

## EXECUTIVE SUMMARY

### COLLABORATION, INNOVATION, AND TENACITY: EXEMPLARY HIGH-ENROLLMENT AP CALCULUS PROGRAMS FOR TRADITIONALLY UNDERSERVED STUDENTS

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Education systems across the country are raising mandatory graduation requirements and promoting advanced coursetaking in order to increase the number and diversity of students who have access to—and who are successful in—postsecondary education. As part of this effort, public high schools in many states are offering new or expanded Advanced Placement® (AP®) programs. This rapid expansion creates new challenges for school systems in terms of their capacity to offer more advanced courses and support more diverse groups of students in those courses. Some high-poverty districts and schools in Texas are successfully meeting these challenges, constructing systems that support high enrollment in AP calculus courses.

We examined the strategies used to support AP calculus courses with increased student enrollments in three urban Texas school districts. The purpose of this study was to obtain detailed knowledge about the specific factors associated with the development of high-enrollment AP calculus programs in high-poverty urban high schools in Texas. Specifically, we examined the infrastructure of these programs, including their recruitment procedures, student and teacher support mechanisms, professional development efforts, curricular and instructional decisions, leadership and educative philosophies, and collaborative efforts within schools and districts.

In selecting sites, we looked for those school districts with effective policies and practices supporting high enrollment and persistence in AP calculus programs in high-poverty urban school districts. We used four different Texas Education Agency data sets to identify possible districts. The data sets included three successive academic years (1996–97 through 1998–99) of AP enrollment, school demographic data, and district demographic data that were disaggregated by race/ethnicity and economically disadvantaged status. We looked for high schools that met the following criteria:

1. The school was located in a district with more than 4,000 students.
2. At least 40% of the school's students were eligible for the federal free or reduced-price lunch program.
3. The school was not an alternative or a magnet school.
4. The percentage of the school's eleventh- and twelfth-grade students enrolled in AP Calculus AB exceeded the 60th percentile for all Texas public high schools in the 1998–99 academic year.

We used qualitative methods to gather and analyze data collected from the schools. During each site visit, we observed one section of AP calculus in each school and audiotaped interviews with principals, deans, counselors, department chairs, and teachers about their views on how AP calculus was structured and supported. We also collected “artifacts of practice” such as district and school improvement plans, lesson plans, teacher resource material, examples of student work, and diagrams of classrooms. In each of the nine schools, we asked teachers to select six students, two performing in each of the high, middle, and low ranges of their AP calculus class, to participate in one focus discussion group about their experiences in the class.

The analysis revealed four key drivers behind the enrollment increases in AP calculus classes: district, outside agency, teacher, and student. A complete description of the findings can be found in the Charles A. Dana Center report, *Collaboration, Innovation, and Tenacity: Exemplary High-Enrollment AP Calculus Programs for Traditionally Underserved Students*.

### *District as Driver*

People in one district used a systems approach, from the central office to the classroom, to improve the enrollment in advanced-level courses like AP calculus. They established policies and practices to promote high-level coursetaking and conscientiously created an infrastructure that supported these policies. Their efforts emphasized

- creating a culture of high achievement,
- planning and collaborating,
- increasing enrollment,
- training teachers,
- aligning curricula, and
- providing resources.

**This district created a culture of high achievement.** The district cultivated an environment of high expectations, and staff throughout the system were able to articulate a common belief that all students could succeed in AP calculus. People worked together to plan and write grant proposals, identify and implement professional development, attend monthly meetings, and collaborate with local universities. These actions moved the district toward a culture that “looked above and beyond” the minimum toward preparing students for a “taste of college.”

**The district began planning and collaborating to support high achievement.** The district began efforts in the mid-1990s to develop a plan that would help achieve their goal of making advanced-level courses available to all students. People met to discuss what to focus on first, how to achieve what they wanted, and how they would know if they had achieved it. These many meetings between district staff, school administrators, and teachers led to a revision of the curriculum goals of both the district Mathematics Department and the district Advanced Academics Department.

**The district focused on increasing enrollment in advanced mathematics courses.** District and school staff used several strategies to increase enrollment in higher-level courses, including setting benchmarks for increased enrollment, actively recruiting students by describing the benefits of the courses, and offering flexible scheduling options to allow students to work through the mathematics course sequence in time to take AP calculus in their senior year.

**The district provided training to teachers in advanced-level content.** The district created opportunities for teachers to expand their content knowledge in mathematics. These opportunities included incentives to take higher-level courses in mathematics, attend summer institutes, and continue professional development focused on content rather than only pedagogy. The district combined student performance data with teacher-expressed needs to develop appropriate and targeted teacher training. Training became more sophisticated and intense over time, focusing on specific content strands and incorporating more research rather than generically covering broad content areas. The district brought in consultants to evaluate and develop curricula and formed partnerships with surrounding universities to support their teachers.

**The district emphasized aligning curriculums.** Teachers identified a need for shared connections and vocabulary so that students would be exposed to a uniform strand of material throughout their educative careers. The district responded in part by redirecting professional development days that were once reserved for issues such as discipline, to provide time for vertical team meetings to discuss curriculum issues.

**The district focused on providing resources to support high achievement.** District staff combined energies with campus staff to seek resources to support these plans. The district applied for and was awarded multiple competitive grants to improve teacher content knowledge and instructional skills. Teachers were compensated for their time spent in tutoring programs and in additional planning and training. Other resources more directly supported students. The district funded summer academies and paid the fees for every student enrolled in an AP course to take the AP exam.

### *Outside Agency as Driver*

Another district collaborated with an outside agency to improve enrollment and course success in AP calculus. This district and their partner agency focused on

- working together,
- recruiting teachers,
- preparing teachers, and
- recruiting students.

**The district and the private agency worked together to support high enrollment in AP calculus.** With the consent of the district, the agency recruited teachers, augmented their district salaries with stipends, provided training, supported them with curriculum and materials, and provided ongoing professional support from lead teachers. The agency also helped create a

culture that not only demanded increased enrollment in AP calculus classes, but also pushed for an increase in the number of students taking the AP calculus exam.

**The agency worked with district and school personnel to recruit teachers into the partnership.** Agency personnel expended great effort to locate and hire caring and dedicated teachers who would fit into their system. They also worked closely with principals to help them hire qualified staff. The partnership was successful at bringing in teachers, allowing for increased enrollment in AP calculus. Some of this success can be attributed to the monetary incentives that the agency offered. Teachers were paid an annual stipend and additional money was allocated to pay for after-school and weekend tutoring sessions. But as the program matured (and the amount of the stipends decreased) teachers were attracted to the program for the tremendous amount of support that it offered and the excitement that it created within the teacher and student communities.

**The agency prepared teachers through in-depth and ongoing training about the teaching and learning of calculus.** During summer institutes, classroom teachers observed lead teachers working with students from the local schools. At bimonthly half-day workshops, teachers learned content, received detailed curricula and lesson plans, and worked with their peers to align curricula. The district and the schools allocated time and resources for the teachers to attend mandatory training and conferences.

**The agency and school staff used a variety of strategies to recruit students into the program.** They changed the criteria for selection to include not only student aptitude, but also attitude and perseverance. They provided several ways for late-starters to make up for lost time and set up a variety of processes to help the students be successful, including before-school, after-school, and weekend tutoring sessions. These programs also addressed student needs such as transportation and supplies.

### *Teacher as Driver*

Individual teacher efforts also supported high enrollment in AP calculus. Even where strong districtwide supports were not in place, we found high-enrollment AP calculus programs driven by teachers dedicated to their students' success. Our time in classrooms showed us that teachers positively affected students by addressing their affective needs as well as their academic needs.

**Teachers acted in the interests of their students, attending to their affective needs on multiple levels.** These teachers intentionally tended to their students by having high expectations for them. They spoke to them in terms of future successes, placing the students in positions of achievement and authority. Teachers also recognized the students' need to feel comfortable and confident in their classrooms, and they tried to address this need by deliberately acting in caring ways toward their students.

**Teachers used various delivery strategies to help students complete mathematics courses and feel confident enough to enroll in AP calculus.** Teachers identified student skill levels early on to provide individual help to reinforce the basics and create solid foundations in mathematical understanding. They extended the curriculum beyond formulas and drills and

connected it to real-world applications. Informal grouping techniques allowed students to work together to solve problems. Teachers worked hard to demystify calculus by making their thought processes transparent as they solved problems and by paying strict attention to aligning all lessons. Finally, teachers modeled discipline and hard work to help students understand that success can be achieved through strong commitment.

### ***Student as Driver***

Students were not passive consumers of other people's initiative, effort, and passion; they were active participants in the successes we saw as we visited these districts and campuses. Students exhibited two distinct but complementary characteristics: taking initiative and finding motivation.

**Students took the initiative to enroll in advanced-level coursework.** Many had to overcome a variety of barriers, including being the first in their families to take advanced coursework, feeling peer pressure to stay in remedial mathematics classes, and even battling the low expectations they had of themselves and the low expectations held by school staff. They asked to be put into AP classes, modified their class schedules to be able to take extra coursework, and took time to attend summer sessions. These students also helped create a new, high-status culture around calculus that helped recruit new students into the program.

**Students found the motivation to persist in advanced-level coursework.** Once in the program, students used an array of strategies to stay in the classes, learn the material, and cope with the stress. They created support networks including family members, peers, and teachers. They attended tutoring before and after school, and often on weekends.

### ***Recommendations***

Based on our findings, we have developed the following recommendations that policymakers and practitioners may use as a basis for professional discussions about efforts to increase enrollment in AP calculus classes.

**Recommendations for all stakeholders** to make sustained improvements in increasing enrollment in AP calculus classes:

- Demand high expectations for students who are traditionally underserved but fully capable of success in advanced-level classes.
- Set advanced-level coursework as a priority in underserved middle and high schools.
- Act now. Do not wait to have all the necessary components in place before beginning these efforts.

**Recommendations for national-level, state-level, and district-level policymakers** to make sustained improvements in increasing enrollment in AP calculus classes:

- Set benchmarks for enrollment in advanced-level courses.

- Provide teachers and curriculum leaders time to plan and collaborate with each other.
- Encourage schools to use flexibility and creativity in meeting the goal of increased enrollment.
- Provide in-depth and ongoing teacher content training.
- Provide fiscal resources that will support campus efforts in setting AP calculus as a priority, such as compensated time for planning and collaboration among mathematics teachers as well as intensive staff development.

**Recommendations for campus-level decisionmakers** to support district initiatives or to promote increased enrollment in AP calculus classes using outside agencies:

- Set benchmarks for enrollment in advanced-level courses.
- Secure fiscal resources and support from federal, state, and district entities and submit grants to private and corporate organizations.
- Provide common planning periods for teachers.
- Provide in-depth and ongoing teacher content training.
- Provide appropriately certified and experienced teachers for all classes leading up to and including calculus for all students.

**Recommendations for classroom teachers** who play a critical role in recruiting students into AP classes and ensuring student success in the coursework:

- Work collaboratively and support each other.
- Attend in-depth and ongoing content training both individually and as a team.
- Build students' foundational knowledge and apply it to real-world scenarios.
- Address students' developmental and academic needs.
- Provide structured and planned tutoring that is directly related to activities in the classroom.

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