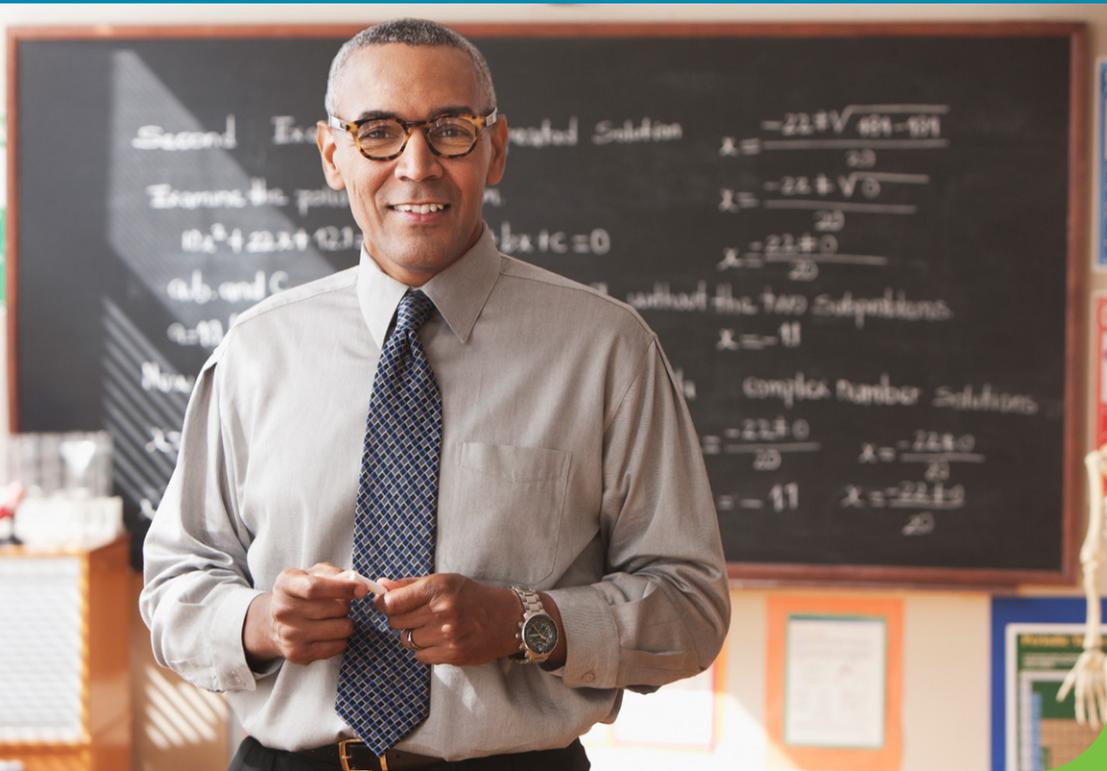


WHITE PAPER | DREAMBOX LEARNING



Strategies for Teaching Middle School Math

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Strategies for Teaching Middle School Math

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Traits of the Middle School Mind

As 13-year-old Logan LaPlante describes in his TED Talk, *Hack Schooling Makes Me Happy*, “Neuroscientists say that the teenage brain is pretty weird; our prefrontal cortex is underdeveloped, but we actually have more neurons than adults, which is why we can be so creative, and impulsive, and moody, and get bummed out.”¹ The middle school mind is emotional, social, intelligent, and independent. These adolescents are constantly working to balance school, public activities, and home life in order to develop a strong sense of self.

“The middle school mind is emotional, social, intelligent, and independent. These adolescents are constantly working to balance school, public activities, and home life in order to develop a strong sense of self.”

Understanding the qualities of the middle school mind helps us better understand our learners. It’s generally observable and recognized that there is a shift in attitude and behavior among students as they progress into adolescence. As we seek to better understand why this shift happens and attempt to better support students through what can be a challenging time, we need to dive into understanding the traits of the middle school mind.

EMOTIONAL

In my experience as an educator, many of my students as young as second and third grade have already decided that they are “good” or “bad” at math, and unfortunately, the middle school grades often further establish each learner’s self-image as a mathematician by developing an even stronger emotional response to math. At the same time that students are learning key concepts that will be necessary for the rest of their math careers in high school and beyond, middle school students are also solidifying their attitudes about the subject. These emotional responses range from having an enthusiastic passion for mathematics, to an intense hatred that is usually perpetuated by the myth that math is something that each person is either “good” or “bad” at. It is therefore especially critical for middle school students to have a growth mindset about learning mathematics. This reality is described in the book *How People Learn: Brain, Mind, Experience, and School*:

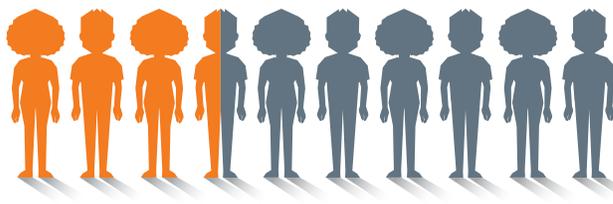
Students who think that intelligence is a fixed entity are more likely to be performance oriented than learning oriented—they want to look good rather than risk making mistakes while learning. These students are especially likely to bail out when tasks become difficult. In contrast, students who think that intelligence is malleable are more willing to struggle with challenging tasks; they are more comfortable with risk.²

Because too many students mistakenly believe that success in mathematics requires remembering countless unrelated facts, they have a tendency to disengage, give up, and assume a fixed mindset in mathematics. This flawed notion can be changed by revising the math curriculum and assessments to emphasize relationships and strategic thinking instead of facts or computations that can be accomplished with a calculator, digital graphic app, or Wolfram|Alpha. When students understand that mathematics is a vibrant field that is focused on finding relationships, documenting patterns, and exploring the unknown, it’s more likely that they will recognize their own math expertise and will be able to grow, just as the field of mathematics is continually growing. But if students are uncomfortable independently engaging in key mathematics processes and practices in new and unfamiliar situations, their long-term growth and achievement will be hindered and their motivation thwarted.

*Because too many students mistakenly believe that success in mathematics requires remembering countless unrelated facts, they have a tendency to **disengage, give up, and assume a fixed mindset** in mathematics.*

Only 34% of 8th grade students are math proficient

[National Assessment of Educational Progress, 2019](#)



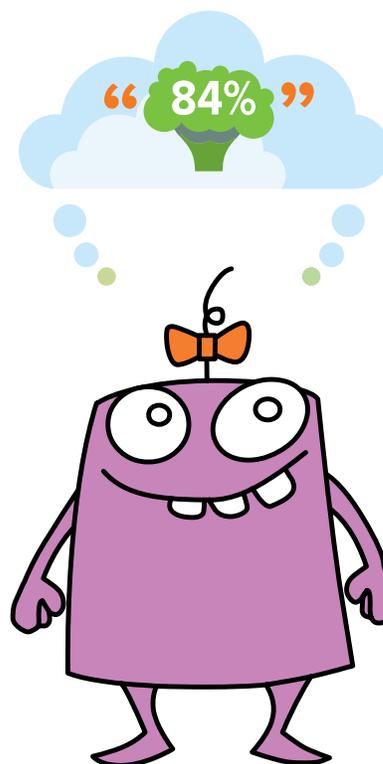
The good news is that the middle school mind is prepped and ready to shift from nervous and self-conscious to willing and self-confident. Middle schools and middle school math classrooms must provide the structure, environment, and guidance that help students make this transition effectively. The freedom to learn from mistakes is an important part of a deeper learning³ process, and supports the development of a growth mindset so that students realize that intelligence is not predetermined but rather will improve with dedication and focused effort.⁴

When Raytheon Corporation asked 1,000 middle schoolers if they'd rather eat broccoli or do a math problem, the majority said broccoli.⁵

SOCIAL

Middle school students are socially aware and often socially motivated. Whether in constant conversation or not, they are continually thinking about where they fit into the world around them and how to find communities in which they belong. Students of any age should always feel they belong in their math classrooms. All students have intrinsic value, and all of them have valuable ideas that deserve to be honored in the classroom. Yet too often in middle and high school math courses, students experience math as a spectator sport. Instead, the middle school math classroom should be engaging with high levels of peer interaction.

Lessons and learning experiences should be more conversational because we need to cultivate a true community of mathematicians. Many standards documents, including the Common Core State Standards for Mathematics and the Texas Essential Knowledge and Skills, detail expectations about how students should engage with mathematics content by being able to explain their problem-solving strategies, construct viable arguments, and critique the reasoning of others. These standards are a useful blueprint for designing a math classroom that meets the social needs of middle school math learners. Thriving mathematics communities engage the group by tackling tough problems and building upon one another's ideas. They believe in productive failure and support an environment where there is peer support for struggle, not peer pressure against it.



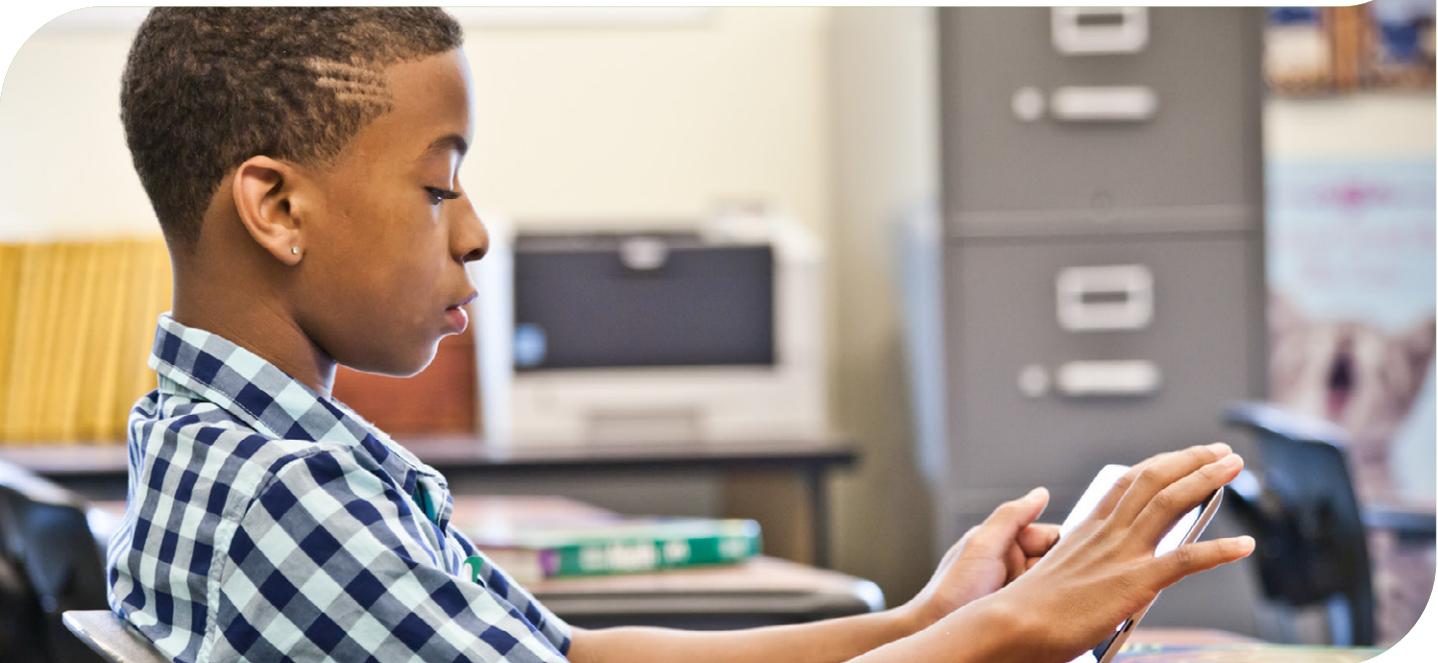
INTELLIGENT AND INDEPENDENT

In *Teaching Adolescents to Become Learners*, the University of Chicago Consortium on Chicago School Research notes that middle school students are developmentally capable of intellectually challenging work, but that they often struggle to realize their own potential and fall short of success because their learning environment is designed to build up their confidence rather than their intellect.⁶ We must allow students to progress along a trajectory of growing independence that leaves students feeling supported, but also allows for the development of expertise, proficiency, increased awareness, and fosters an ownership of learning. The beauty of the middle school mind is that it is replete with prior knowledge and critical thinking capabilities that can be activated, exercised, and developed. Whether it be math content or life experience, middle school students arrive in class each day with connections just waiting to be made in their minds. They already know how to construct arguments among their friends about which movies to watch and why certain games, clothes, or products are better than others, but they have difficulty applying those reasoning skills to math content.

When math classrooms value and leverage the prior knowledge and reasoning abilities of students, their minds become open to accessing more information, and the likelihood of developing strong connections and transferring critical thinking to new applications and contexts increases. From a cognitive standpoint, “all learning involves transfer from previous experiences,” and due to the delicate nature of adolescent confidence, it is important that we acknowledge the intelligence and experience each student brings to class so that we can encourage its advancement.⁷

Guiding Principles Paul Cuffee Middle School, Providence Rhode Island

- 1. Respect the environment,** yourself, and the community.
- 2. Cooperate:** Teamwork makes the dream work.
- 3. Support each other** even when the odds are against us.
- 4. Be yourself,** do what you love, and try!
- 5. Be resilient:** Fall 7 times, stand up 8.⁸





Learning in the Middle School Mind

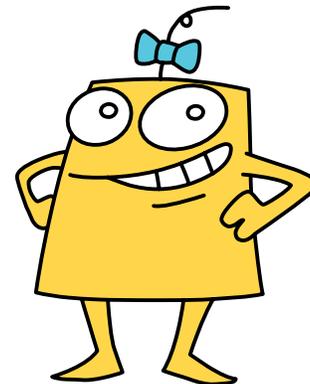
Identifying characteristics and traits of the middle school mind enables us to better understand how our students think, engage, and ultimately, learn. We know that middle school students are in a stage of transition to more independence, but with social influences, which means that supporting the transformation requires specific attention and longterm guidance. The challenge is that the design of many schools and math classrooms is impersonal, which prevents students from developing their intellectual independence in a way that also recognizes and responds to their social needs. Middle school students thrive in schools and classrooms that focus on more personalized learning and leverage obvious opportunities to build emotional connections between peers, teachers, and mathematics.

Research shows that eighth-graders who miss five weeks of school or fail math or English have at least a 75 percent chance of dropping out of high school.⁹ In order to increase the likelihood of success in high school and beyond, students must see benefit in attending school as well as be invested in and see meaning in their work. This means offering an education experience that meets their unique needs and supports their physical, social, and emotional development. According to the Educational Policy Improvement Center, of 100 middle school students, 93 want to go to college. Of those, 70 graduate from high school.

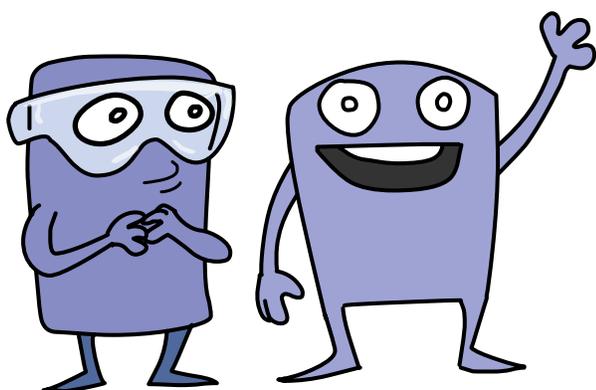
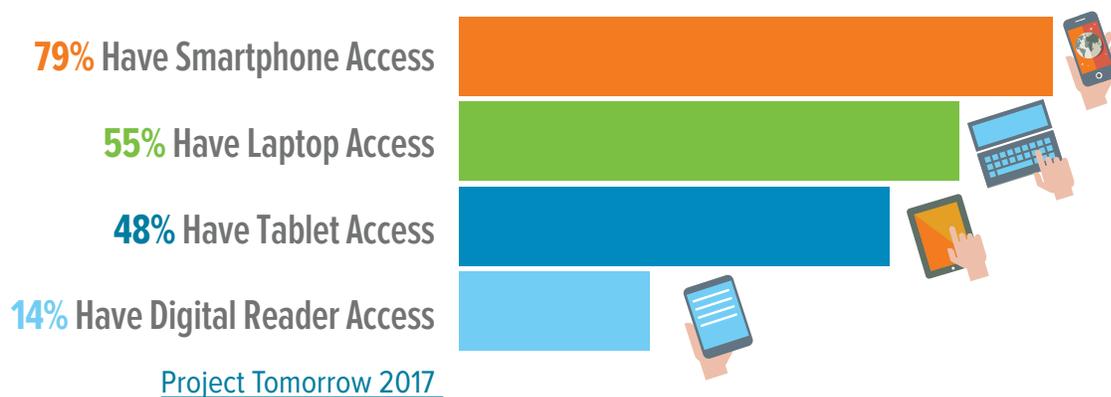
Middle school students thrive in schools and classrooms that focus on more personalized learning and leverage obvious opportunities to build emotional connections between peers, teachers, and mathematics.

Of the high school graduates, only 44 enroll in college, and just 26 of those enrolled in college will successfully earn a college degree.¹⁰ As the authors of *Core and More: Guiding and Personalizing College and Career Readiness* ask, “What is happening to those 23 students who had a desire to go to college, but were unable to take the first step towards that dream?”¹¹

According to national and international achievement comparisons (IEA and NCES/OECD/ NAPE), American students begin to fall drastically behind their international counterparts between the fourth and eighth grades. This statistic is especially true for those students who are in high-poverty environments or who are considered at risk due to other circumstances.¹² For middle school students, especially those with higher academic needs and more challenging life circumstances, a social and personalized experience is essential to combating the reality revealed by the achievement data.



Students' Access to Mobile Devices (not school provided)
Grades 6-8



SOCIAL COLLABORATION

When students enter a math classroom with varying levels of skill and knowledge, it is vital that they are met exactly where they are at in their learning journey and are invited to contribute meaningfully to the mathematical community. In order to construct arguments and critique the reasoning of others, it's necessary to tackle meaningful mathematics problems and engage in debates and conversations with other students. Math classrooms are more personalized when every student's individual ideas, strategies, and contributions are heard, honored, and discussed. In her book *Young Mathematicians at Work* and her *Contexts for Learning* resources, math educator Cathy Fosnot describes these thriving mathematical communities and shares classroom models that use a “Math Congress” and other strategies to support student learning and engagement.

INDIVIDUAL PROGRESS

Many middle school students have significant gaps in their prior knowledge, and it is an overwhelming challenge for a middle school teacher to address these gaps for an entire classroom of students. While there are important times for students to engage with their peers in the mathematics classroom, it's also important for students to have independent learning opportunities during which they are able to engage with more individualized lessons over the course of time. One critical aspect of more independent learning is that each student's personal ideas, strategies, and contributions are honored. Students should not simply "sit and get" someone else's ideas, but rather be active thinkers and problem solvers. By using pedagogically valid digital programs that continuously assess student progress and proficiency, make individualized lesson recommendations, and provide scaffolding and feedback in real time, teachers have powerful new tools for supporting student learning. Initial data is collected and analyzed, establishing where students are successful and where they need the most support. Based on this initial data collection, personalized software programs can change course and adapt as a student succeeds or struggles.

Students should not simply "sit and get" someone else's ideas, but rather be active thinkers and problem solvers.



BLENDED LEARNING

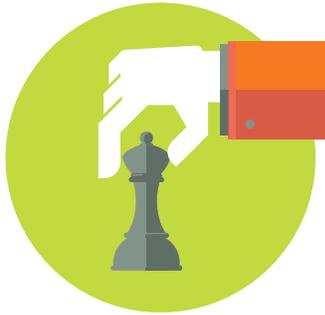
Many schools and classrooms are adopting a blended learning model by taking steps to socialize mathematics lessons in the classroom as well as leverage technological advances in digital learning. The result is better support both for student learning and data-informed teaching. This type of personalization addresses achievement gaps between both affluent and high-poverty students, as well as gaps between high and low performers by allowing students to feel success, to be challenged, and to progress on a learning pathway that holds students to high standards in a developmentally appropriate way.

Impacting the Middle School Mind

As educators, we want to understand how the middle school mind works so that we can take action in our own classrooms, in our curricula, and in our selection of print materials and digital resources. This knowledge allows us to directly increase learning opportunities for our students by creating a space that ensures all students thrive. Blended learning can support the development of an environment that is able to sustain the middle school mind by increasing engagement, building connections, encouraging motivation, and fostering independence.

The complex set of challenges for middle school math education, coupled with the opportunities created by more rigorous standards and new education technologies, yield four principles that can support improved math achievement for middle school students: engagement, connectedness, motivation, and independence.

Reaching the middle school mind means increasing engagement, building connections, encouraging motivation, and fostering independence.



ENGAGEMENT

Especially during this educational phase of their lives, students want to be engaged at school, but likely expect math class to be boring and uninteresting. Math curricula and lessons must therefore be designed in ways that ensure high expectations for conceptual understanding while increasing achievement and making time on task more enjoyable. The evolution and expansion of video games has provided educators with useful design principles that can be leveraged to improve engagement. Sometimes called “gamification,” these principles work well in blended learning environments and enable students to learn by trial with instant feedback while increasing their ability to creatively solve problems and make progress. The paper, *Blended Learning Innovations: 10 Major Trends*¹³ outlines eight emerging principles of productive gamification:

Product Gamification: Productive Gaming = Good Learning

8 PRINCIPLES OF PRODUCTIVE GAMING

1. Conceptual Challenges
2. Productive Failure
3. Careful Calibration
4. Boosts Persistence
5. Builds Confidence
6. Enhances Intrinsic Motivation
7. Accessibility
8. Deeper Learning

<http://www.dreambox.com/blog/blended-learning-10-trends>



CONNECTEDNESS

A new level of social awareness develops as students enter their middle school years. The social nature of this age group should be celebrated rather than stifled. A blended learning classroom addresses the personalized needs of each student by strategically leveraging the best of online and face-to-face learning experiences, and also allows for collaboration and peer support. Community conversations driven by individual work are a valuable approach for students to express challenges and problem solve together. They also enable key connections to form between students' online work and offline work. The math classrooms we want for learners are places where they can engage in great thinking and dialogue rather than as places where they go to merely acquire information.



A blended learning classroom addresses the personalized needs of each student by strategically leveraging the best of online and face-to-face learning experiences, and also allows for collaboration and peer support.



MOTIVATION

A new brick-and-mortar school environment coupled with the physical, social, and emotional changes that occur during this time can have significant impact on students' confidence and motivation to learn and grow. Middle school students enter the classroom with a wide range of contextual understanding and a high need for a personalized learning path. Blended and personalized learning not only foster high levels of engagement, but will also build confidence through student-centered learning environments, where students are able to fill gaps in understanding or advance beyond grade-level content, leading to increased proficiency. Students should be regularly presented with difficult problems that require significant work and present unique challenges. Problems such as these encourage students to persist through obstacles while developing pride in their abilities. Providing students with the right lesson at the right time sets them up to feel success, while helping to monitor and track growth can help build confidence and grit.

INDEPENDENCE

Data-driven decisions are vital to the personalized learning experience, but they do not have to be the sole responsibility of the educator. Showing students how to gather and effectively use data can support a growth mindset that inspires students to work hard to achieve greater results. An adaptive program builds a new level of student ownership while providing a supportive platform for guidance. This is a learning experience that most middle school students appreciate as they navigate their own paths to independence. Goal setting and monitoring progress also provide a structure to support the path towards a more independent learning experience that is highly driven by intrinsic motivation.



Conclusion

Middle school can be a challenging time for students, which means middle school educators must take great care to design schools and classrooms that will support the success of all students. It's important to plan backward from our desired outcomes, which means we should design with these three overarching goals for middle school mathematics in mind:

1. All students are critical thinkers with a growth mindset and habits of mind that enable them to tackle complex problems in unique and effective ways.
2. All students engage mathematics topics and content in authentic ways to develop conceptual understanding and procedural fluency.
3. All students are curious and self-directed learners who are able to successfully persist through even the most challenging problems.



Of 100 middle school students, **93** want to go to college



Of those, **70** graduate from high school



Of the high school graduates, only **44** enroll in college

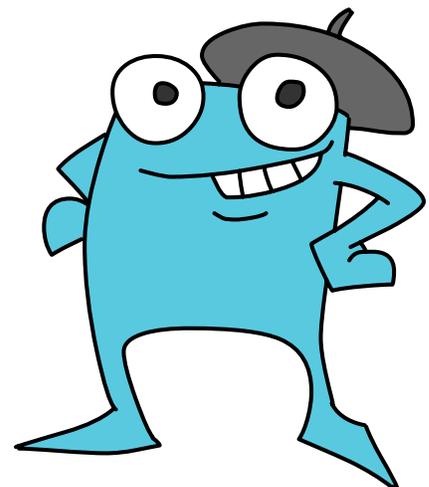


Of those enrolled in college, only **26** will successfully earn a college degree

[Educational Policy Improvement Center](#)

To achieve these goals, educators must explore innovative ways to provide a learning experience that engages, socializes, motivates, inspires, and builds independence for all middle school students. Blended learning is one promising strategy that empowers teachers to more authentically personalize learning for their students, while also enabling learners to take greater ownership over their learning.

Meeting students right where they are means more than just assigning them a percentage, percentile, or scale score on a standardized test. In order to truly meet them as unique individuals, we must understand how their minds engage, make sense of mathematics, and thrive. Then we can design a learning environment that is built around those fundamentals. The middle school student is emotional, social, creative, and self-conscious, and it is those qualities that make the educational experience in middle school so powerful. We are not only teaching students mathematics, we are also supporting personal growth that will help develop lifelong success in mathematics and beyond.



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About DreamBox

DreamBox is an award-winning, online K–8 math program that is both engaging and proven to boost your child's math performance. Created by educators, DreamBox math lessons dynamically adapt and adjust based on how students are solving problems—providing your child with personalized one-on-one instruction to meet their unique needs.

For more on how DreamBox Learning can help support your middle school students, visit: dreambox.com/middle-school.

For a demo, call 877.451.7845.



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