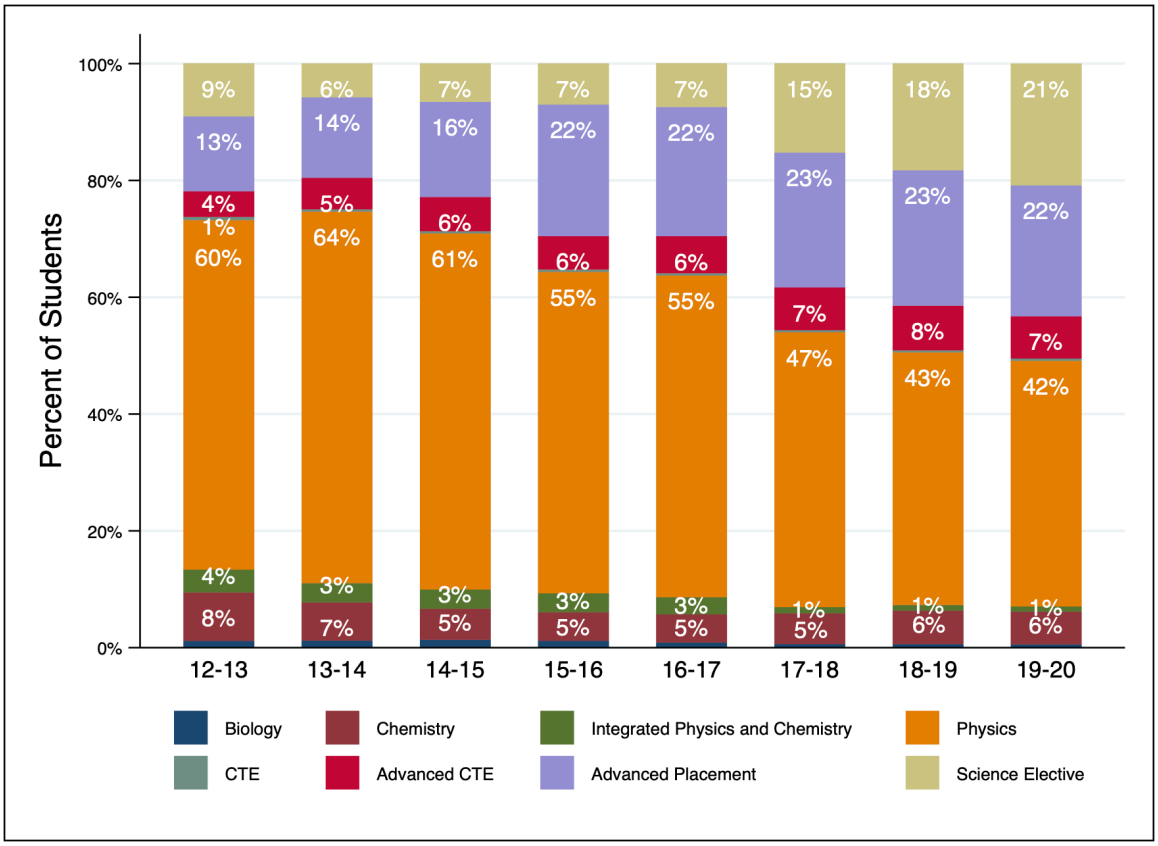
Post Secondary Outcomes

For our third analysis, we analyzed the effect of the highest category science course taken on 2-year and 4-year enrollment[7]. Student course taking was examined by category of science course determined by prerequisites set by TEA. We grouped science courses into 8 categories – Biology, Chemistry, Integrated Physics and Chemistry, Physics, Science Electives, CTE Science Courses, Advanced CTE Science Courses, and AP/IB Science Courses.

The "Biology" category included both Biology and Alternative Biology. "Chemistry", "Integrated Physics and Chemistry", and "Physics" were categorized by singular classes. "Science Electives" includes Environmental Science, Anatomy, Astronomy, Earth and Space Science, and Aquatic Science which all required at least Biology and one other science course prior to taking. CTE Science Courses were disaggregated further by prerequisite. These are CTE credit courses that also satisfy the science graduation requirement. "CTE Science Courses" include Advanced Plant Science, Anatomy and Physiology, Biotechnology I and II, Food Science, Medical Microbiology, Pathophysiology, and Principles of Technology. "Advanced CTE Science Courses" require additional math credits as a prerequisite and include Advanced Animal Science, Engineering Design and Problem Solving, Engineering Science, and Scientific Research and Design. The last category examined includes all AP and IB courses that satisfy the science graduation credit requirement.

These categories allowed us to group students by prerequisite needed to advance in science course taking. Initially, we looked at trends over time by cohort. Prior to HB5 implementation, physics was the predominant highest category taken by students. As physics declined, both AP/IB and science electives increased.

Figure 2. Highest Science Shifts in all Directions, Pre and Post House Bill 5[7]

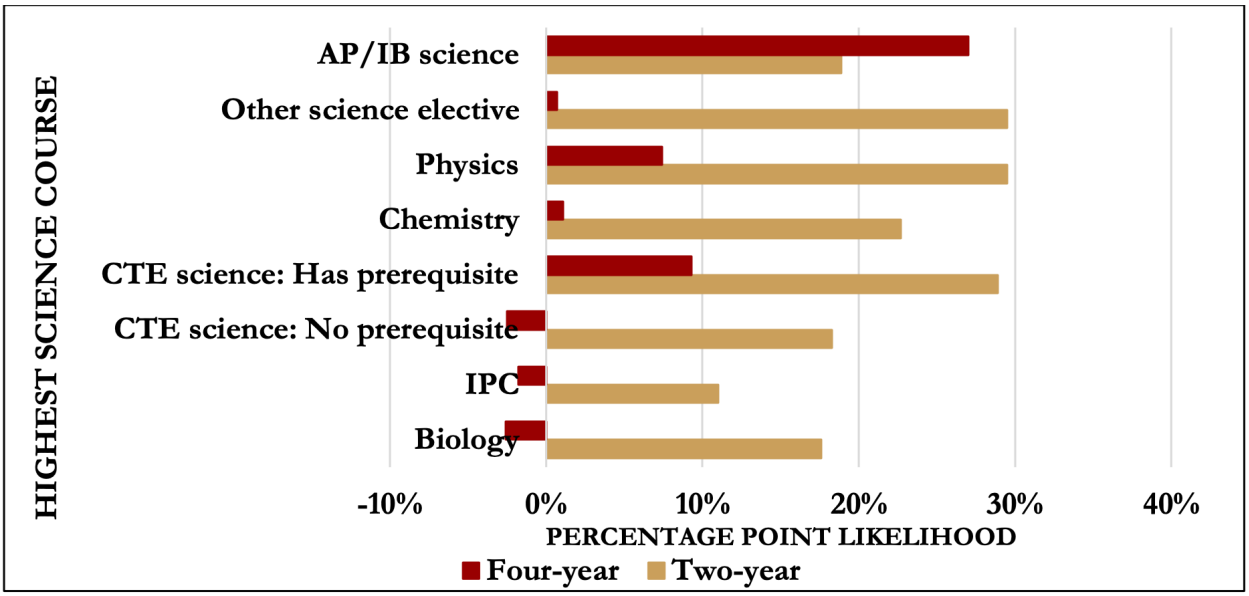


With physics removed as a graduation requirement by HB5, our findings suggest that students began to take courses that would either provide college credit or engage their personal interests through science electives while an upperclassman in high schoo[7]. Notably, the percentage of students ending their science course taking post HB5 implementation increased most in science elective course taking[7].

Next, we sought to understand if science course taking impacted post secondary enrollment. We again used highest science category taking in high school as a predictor. Though all sciences appear to positively impact enrollment in a 2-year institution, a student ending their high school course taking physics has the highest association to enrollment followed closely by advanced CTE Science and science electives. In terms of 4-year institution enrollment, a student ending their highest science high school course taking with biology, integrated physics and chemistry, CTE science, or chemistry has a negative association with enrollment meaning that these students are less likely to enroll in a 4-year institution.

Though Science Elective students have a positive association with 4-year institution enrollment, it is negligible. Both physics and advanced CTE science results in a much greater association, yet AP/IB science had the highest association to enrollment in a 4-year institution.

Figure 3. Highest Science Completed in High School and Change in Likelihood of Postsecondary Enrollment[7]



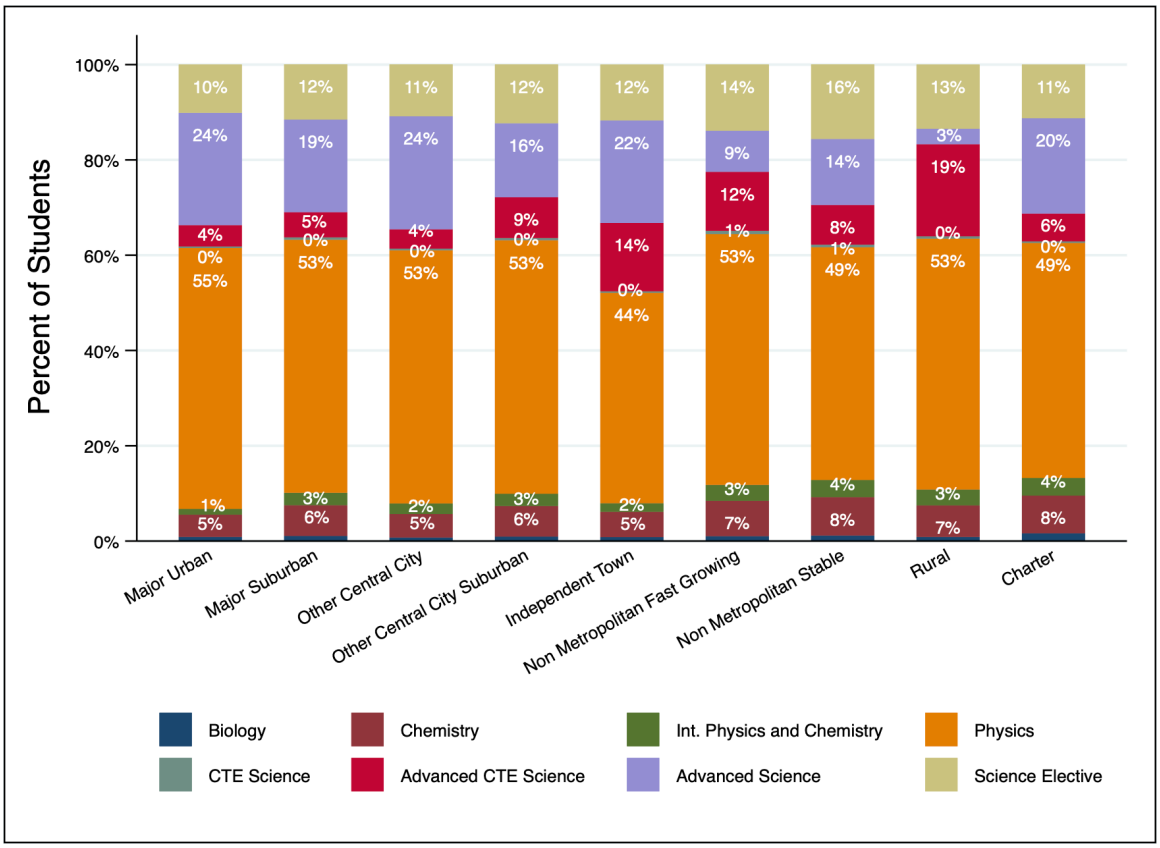
Our findings suggest that science course taking does have an impact on post secondary enrollment[7]. Students ending their high school science course taking with a more rigorous science course have a greater likelihood of enrolling in a 4-year institution. In fact, all other levels of science students have a greater association to 2-year institution enrollment than 4-year institution suggesting that students who are college bound have a greater likelihood of taking an AP/IB science course[7].

What about students who do not attend college?

With approximately 50% of Texas graduates attending an IHE within a year after graduating high school, we were interested in understanding information about the 50% of students who entered the workforce. Therefore, workforce need outcomes were examined for our fourth analysis which again uses highest science taken in high school to categorize students based on science and math prerequisites taken. However, our workforce need outcome data is limited to students who did not enroll in a 2-year or 4-year institution after high school. Students examined for this analysis were students who graduated from a high school in Texas and continued to the workforce immediately after high school. Additionally, workforce needs are associated with TEA district types to assess the likelihood of a student aligning to the workforce need of the region.

Because CTE coursework is geared towards career and technical experiences in preparation for the workforce, we were most interested in the alignment of students who took their highest science coursework in CTE science courses and the workforce need of their region. The most significant alignment for students who chose to take CTE science credit coursework as their highest science in high school occurred in Independent Towns (36%), Rural (48%) districts, and for Advanced CTE in Non-Metropolitan Stable Districts (27%). Not only do students who take CTE coursework as their most advanced science in high school have a greater alignment to workforce needs, but this group of students are the only students throughout each district type in Texas that have a positive association to workforce alignment needs.

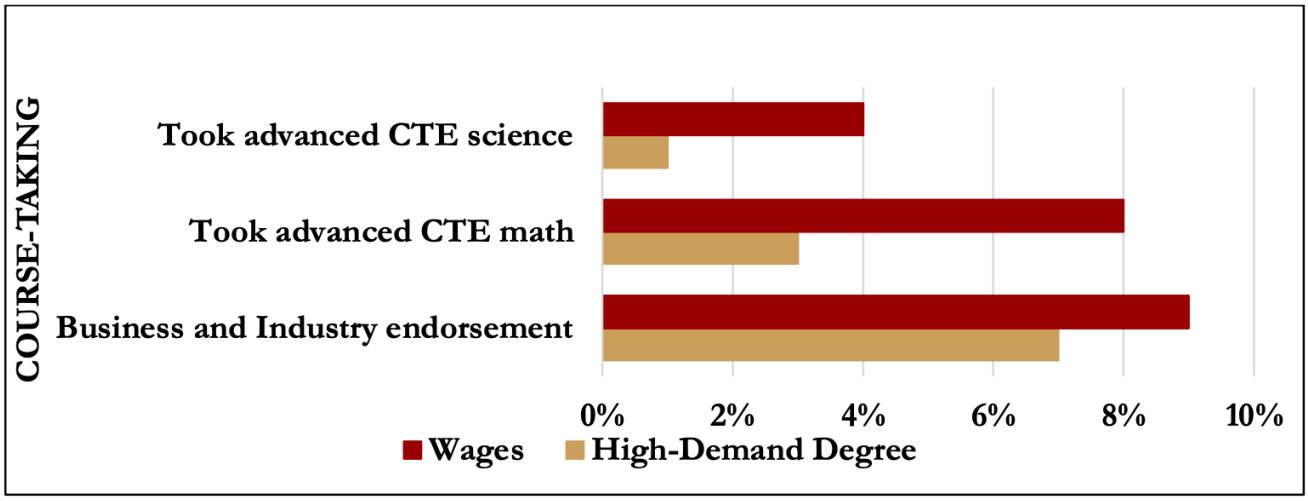
Figure 4. Highest Science Course Taken by TEA District Type



This analysis suggests differences between district types in terms of highest science taken. The largest difference appears in Rural districts. Students in Rural districts appear to take significantly less AP/IB science courses (3%) as their highest science level compared to other districts which range from 9% - 24% of students taking AP/IB science coursework. When comparing this with other findings in our study, this suggests that students attending a rural school district may be less likely to enroll in a 4-year IHEs since AP/IB Science enrollment is a predictor of enrollment. However, since more students end their science studies in high school taking Advanced CTE and physics, our findings suggest that most students who attend high school in Rural districts may have a greater likelihood of attending 2-year IHEs or if a student choses to enter the workforce, greater workforce need alignment and salary obtainment.

We also analyzed average salaries for students entering the workforce immediately out of high school categorized by these same groupings and urbanicity location[7]. Again, those students who took CTE science coursework as their highest science in high school were of greatest interest due to course curriculum geared towards science industry occupations. Students taking advanced CTE science coursework appear to have a wage boost, depending on district type as compared to students ending their science coursework in advanced science directly out of high school suggesting that CTE science coursework does impact student outcomes of those not seeking IHE admission. Figure 5 illustrates not only science CTE course taking benefits on wages and high demand degrees, but also math CTE course taking and business and industry endorsement[7].

Figure 5. How Postsecondary versus Workforce Pathways Have Changed After House Bill 5[7]



Based on our study, science course taking appears to not only impact student enrollment in IHEs, but also workforce need alignment and salary of those students who enter the workforce out of high school[7].

Conclusion

In terms of science course taking, students who intend to attend 2-year and 4-year IHEs appear to continue to take high level science courses of Physics and AP/IB Sciences even when not required for graduation. It appears that students who plan to enter the workforce after high school take science courses not aligned to IHE, such as CTE science credit courses. Our studies suggest that students taking CTE science coursework better align to regional workforce needs than their advanced science peers when entering the workforce after high school. The STEM endorsement, which requires algebra II, biology, chemistry, physics, and two other advanced STEM electives aligns best with IHE admission requirements; yet many students do not obtain this endorsement perhaps due to STEM perseverance, STEM interested, or lack of credit time within their high school coursework based on their 8th grade math course. Indeed, HB5 sought to create pathways for students to take science credit coursework that aligned with their personal interests and career goals. This was confirmed by our study of science course taking and the clear alignment to post-high school outcomes.

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