High-Imp
Solu
for Struggling Mathematics

During the 2013–2014 school year, the Maryland State High School Assessment in Algebra with Data Analysis (HSA) was a requirement for high school graduation in Maryland. At Frederick High School, only 27 percent of students who took the test that year passed. To respond to such an alarming failure rate, three teachers and I developed and piloted a new approach to teaching the curriculum, along with other skills necessary for improving students' success—not only on the HSA but also in the class, their other classes, and in life.

The Frederick County Public School System has two levels of classes: (1) The merit level is for students who struggle with the content and need more time and resources to learn; (2) the honors level is for students who quickly absorb the content and do well on assessments. At Frederick High School, the day is organized into four 80-minute blocks, plus one 40-minute block in the middle of the day that is used as an intervention/enrichment period. Our pilot program had four sections of twenty preselected students each, with a mix of ability, grade level, and language comprehension (27 percent of the pilot students were classified as English language learners [ELLs]). All our students had failed the HSA at least once; several had done so multiple times (it was still a requirement for graduation at that time), and all students were considered likely to fail either the assessment again or the class itself.

act tions Students

To maximize classroom time spent on practice and concept attainment, a teaching team discarded traditional warm-up activities and homework assignments.

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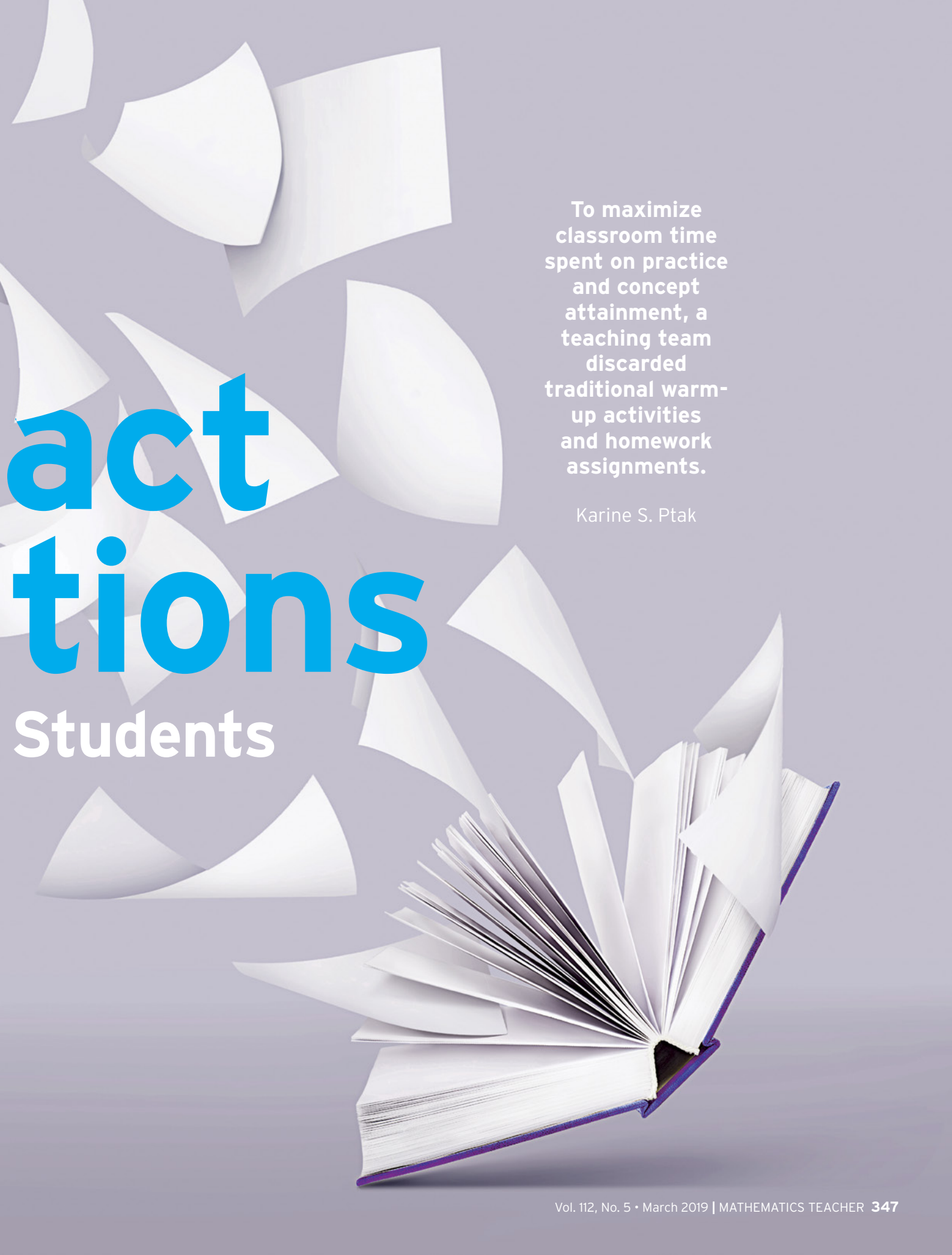

We deliberately chose to redefine our instructional methods and refrain from giving homework.

BREAKING THE INSTRUCTIONAL ROUTINE

These sobering facts led us to suspect that the more traditional approaches to teaching mathematics were not reaching these students. Therefore, while keeping the Common Core mathematics standards and practices in mind (CCSSI 2010) and concerned with students' success with the curriculum and standardized assessments, we carefully examined traditional teaching approaches, and we deliberately chose to redefine our instructional methods. One of the controversial decisions we made was to refrain from giving homework to our students, focusing instead on maximizing their time in the classroom by having them practice skills and discover concepts.

Practicing in Class

Our main motivation was to free up time in class so students could develop their understanding of concepts and practice independently, in pairs, or in groups. We believe that practicing in class helped our students gain confidence in their abilities and reduce their stress, which in turn may have alleviated behavioral issues, off-task activity, and resistance to learning. A benefit of doing most of the work in class is that students receive immediate feedback, which helps them correct course immediately if needed and learn it "right the first time," or seek enrichment when they are finished. Immediate feedback from teachers, as well as reinforcing the use of resources in class, helps students build confidence and self-reliance. Collaborative work in class fosters the practices of mathematical discourse, perseverance, and the strategic use of appropriate tools (CCSSI 2010).

Practicing in class also allows students to have access to the technology they need and deserve but cannot always get at home. About 30 percent of our students had little to no access to the Internet at home; more than 90 percent of them did not have access to a calculator outside of school. If we intend on leveling the playing field for all students, we must ensure they are able to use the technology where they can find it, and that is in school. Assigning technology-heavy homework every night can result in low participation from students, which means they have fewer opportunities to practice the skills they need to succeed on assessments. Although it is possible to set aside some time for in-class practice using the traditional teaching model, maximizing the time may require letting go of some, or all, traditional practices.

Many effective teachers will say that a coherent math class session follows this routine: warm-up, homework check, lecture, in-class practice (if time allows), exit slip, outside-of-class practice, and start all over the next day. Although we realize that this structure works in many honors-level classes, at our school, we find that this approach is ineffective for our merit-level students. We believed that we could increase the rate of success in the course if we dedicated most of the class time to practicing skills that would be assessed either on state standardized tests or tests in class. When students struggle with the material, it becomes essential to make sure they have access to resources (teachers, classmates, notes) that will allow them to make progress. We maximized practice time in class so students would be able to work collaboratively or alone, would have access to resources in class that were unavailable to them at home (Internet, peers, teachers), and would receive feedback as soon as they needed it instead of the next day or not at all. To have more in-class practice time, we had to make cuts in class routines. Removing ineffective, time-consuming activities is one way to ensure more time is spent on practicing in class.

Assigning No Homework

Let's take the example of a traditional, merit-level student's experience of a mathematics class. The warm-up is typically a repeat of the homework from

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the night before. While students are working independently on their warm-up activity, the teacher walks around the room to check on homework. When polled, unfortunately, 73 percent of the pilot students stated that the reason they do not do homework is because they "do not know what to do." Only 21 percent said they "do not have time." From the minute they sit down in class, they are staring at a set of questions that they still do not know how to answer, and they have not completed their homework either. When students who cannot do homework are placed in a situation of being judged every day on something they were unable to do, they often shut down. Learning under these conditions is difficult at best, impossible at worst. Teachers also struggle with repeatedly having to encourage students to do their homework and can often become distraught and/or irritated when they perceive their students as disrespectful for not doing the homework. These emotional responses from students and teachers contribute to a negative environment, which increases the likelihood of a less productive classroom (Kohn 2006).

Moreover, some of our students do not have homes to return to after school, and the term *homework* may carry negative connotations for them. Additionally, the results of a survey of our students highlighted that 58 percent of them worked after school at least three days per week. Some chose to work to earn spending money, but some had to work to help pay bills at home. Our students had already put in a full day's work by the time they left school, only to face putting in more time working outside of school. Some did not get home until late at night, often working a full eight-hour shift and arriving home at about midnight. The idea of giving them homework on top of everything else they had to do seemed unfair to us. Even for our nonworking students, after asking them to work in school for eight hours, we wondered if we had "the right to dictate how our students spend their time after school" (Kohn 2006).

Therefore, one of the modifications we made was not to assign traditional at-home practice of any kind. Instead, we used the concept of an "optional daily practice." These practices were composed of ten to fifteen exercises that highlighted essential skills for students to master each week, such as solving equations of any type, graphing, analyzing graphs, and modeling various functions. On the first day of each week, students were given access to the daily practice (either electronically or on paper, as needed). Students were to complete it by the last day of the week, and we encouraged them to sign up for the midday 40-minute intervention/enrichment block, form study groups, work as a team, rely on one another, and use their resources (notes and prescribed websites). In return, if the review was completed by the end of the week, they would receive one extra percentage point on their next assessment, but they were not penalized if they could not or chose not to complete it. Many students quickly realized that doing the daily practice, in addition to giving them an extra point, gave them the advantage of knowing some of the types of questions that would be on their tests and helped them retain information better. Finally, the daily practice reinforced the idea that although a unit of study has ended, the skills and concepts are still useful for application in later units. Over time, the number of students doing the daily practice increased; thus many students learned the value of extra practice outside of class. In addition to encouraging students to practice daily, we encouraged students to review their notes daily, redo examples as needed to build confidence and fluency, and generate questions to ask the next day, since they often worked on their notes at the end of a block. Placing direct instruction and note taking toward the end of class was another deliberate choice of ours, after researching the concepts of "primacy and recency." These concepts refer to the brain's ability to retain information in chunks; the first topic and the last topic covered in class are most likely to be remembered (Morrison 2015).

Not having to go over homework in class (an activity that can take up to one-third of class time) gave us more time to help students practice skills in class. Moreover, it freed us to do other activities to better support and enrich our students. For example, we had more time available to spend on specific vocabulary instruction using a modified Frayer

model, weekly or biweekly, which helped our students with varied literacy and language skills. We also used that time to introduce structured and organized Complex Instruction activities (Stanford University 2017) to build our students' ability to work collaboratively, use mathematical discourse, and critique one another's work. We registered our students with Code.org, a website designed to introduce high school students to computer coding, and we gave students time in class to practice applying mathematical logic to create small computer programs. We provided opportunities to learn keyboarding during that time as well as to become more familiar with Google applications such as Google Docs™, Sheets™, and Slides™. We asked students to enter their thoughts on many different topics into a journal to help them gain confidence in their writing and to help us get to know them better. We fostered their natural curiosity using Notice and Wonder activities (Fetter 2015). Finally, we used some of that time to do intensive HSA testing review to help students understand the questions and become more familiar with the format of the assessment.

THE RESULTS

Our students took the Algebra High School Assessment in November 2014, and some took it again in January 2015. The pass rate went from 0 percent at the beginning of the school year to 47 percent after the first administration and 67 percent after the second administration (see **table 1**). Although we are proud of our students' accomplishments on the assessment, those results pale in comparison to what they accomplished in class, which was that 93 percent passed the class, with 53 percent earning a grade of B or better. Remember that all students had previously failed the class at least once. Because 20 percent of them did so well, we recommended that they be placed into an honors-level geometry class for the next academic year.

Student behavior also improved over time. Student satisfaction increased (as shown in their journals and on surveys). Our students learned to become more self-reliant, to be self-starters, and to depend more on one another and their resources and less on us. By the end of the year, students would automatically log onto their classroom website and start working on their own. They no longer relied on prompts provided by us during journaling activities or group activities, and they were able to ask thoughtful questions of themselves and others.

CONCLUSION

As Maria Montessori said, "The greatest sign of success for a teacher is to be able to say, 'The children are now working as if I didn't exist.'" I am proud to report that we were able to say so by the end of the year. When presented with a new

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Table 1 Students' Rate of Success on HSA by Demographic Criteria (in Decreasing Order)			
Demographic Criterion	Total No. of Students	No. of Students Who Passed the HSA	Rate of Success (%)
Multiple Races	3	3	100
Asian	6	5	83
African American/Black	25	20	80
Caucasian	12	9	75
Students on an Individualized Education Plan (Special Education)	9	6	67
Students Receiving Free and Reduced-Price Meals (FARM)	47	26	55
English Language Learners (ELL)	21	9	43
Hispanic	33	13	39

approach, our students showed many areas of growth, including achievement, engagement, motivation, and self-reliance. They became organized—a skill they will certainly need in geometry, the following course.

Much more progress, however, remains to be made if we want to level the playing field for all students, not just our small pilot program. To help us in this task, we have recruited other teachers to join us. We have a plan to refine our process even more by including targeted instruction for our ELL students (using resources in their native language), increasing the number of Complex Instruction activities, and reinforcing soft skills, such as organization and study skills, earlier in the year. We are hopeful that our struggling students will continue to show gains and increasing success.

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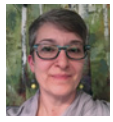

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