PERFORMANCE AND PRACTICE



CASE STUDY

Core Practices in Math & Science:

An Investigation of Consistently Higher Performing Schools in Five States

Excel High School

Boston Public Schools (Massachusetts)



Introduction

Since 1999, the National Center for Educational Achievement (NCEA) and its affiliated research teams have studied over 500 public schools across the country in an effort to identify and disseminate effective practices embraced by higher performing schools that distinguish their campuses from their average-performing peers. Building on the foundation established by this previous research, NCEA sought in the current study to focus specifically on educational practices in the areas of mathematics and science in five states: California, Florida, Massachusetts, Michigan, and Texas.

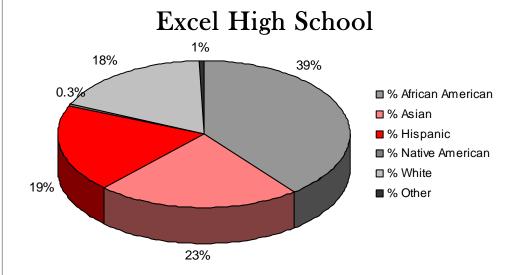
Criteria used in school selection in the current study included three years of state assessment data in mathematics and science (2004, 2005, and 2006), campus demographic make-up, percentage of economically disadvantaged students, school size, and geographic location. In addition, all of the schools selected for participation met the state and federal requirements for Adequate Yearly Progress (AYP) in 2006. Schools categorized as higher performing based on the selection criteria were those "beating the odds" with consistently better student achievement over three years, when compared to peer campuses with a similar student population. Therefore, a list of the state's highest performing schools may contain schools different from those selected for this study.¹

In order to illuminate the roles of different members in a school community, for each selected school, NCEA researchers interviewed district-level administrators, school administrators, and classroom teachers. To supplement the interview data, researchers collected pertinent documents, observed secondary level algebra classes, and invited participants to take part in the NCEA *Self-Assessment* online.



¹ For more detailed information about the school identification process and the list of higher performing schools included in the study, please see the full cross-case report at http://www.nc4ea.org.

Figure 1: Student Demographics



District and School Profile

The Boston Public Schools is a large urban district serving approximately 56,000 students in 144 schools. In 2006, The Boston Public Schools received the \$1 million Broad Prize for Urban Education. The district was a Broad Prize finalist from 2002 through 2005. Approximately 74% of Boston students are eligible for free and reduced-price meals.

All high schools in Boston are citywide schools, with any student in the district able to apply to attend a particular school. The district uses a computerized lottery system to determine admission to most district high schools.

Excel High School is a college preparatory high school serving 336 students in grades 9 through 12, with 64% of students eligible for free and reduced-price meals. The school serves a diverse student body, including several English language learners (13% of all students). The school offers a sheltered English immersion program for Vietnamese students. Excel High School is one of three small high schools housed in the South Boston Educational Complex. The three schools in the complex share facilities, extracurricular activities, and some non-instructional staff support positions. Otherwise, the schools operate independently, with their own headmasters, teachers, and students. The state accountability system measures each school's performance separately, and each school has its own goals and areas of focus.

As a strong proponent of higher standards, NCEA recognizes school efforts to move more students to the state's higher standard of achievement by accounting for those students in the analysis of consistent higher performance. Tables 1 and

2 summarize performance at both the state's proficient and advanced standards attained by the students at Excel for the years of 2004, 2005, and 2006. The state averages included in the tables represent student performance among schools with a student population similar to Excel, particularly based on the percentage of economically disadvantaged students. In Massachusetts, the state department of education pilot tested the new high school science assessment in 2006 and did not release the collected student data. Therefore, high schools in Massachusetts were identified based only on their mathematics performance over three years.

Table 1: Performance Trends based on Proficiency Standard

	2004	2005	2006
Grade	10	10	10
Mathematics	50%	48%	60%
State Average for Similar Schools (Math)	30%	34%	42%

Table 2: Performance Trends based on Advanced Standard

	2004	2005	2006
Grade	10	10	10
Mathematics	15%	27%	36%
State Average for Similar Schools (Math)	10%	13%	18%

Theme 1

Student Learning: Expectations & Goals

School and district goals focus on closing achievement gaps and preparing all students to succeed in college and skilled careers.

- At Excel High School, all stakeholders, including teachers, staff, faculty, students, and parents, participate in goal setting. A school leader explained, "This process provides an opportunity for the entire school community... to have a lot of productive discussions about academic and social expectations. Closing the achievement gap is a strong focus for the district's new superintendent, and this goal is shared by Excel High School. However, no matter what the district goals are, the goals of Excel High School will always be academic rigor and love for the students. The students are the clients, and the school has to serve them."
- In order to prepare students for college, school leaders and teachers work together to increase rigor in the curriculum and course offerings. All 9th-grade students at Excel take Algebra I, except those who place out of the class after passing an exam. These students move on to more advanced coursework. A

school administrator explained, "Last year, the school offered Advanced Placement (AP) Calculus AB for the first time, and two students in the school scored 5s on the AP exam. For an inner-city school, this is a real accomplishment. The math department is always working to get more students to take and succeed in advanced coursework. Students get confidence from taking AP classes, because they understand what collegelevel work looks like." Students who opt to take AP Calculus must first complete a summer class at nearby Northeastern University in order to strengthen and review the skills and content they learned in pre-calculus.

School leaders and teachers define success as getting students ready for and accepted to college, rather than simply passing the state assessments. Explained a school leader, "We want students to be ready for the ACT/SAT, not just the state test. It is really important to everyone that students arrive at college without having to take any remedial classes. At Excel, we try to put enough rigor into the high school curriculum that students arrive at college with the skills to succeed in college-level work."

Teachers and school leaders carefully review district-developed curriculum documents, prioritizing and adding additional detail as necessary in order to help teachers and students meet academic goals.

- Educators can access model lessons, curriculum frameworks, and pacing guides developed at the district level online through the Boston's "MyBPS" intranet. These documents explain the concepts and content instructors must teach and students must learn in each grade and subject. Teachers and school leaders then work together to determine the best way to meet those district-specified outcomes. Explained a school administrator, "We provide curriculum notebooks to teachers of all the core subject courses. The notebooks present the pacing guides provided by Boston Public Schools, but we add an additional layer of detail by outlining for each topic in the pacing guide the key concepts that should be taught. The curriculum notebooks also identify the materials and resources to be used in teaching each concept."
- Vertical teams of teachers play an active role in the aligning the curriculum and adding detail to the district-provided curriculum documents. "When I first arrived at the school" a school administrator noted, "many teachers told me that the pacing guides provided by the Boston Public Schools moved much too quickly, and they could not really keep up. I asked the teachers to examine what they are being asked to teach, and figure out how to serve students so that they can learn the materials and not get frustrated. In Physics, for examples, teachers look at the areas where the district curriculum is strong or weak, and the teachers have actually created their own curriculum and pacing guides, with the understanding that they still must to participate in Boston's assessments and cover all the same material in the state standards. They can change around the sequence and pacing if they need to. The

Physics teacher, for example, designed new labs with a strong math focus." A math teacher explained, "Math teachers have a pacing guide, but the principal makes sure that teachers feel free to change the sequence of the pacing guide. We look at the pacing guide as a tool to enhance teaching and learning, rather than just something the district requires."

Recent curriculum revision efforts ensure that the district focuses on closing achievement gaps and meeting the needs of all students. A district administrator noted that this is a new initiative for the district 4/4 one that she hopes will gain additional traction in the years to come. "It is hard somewhere like Boston, where the district has received lots of recognition for their work, to encourage people to go back and critically evaluate their curriculum and curriculum materials. Districts always need to ask: 'Is this working for all kids?' Obviously we know what works for the kids we have already reached, but what can we do to better serve the students we haven't reached before? There's still work to be done despite all the dramatic improvements the district has made in the last ten years. This is an important and opportune time for the district."

Theme 2 Staff Selection, Leadership, & Capacity Building

A variety of human resource strategies support the development, recruitment, and selection of promising teacher and school leaders.

- The New Principal Fellowship Program, a yearlong, full-time fellowship program for aspiring principals, helps district administrators develop a cadre of highly skilled, highly trained school leaders. Though the program selects from both internal and external applicants, many Principal Fellows are former teacher leaders or instructional coaches from within the district who have decided that they are ready for the challenge of school leadership. Principal fellows complete a yearlong residency with a high-performing principal mentor in Boston and take coursework in order to receive the Massachusetts Initial Principal License. Each participant receives a stipend while participating in the program, in exchange for agreeing to work in district schools for a minimum of three years following the end of the fellowship. Explained a district administrator, "Principals who come to the district through the New Principal Fellowship program are members of a cohort of school leaders who provide each other with collegial support long after the completion of the program."
- In the district's critical needs areas, such as math, science, special education, and bilingual/ELL instruction, the district seeks to put career-changers and others who come to teaching through non-traditional paths on the fast track to certification. One especially successful program is the Boston Teacher Residency Program, a partnership with the University of Massachusetts at

Boston (UMass-Boston). This program is a yearlong, full-time teacher prep program. Teachers first attend a summer institute, where they assist with and observe the district's summer school program, as well as participate in intensive coursework. During the next school year, the program combines teacher licensure coursework at UMass-Boston with fieldwork experience. Participants work in classrooms, under a master teacher, 4 days a week. During the school year, they receive a living stipend of approximately \$12,000. The program loans all residents the full tuition amount, and participants have one-third of the loan forgiven for each year they spend teaching in the Boston Public Schools after completion of the Residency.

District human resources staff members in the Boston Public Schools focus their efforts on building a pool of highly qualified teacher candidates. Decentralized teacher selection and hiring in the district occurs at the school rather than the district level. A school leader at Excel explained that, when recruiting and selecting math and science teachers, her priority is finding candidates with strong content knowledge. "When I first arrived here, there were a lot of teachers at the school who were not particularly strong in their subject area, and it showed when you looked at student data," she noted. "I've been able to attract and hire better teachers and retain a solid core of good teachers who have strong subject knowledge and really care about the students. When hiring new teachers, I'll only consider applicants with a degree in the subject they are applying to teach." To further ensure that candidates have strong content knowledge, current teachers are deeply involved in the interviewing and selection process. The school leader explained, "When I need to hire a new math teacher, I will ask my math teachers to develop the interview questions. They will want to know about applicants' subject area background and classroom management skills. In the interview, the current teachers will be able to judge whether or not a candidate possesses a strong grasp of how to teach particular math concepts. The teachers here have very high standards, so I generally trust the teachers' opinions of a candidate. Once a new teacher is hired, the veteran teachers will be expected to support that person and share resources with them. So teachers are often the best judges of who their new colleague should be."

Staff collaboration, mentorship, and professional development opportunities allow teachers and school leaders to address specific curriculum, instruction, and assessment needs.

A few years ago, school leaders at Excel High School revamped the school schedule in order to give subject-area teachers a common free period each day. Teachers began meeting weekly in subject-area teams to vertically align their curriculum and instructional practices. Explained a school leader, "The goal of the weekly meeting is for teachers to take a more active role in discussing curriculum and pacing guides and to ensure that they are all in

agreement about what they wanted their students to learn. Teachers at this school used to be very separated according to the populations they served. Special education teachers only met with other special education teachers, ELL teachers only met with other ELL teachers, etc. Now teachers meet by subject areas, and these meetings include the special education teachers and teachers in the sheltered English instruction program who teach these subjects." Teachers explained that they hold each other accountable for student progress. "All math teachers expect that the previous year's teachers will be sending them well-prepared students," a math teacher noted. "If students are not well-prepared, the teachers will ask their previous teacher why." In addition to the weekly meetings, teachers use their daily common free period for frequent informal collaboration. Explained a math teacher, "We share ideas and collaborate informally all the time. We have regular teacher lunches, and we plan field trips together. The math department thinks of ourselves as one big family."

- School leaders pair all beginning teachers in the Boston Public Schools with a mentor teacher in their school. Mentors, who receive small stipends, frequently observe the teacher's classes and offer feedback during weekly meetings. A district administrator noted, "There are often special challenges with math and science teachers, because so many are career changers who come to the district through alternative certification routes. They often need more support, so the instructional support provided by mentors becomes especially useful."
- To supplement existing mentorship programs and provide instructional leadership opportunities for outstanding teachers, district leaders launched the New Teacher Developer Program in 2007. Thirteen full-time New Teacher Developers provide classroom-based support to new teachers in over 50 Boston schools. The schools selected for participation were those with a high population of beginning teachers. Another 60 to 70 part-time Teacher Developers devote one half-day each week to mentoring novice teachers. The district hires both full and part-time New Teacher Developers from the ranks of current district teachers. New teachers work each day with New Teacher Developers, reviewing a rigorous new teacher curriculum developed by district instructional specialists. "This program provides new teachers with the training and support they need during that first critical year on the job and is a key strategy to increase teacher retention in the district," explained a district administrator.
- Excel High School's professional development plan results from careful analysis of the school's academic needs and, specifically, gaps in student skills. The district requires teachers to participate in ongoing professional development related to district-selected instructional programs. Beyond these trainings, district administrators recognize that each of the district's 144 schools is unique and allows school leaders to tailor further professional

development to school-specific needs. After schools identify their professional-development needs, they can access a wide selection of professional development courses provided by the district, often in partnership with local universities. For example, teachers at Excel high school recently participated in a school-wide professional development program designed to strengthen their abilities to analyze student data. As part of the training, small groups of teachers and administrators examine recent performance data and analyze the root causes of areas of student weakness. A school leader explained that she encourages teachers to seek out their own professional development, and she tries to find ways to fund all or part of the training. "I tell teachers, both individuals and subject-area teams, that they are the best judges of what they need, and I trust them to find the workshops, conferences and classes that meet those needs. I will work hard to find the resources to cover the training expenses"

Theme 3 Instructional Tools: Programs & Strategies

District and school policies encourage all students to pursue honors and AP coursework and provide the support necessary for students to succeed in these advanced classes.

- Administrators in the Boston Public Schools believe that AP participation helps prepare students for success in college. The district science department has developed multiple strategies for bringing AP classes to urban students district-wide. Explained a district administrator, "The science department in Boston is really a leader in the field. In the past, the other content areas were focused on raising state test scores, but the science director knew that, for urban students, AP participation had more impact than for suburban students, because it provides external validation for their work." The science department works to prepare students for the rigor of AP coursework before they even enroll in advanced classes. Teachers participate in vertical teaming training to increase rigor across grade levels, and many AP teachers commit to teaching summer bridge classes. Students take bridge classes the summer before enrolling in advanced coursework to ensure that they have the necessary skills and knowledge to succeed in the AP program. A district administrator noted. "Scores on the AP tests have increased the most in science, and to a lesser extent in math. Humanities and social science AP scores, on the other hand, have lagged behind where they should be."
- Educators encourage all students at Excel High School to pursue advanced coursework. The school offers honors classes in English, history and geometry, and AP courses in AB calculus and English composition, but it maintains flexible enrollment policies. Explained a school administrator, "We do not track students. We want to give students who are extra motivated the

opportunity to challenge themselves. Teachers recommend students for honors and AP courses, but they make recommendations based on their perceptions of a student's work ethic, attendance record, and overall motivation."

Across grades and subjects, all teachers use evidence-based instructional practices such as student-directed learning, hands-on activities, and the use of real-world examples to illustrate key concepts.

- The major mode of instructional delivery in the Boston Public Schools, across subject areas, is the "workshop model." Each class period has three sections: a mini-lesson delivered by the teacher on the objective of the day; a conferencing phase where students work on an assignment related to the objective and teachers circulate around and work with students one-on-one or in small groups; and a reflection phase, where the class discusses what they learned that day. Noted a district administrator, "the workshop model is intended to provide a balance between teacher and student voices. It's an instructional model that gives students the ability to communicate and create." The lesson plan template used by teachers at Excel reflects the workshop model. Teachers all start their classes with a 5-minute "Do Now" or warm-up. The "Do Now" reviews information the students have already learned, and teachers reported that they like this activity because students need to constantly review the skills and concepts from earlier in the semester if they want to make progress. As a teacher explained, "Math is cumulative: each new skill/concept builds on the ones learned earlier."
- Teachers are skilled at developing instructional approaches that keep all students engaged in the classroom. Noted a math teacher, "To improve student achievement in math, the most effective instructional approach is simply asking questions. This forces students to take the initiative to explain their thinking." Another teacher elaborated, "When I'm teaching, I frequently ask students to respond to each other's ideas. I ask, 'What do you think of what he said? Are you with him? Or can you explain it better? Do you agree or disagree?' Creating a somewhat competitive dynamic in the classroom really helps keep students engaged." Math teachers reported that incorporating many different technology-based activities into classes helps keep students interested in the lesson. Teachers frequently ask students to prepare PowerPoint presentations or do Internet research related to the math concepts being taught.
- School leaders encourage teachers to integrate literacy into the curriculum across subject areas, especially in math. The purpose of this instructional approach is to link the language of math to basic math skills, in ways such as teaching students how to understand and express mathematical ideas through writing For example, teachers help students understand how to read and analyze story problems, or ask students to explain in writing how they solved

a math problem. Explained a math teacher, "We're not just doing this because of the state assessment [the Massachusetts Comprehensive Assessment System, or MCAS]. However, the literacy focus helps raise achievement on the MCAS, because the MCAS is still at its core a literacy test, even in math. Students need to work on their literacy skills in order to do well on the MCAS."

Theme 4 Monitoring: Compilation, Analysis, & Use of Data

District benchmark assessments and other classroom assessments allow teachers and school administrators to identify gaps in student learning and curriculum delivery. This data informs revisions to lesson plans and instructional practices.

- The Boston Public Schools district administers common formative and summative assessments across the curriculum and across grade levels. In grades one through eight, students complete quarterly benchmark assessments in math and literacy. In math and science at the high school level, students complete mid-year and end-of-course assessments. Educators administer similar district-developed assessments in reading, writing, and history. Observed a district administrator, "The high school benchmark testing program was really an attempt to replicate the same kind of benchmarking that had taken off in elementary and middle school practices."
- School-based assessments complement the district formative assessment program and provide teachers with useful information about gaps in student learning. Excel High School administers a "mock MCAS" exam to all students shortly before winter vacation to help students practice taking the state assessments. Explained a school administrator, "This formative assessment has two purposes: 1) to provide more data for teachers, and 2) to get students comfortable with test procedures, such as using bubble sheets and filling in all their basic descriptive info correctly."
- A school administrator reported that she uses frequent, informal evaluations to monitor instruction and make sure that teachers are following the school curriculum. She explained, "I check often to make sure that each teacher, in each class, has the name of the lesson, the objective for the day, the agenda, homework, and the key vocabulary written on the blackboard. I'll do quick 5-minute walkthroughs to check for this. I also spent lots of time talking with teachers and students. During the school day, I am pretty much always either walking the hallways or in classrooms. I try to give teachers lots of informal feedback. When I speak to teachers about what I observed in their classes, I try to ask them lots of questions, rather than just telling them what they were doing wrong."

Teachers and administrators meet regularly to monitor and discuss the academic progress of individual students, as well as ensure that all students are on track toward meeting college entrance requirements.

- During their weekly subject-area team meetings, teachers discuss the progress of individual students. For example, the 9th-grade algebra teacher tells the 10th-grade teacher what to expect from particular students, so the 10th grade teacher feels like he knows all his students before he even meets them. The teachers emphasized that these discussions are not "gripe sessions" about individual students, but rather "scouting information." The school assigns each of its three guidance counselors to a particular core subject area (math, science, and English), and they each attend their respective department meetings. Close collaboration between teachers and counselors allows Excel's staff to coordinate academic support services and the first sign of academic difficulty.
- Because college readiness is central to the school's mission and goals, counselors monitor each student's college application process carefully. Explained a counselor, "The school culture here really expects every student to go to college. We enroll many first-generation college students, so the counseling team really micromanages each student's college application process. We begin preparing students for college admission requirements from the first moment they walk in the door in ninth grade. We explain to students how GPAs are calculated, so that they can see how the grades you get in ninth grade 'count.' when they apply to college." In addition, teachers and counselors communicate closely with parents. A counselor noted, "Because many parents are not college graduates, they may be less familiar with college entrance requirements, SATs, financial aid forms, etc, so the counselors do a lot of financial aid and admission counseling with parents and students. We also do a lot of 'hand-holding' with parents, because many of them believe that college is unattainable because it is too expensive." In 2007, 80% of Excel High School's graduating seniors went on to college, and students from Excel received over \$2 million in financial aid.

Theme 5 Recognition, Intervention, & Adjustment

Teachers, school administrators, and counselors ensure that struggling students receive specific, proven intervention strategies.

All 9th-grade students take a class in study skills and organization. The class teaches skills such as careful reading, critical thinking, note taking, test preparation, and working effectively in groups. The counselor explained, "There are no honors classes in ninth grade, because they don't know the

students yet and don't know what they are capable of. We want to make sure that all entering ninth graders learn the skills they need to succeed academically."

- Counselors and teachers meet weekly for student-support team meetings. They discuss any students that they worry are falling behind academically. After identifying a struggling student, counselors work with teachers and parents to get the student into after-school tutoring, counseling, or outside services as necessary. For example, counselors created a group for male students who recently failed the MCAS and/or failed at least one course. They meet with this group of students and try to help them develop strategies to improve academically. A school leader noted that she has arranged the budget to hire more core subject-area teachers and guidance counselors, rather than more elective teachers and administrative support staff. "The one-on-one attention students receive from guidance counselors is incredibly valuable," she observed.
- Campus-based interventions far outnumber district-based interventions at Excel High School. Explained a school administrator, "All the teachers here work really hard to help students. Nearly all teachers stay after school to tutor students, many without any additional compensation. This is not the kind of school where teachers are out the door as soon as the school day ends at 2:00 PM. I really look for teachers who don't have an attitude that they work only from 7:00-2:00. It is important to be good in the classroom, but teachers at Excel need to go the extra mile outside the classroom as well. This one-on-one help offered after school is probably the most powerful intervention strategy at the school."
- Students at Excel High School have opportunities to make up missed work and still graduate. The school offers an after-school credit-recovery program in core content subjects, known as the "buyback" program. Explained a school counselor, "We really want students to graduate in four years, so the credit recovery program helps students catch up if they've fallen behind on their credits."

Discussions of college readiness occur frequently, and teachers and school leaders create multiple recognition activities for students who are meeting standards of college and career readiness. Everyone at the school works to build students' confidence so that they graduate feeling that they can successfully tackle higher education.

Teachers and guidance counselors encourage students to take more advanced courses whenever possible. Teachers meet together to discuss reassigning students to more advanced classes. Additionally, teachers collaborate to develop strategies that prepare students for¾and assign students to¾the classes they need. Since the Boston Public Schools pay for all 10th- and 11th-grade students to take the PSAT, teachers and counselors especially look for students who are scoring high on the PSAT but may not yet be trying hard in their classes. Explained a counselor, "I really think that students get a lot of confidence from taking AP classes. Even though not all of them earn high scores on the AP Exams, they've at least been exposed to the material, and they go into their post-secondary education knowing what to expect, because they know what college-level work looks like. We try to put enough rigor into the high school curriculum that students arrive at college with the skills to succeed in college-level work."

School leaders, teachers, and counselors organize many student recognition and award events. Each semester they hold an award ceremony, and each teacher picks one of their students to receive a "Most Improved Student" award. A school counselor explained, "All of the counselors encourage teachers to think of lots different reasons to recognize students, so that it is not just the highest-performing students in every class who received awards. We like to recognize as many students as possible.

Summary of Findings

Student Learning: Expectations & Goals

School and district goals focus on closing achievement gaps and preparing all students to succeed in college and skilled careers. Teachers and school leaders carefully review district-developed curriculum documents, prioritizing and adding additional detail as necessary in order to help teachers and students meet academic goals.

Staff Selection, Leadership, & Capacity Building

A variety of human resource strategies support the development, recruitment, and selection of promising teacher and school leaders. Staff collaboration, mentorship, and professional development opportunities allow teachers and school leaders to address specific curriculum, instruction, and assessment needs.

Instructional Tools: Programs & Strategies

District and school policies encourage all students to pursue honors and AP coursework and provide the support necessary for students to succeed in these advanced classes. Across grades and subjects, all teachers use evidence-based instructional practices such as student-directed learning, hands-on activities, and the use of real-world examples to illustrate key concepts.

Monitoring, Compilation, Analysis, & Use of Data

District benchmark assessments and other classroom assessments allow teachers and school administrators to identify gaps in student learning and curriculum delivery. This data informs revisions to lesson plans and instructional practices. Teachers and administrators meet regularly to monitor and discuss the academic progress of individual students, as well as ensure that all students are on track toward meeting college entrance requirements.

Recognition, Intervention, & Adjustment

Teachers, school administrators, and counselors ensure that struggling students receive specific, proven intervention strategies. Discussions of college readiness occur frequently, and teachers and school leaders create multiple recognition activities for students who are meeting standards of college and career readiness. Everyone at the school works to build students' confidence so that they graduate feeling that they can successfully tackle higher education.

