STEMconnector

THE STUNNING POTENTIAL TO CREATE EQUITY

How Adaptive Technology Can Eliminate Barriers to Opportunity and Increase the STEM Talent Pool

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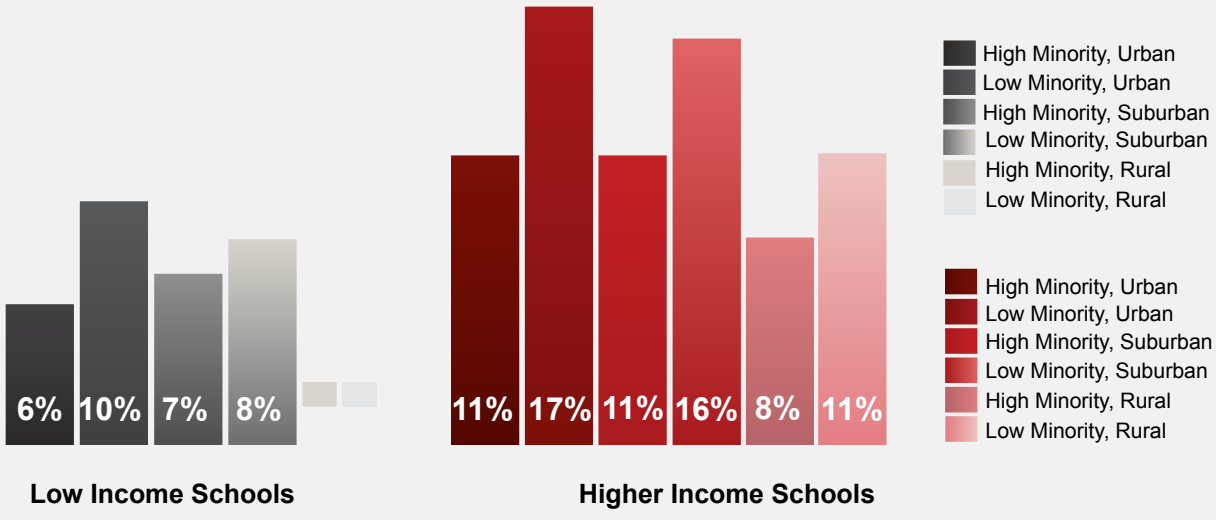
CONTENTS

INTRODUCTION & PURPOSE

Much has been written about the promise of a STEM (Science Engineering Technology Math) degree over the past decade. With as many as 2.4 million STEM jobs expected to go unfilled by 2025 according to the Bureau of Labor Statistics,[1] and knowing that the average STEM worker earns 2/3 more than non-STEM workers, even when controlling for educational attainment,[2] the push for more students to pursue degrees in these fields is not surprising. Even beyond jobs that fall squarely into a STEM category, the majority of careers today and those for the future demand a basic foundation in STEM learning.[3]

However, despite years of efforts to increase interest in STEM learning, we're not moving the needle on filling overall STEM vacancies, costing companies billions of dollars per year in recruitment and turnover[4] and leaving them without the talent they need to remain competitive and innovative in a constantly evolving market. The gaps are particularly stark for individuals from underrepresented backgrounds and traditionally overlooked communities, where barriers to opportunity often keep them out of the STEM talent pipeline early on. Currently, African Americans make up only 9% of the STEM workforce, while Hispanics make up only 7%.[5] Additionally, students from low income backgrounds are approximately 2/3 less likely to pursue a STEM discipline than their wealthy counterparts,[6,7] perpetuating income disparity down the road (Figure 1). To meet the demands of the current and future workforce, eliminating barriers to entry for future workforce participants from traditionally overlooked communities and underrepresented backgrounds is critical.

Figure 1: College Completion Rates Six Years after High School Graduation, STEM Field of Study, Class of 2008



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While there are many potential obstacles faced by underrepresented populations, deficits in mathematics and general STEM foundational knowledge, often resulting from limited exposure, practice, and opportunity, are key barriers to college completion and/or persistence in STEM.[8] In fact, a California State University study found that completing college level math courses increased the probability of bachelor's degree completion by 42 percent.[9] College degrees provide the first point of entry for a majority of STEM jobs, and fortunately, new intelligent adaptive learning systems promise potential solutions to build equity in postsecondary foundational math knowledge and increase participation in the STEM workforce. Best-in-class intelligent adaptive learning systems give every learner their own personalized path through a course tailored specifically to their strengths, weaknesses, goals, and engagement patterns. These courses adapt in real-time to a student's activity and adjust the content it surfaces to the student, moment by moment, based on his/her performance and effort, allowing them to begin at their own starting point, but end in the same place.

This paper sets out to:

- Outline the challenges faced by corporations to hire diverse talent from underrepresented backgrounds and traditionally overlooked communities
- Examine mathematics foundation as a key barrier to entry for those pursuing STEM disciplines
- Showcase how intelligent adaptive learning systems can promote equity by eliminating barriers to entry through personalized instruction and confidence-building for youth from underrepresented backgrounds, increasing the greater STEM talent pool

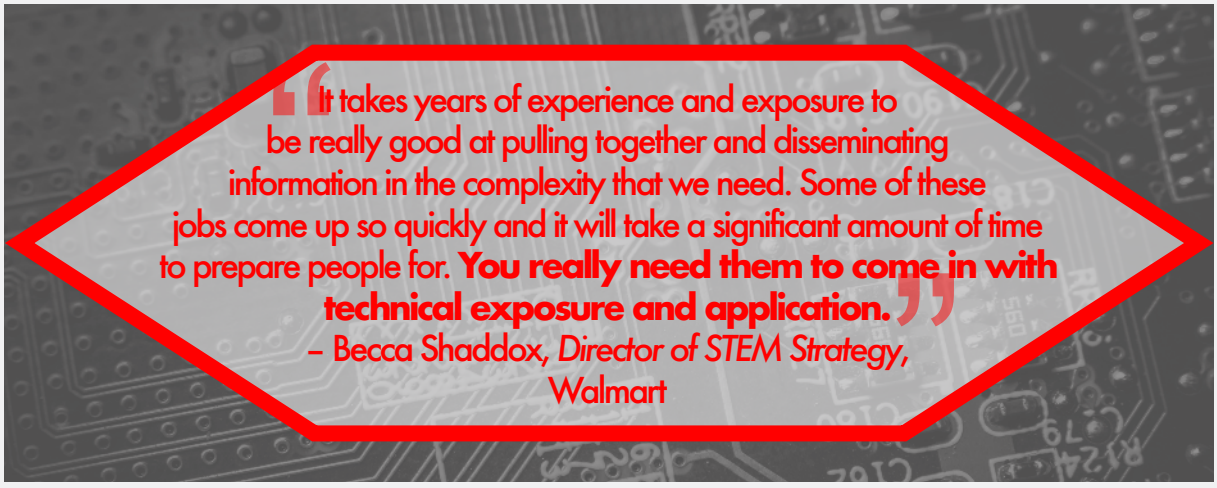
While intelligent adaptive learning technology presents a promising solution for building equity, a long-term impact on the STEM talent ecosystem will also require holistic investments across the pipeline and collaboration between sectors. Although this paper skims the surface of these investments, its core purpose is to provide a roadmap for improving students' confidence and success in foundational math to help them advance to and through STEM degrees and into fulfilling long-term careers.

LANDSCAPE OF THE FUTURE OF WORK: A CORPORATE PERSPECTIVE

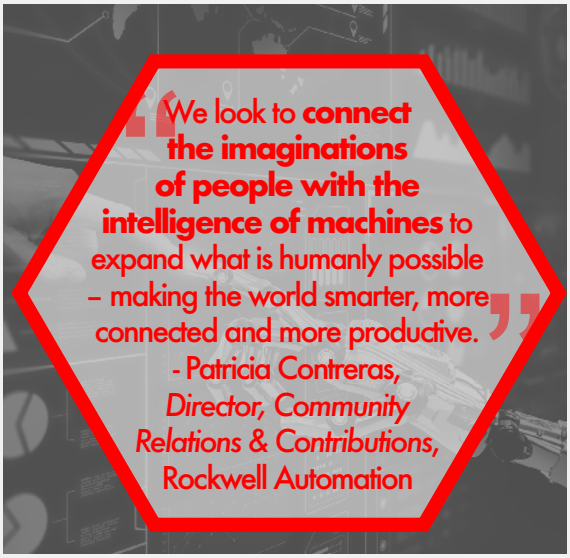
Despite STEM jobs often being clustered together in concept, not all STEM jobs are equal. There are areas, for example, such as the health sciences, where underrepresented populations are less underrepresented, and areas that are less challenging for corporations to fill.[10] For this paper, a number of corporate leaders across sectors shared their perspective on what they see as the hardest to fill positions and the particular challenges they face when trying to hire diverse talent. Even across sectors, themes emerge across these conversations.

THEME 1: The hardest to fill positions require a combination of technical skills, analysis, and communication

Jobs that are hardest to fill, both according to data reports from organizations such as Burning Glass and Brookings Institution, but also in conversation with industry leaders, are jobs in data analytics, cyber security, and software development.[11,12] Notably, these positions require a combination of technical skills – understanding specific coding languages, maneuvering data sheets, etc. – along with the ability to synthesize complex information and communicate the implications and potential solutions that arise as a result. Because of the complexity of this work, most employers seeking to fill these positions look to hire individuals with advanced credentials, and positions requiring the most advanced credentials go unfilled the longest.[13] In conversations with corporate leaders from companies ranging from retail to aerospace engineering to manufacturing, many leaders cited using advanced degrees to signal to the hiring manager that a candidate possesses skills such as communication, collaboration, and critical thinking, which are required to put technical skills to use on the job.



Filling these positions is challenging given the extreme competition for limited talent. Fifty percent of S&P 100 companies are hiring for the same 37 roles.[14] For companies like Walmart or PepsiCo, not traditionally seen as STEM employers, or lesser known organizations like United Technologies Corporation or Dassault Systémes, it means competing against traditional and widely known technology companies for the same positions and the same talent. The difficulty isn't in the job descriptions themselves, but in the dearth of individuals entering the workforce with the proper training and credentials to be considered for these roles, particularly outside of known tech hubs.



THEME 2: Hiring diverse talent is not optional. It's a necessity, and it requires investing in traditionally overlooked talent pools

Leading corporations know that diversity and inclusion (D&I) isn't just a Corporate Social Responsibility (CSR) initiative; it's actually about innovation and sustainability. Brands that get it right are able to anticipate the needs of the market, and that means bringing the most ideas possible to the table. Even beyond the need for innovation and diverse thinking, building a talent pool wide enough to accommodate the increasing number of jobs requiring technical STEM skills necessitates investment in diverse talent from traditionally overlooked communities. If corporations continue to hire the way they always have – through, for example, traditional partnerships with specific universities, or from specific areas – they will not have enough talent available to continue filling these STEM jobs.

It is not on the shoulders of any one sector to create a more prepared workforce. Corporate leaders know that it is through collaborations that real impact can occur. Organizations think about this in myriad ways, but common threads emerge around increasing the confidence of young people to pursue STEM pathways. Combating the Belief Gap – young people, and the adults around them, hold incorrect beliefs about the aptitudes or traits young people must have to belong and thrive in STEM careers[15] – requires effort on the part of every sector involved with youth including teachers, administrators, counselors, families, and employers themselves. This means creating opportunities to provide role models and mentors for young people, building empathetic

and supportive partnerships with community organizations and families in target regions, and also investing in supports to boost young people's foundational skills knowledge so that they feel confident in pursuing STEM degrees. Without a strong foundation in STEM, young people will face barriers to entry for STEM majors and careers, leaving them without the ability to participate in the STEM workforce.

Many companies are thinking more creatively about how to reach "hidden" talent pools through programs and investments

- ***Returnship programs***: Individuals who have left the workforce for personal reasons can come back into the workforce and gain the new skills they may have missed out on while they were away through programs tailored to support them and their education to get them where they need to be.[16]
- ***Stackable credentialing:*** Many employers are considering options where students do not need traditional 4-year degrees or advanced degrees if they can prove they have the necessary skills to succeed in a specific job.[17]
- ***Location exploration:*** Many individuals want to work close to home but feel that the most fulfilling jobs will require them to leave. Alternatively, there are areas with great job opportunities without a significant population ready to fill them. Companies are working to identify which positions need to be centrally located versus remote, and are similarly investing in local talent pools to ensure the talent is there.[18]
- ***Investing further down the pipeline to build exposure and confidence:*** There is a pervasive Belief Gap when it comes to building a robust STEM talent pool.[19] To build young people's confidence and their own perception of themselves as STEM professionals, companies are partnering with organizations to reach youth further down the pipeline to inspire their confidence.

THEME 3: Postsecondary institutions can and should work with employers to create more authentic learning experiences for students as they prepare for the workforce

Unless a student pursues academia professionally, it is unlikely that they will find themselves in many situations in a career where they are asked to sit in a lecture hall taking notes and regurgitating information back in the form of a test or an essay. Yet, the majority of American university classrooms still follow this model. While learning for the sake of learning has absolute value for many students, millions of others enter postsecondary education with the sole purpose of earning the experience and credentials necessary to compete in the job market.[20] Colleges or institutions can work with employers to create more authentic and real-world learning so that young people are not only more aware of the career opportunities in front of them, but are also more prepared for those roles and more confident in their ability to perform the required tasks based on their exposure.

Postsecondary institutions, and K-12, can also better reflect the needs of the modern workforce by un-siloing programs. Math does not exist in a vacuum, and it should be taught alongside teamwork, problem-solving, writing, synthesis, etc. – the way people will actually have to approach their jobs one day. This requires a solid foundation in the core STEM subjects that will relate to a variety of careers in addition to the technical skills required for a particular profession.

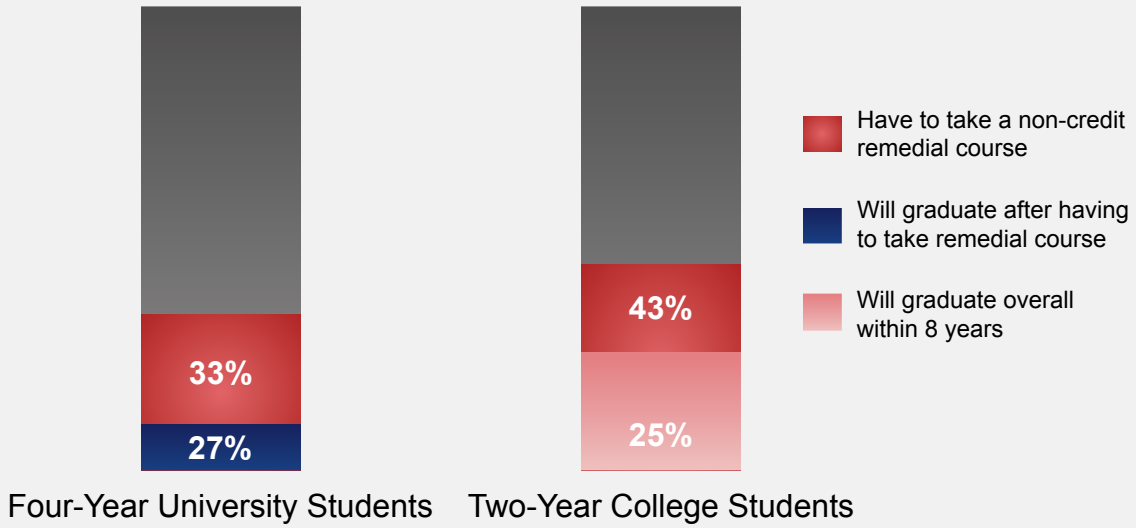
Many postsecondary institutions are currently prioritizing these kinds of shifts and partnerships. For example, Northeastern University in Boston, MA and Northwestern University in Evanston, IL both have cooperative learning programs that pair periods of academic learning with periods of employment in positions related to the student's field of study. These kinds of experiences allow students to better prepare for, and understand, the fields they will be going into after earning their degree.

INNOVATIONS IN POSTSECONDARY EDUCATION: USING TECHNOLOGY TO BUILD EQUITY

Postsecondary institutions across the nation acknowledge that too often, zip code determines a student's educational destiny.[21] Those who come in from underrepresented backgrounds and low-income communities are often behind from day one, due to myriad circumstances, even in the schools where they have been accepted.[22] And given that where students can be accepted to college is based on their grades and test scores, many do not have access to the most promising postsecondary pathways for their ambitions. The gap is especially stark for STEM degree majors, for whom a mathematics and science foundation can be immediate barriers to entry,[23] particularly given that a significantly larger number of students from underrepresented backgrounds come from high schools that do not even offer advanced math courses.[24]

Currently, 1/3 of college students in a 4-year college or university must enroll in at least one non-credit remediation class to perform successfully at the college level, while 43% of community college students must do so.[25] Of those students at four-year colleges enrolled in remedial reading and math classes, only 17% (reading) and 27% (math) will graduate, while fewer than 25% of community colleges students overall will earn a certificate or degree within eight years[26] (Figure 2). For students who enter college planning to earn a STEM degree, where even more advanced math courses such as College Algebra and Pre-Calculus are generally pre-requisites, this makes it all but impossible for students entering college behind in math to catch up to their peers and earn STEM degrees, closing off access to the STEM talent ecosystem altogether.

Figure 2: Percentage of 4- and 2-year college students who have to take remedial courses and the likelihood of graduation



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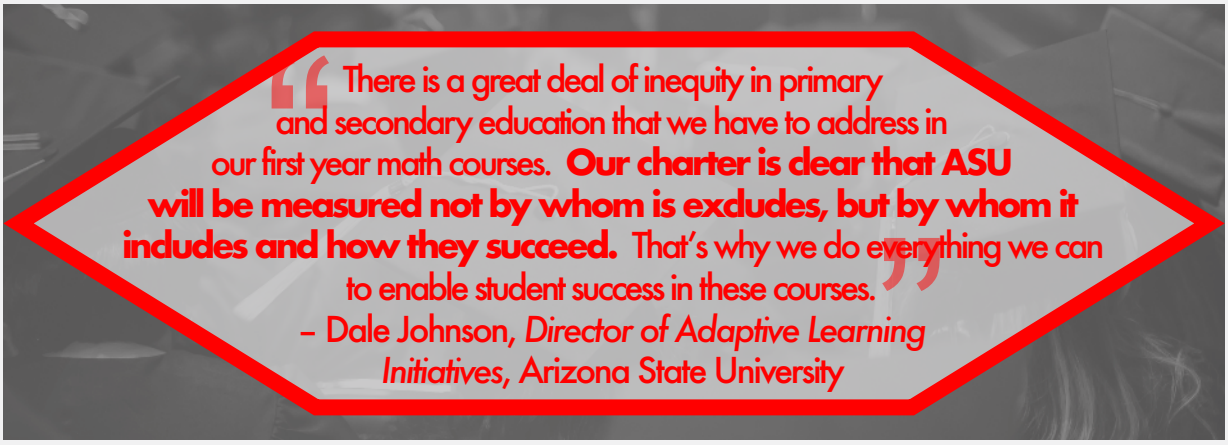


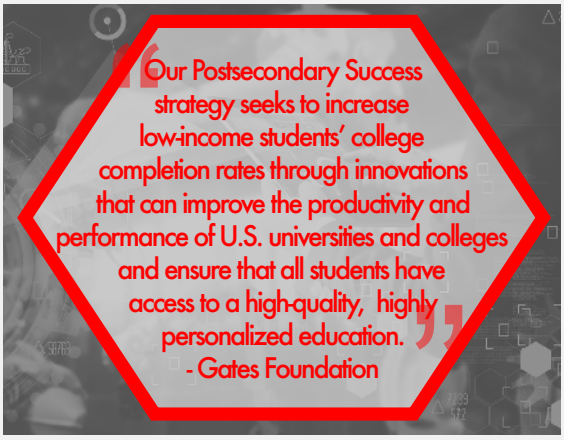
Traditionally, postsecondary institutions, particularly four-year colleges and universities, have sought to cut students who were not academically advanced early on before they could enter the most challenging courses in STEM majors. However, given the imperative facing industry and society as a whole, creating more access to STEM majors is now critical. And the most progressive professors and postsecondary administrators better understand that it is not about being the most academically elite that makes students prepared for advanced study in STEM fields, but actually their background and experiences that have prepared them for those courses.[27] Moving away from what have been called "weed out" courses, whose primary purpose is to "thin the herd" early on, many postsecondary institutions are creating innovative ways to admit more students from underrepresented backgrounds, especially those who enter college not yet ready for advanced courses, and support them in catching up to their peers to be able to pursue STEM degrees, and other majors that require a STEM foundation.

USING ADAPTIVE LEARNING PLATFORMS TO INNOVATE IN THE CLASSROOM & IMPROVE MATH PERFORMANCE

If foundational math performance is a barrier or access point into STEM majors, and industry needs more STEM majors to fill current and future vacancies to continue innovating and accelerating advancements in the economy, then improving educational math performance and opportunities for workforce entrants is critical.

Students often believe that math is a black and white subject – either you are good at it early on or you never will be, and as such, they often opt out of STEM because of this misattribution.[28] However, several studies have shown that much of math success is rooted in confidence as opposed to innate ability,[29] and as math follows a building block structure, students may unknowingly miss a foundational building block and lose confidence. This does not mean they are "bad at math." New technology, in the form of intelligent adaptive learning software, has shown that all students are capable of high achievement—even those from disadvantaged backgrounds. Increasing these students' math achievement grants them access to STEM majors and careers.

We spoke with professors and administrators from three postsecondary institutions who are all using an intelligent adaptive learning system to repair the education debt found with disadvantaged students and have found an increase in student ability, confidence, and persistence in more advanced math courses. Additionally, we spoke with Stacey VanderHeiden Güney, Director of Every Learner Everywhere (a Gates Foundation-Funded Initiative) who supports the use of intelligent adaptive learning to promote high-quality, highly personalized instruction for postsecondary students.



Although personalized learning as a concept is not new – K-12 institutions have been using different personalized learning platforms for years with mixed results (much depending on implementation)[29] – using subject-specific technology to allow college students to access new math concepts when they have demonstrated they are ready for them has proven to drastically increase the confidence of those students in their own abilities, and has led to a significantly higher number of students pursuing and finishing STEM degrees at the institutions that use these platforms.[30,31,32]

Given the successes seen by these institutions, we can hypothesize that if more postsecondary institutions use intelligent adaptive learning platforms for math and science courses, we could reduce the need for remedial education and drastically improve outcomes for underrepresented students seeking STEM degrees and careers with them.

How Adaptive Learning Platforms Work in the Classroom

Intelligent adaptive learning platforms begin with a diagnostic to help a student determine where they are most in need of support, allowing for a personalized learning path which supports the student's learning needs and makes efficient use of time. Unlike traditional math or science courses, where a student is placed in a particular level and has to learn or re-learn everything that is taught in that course regardless of their aptitude in particular aspects of the course, students can advance when they demonstrate mastery of a concept, and take more time and continue working on a concept when they require more review. As opposed to a model where a student who does not fully understand a concept must move forward with a pace set by the instructor, the student is encouraged to spend the time needed to master the concept. This also means that students do not feel the effects of failure on a concept. Rather, they can continue to work until they feel confident, and can improve on essential elements when they are most critical. With adaptive learning, students know that if they put in the time, they will eventually succeed. This increases their confidence in their abilities, and students tend to move ahead more quickly once they get the sense for how the technology can support them.

The Role of Instructors with Intelligent Adaptive Learning

While adaptive technology does some of the work of diagnostics, repetition and testing, the teacher can focus on helping students understand the more critical thinking elements of math problems – drawing on real world lessons and experiences to help students understand that particular concept. Students come to class knowing where they need a bit more support and the teacher can focus more one-on-one attention on that student, helping them understand the concept rather than rote memorization of formulas and procedures that do not apply to their greater understanding.

Many schools that have put adaptive learning successfully in place follow a "flipped classroom" or a blended learning model where instead of attending a lecture during the day and then going home to do problems on their own, students spend all of their time in class solving problems. What that means for students is they have to apply themselves to solving the problems in the adaptive learning platform and if they get stuck, faculty members can respond in real time. At Arizona State University (ASU), for example, the college put into place a four level assistance model to support students as they work on their math problems in McGraw-Hill ALEKS:

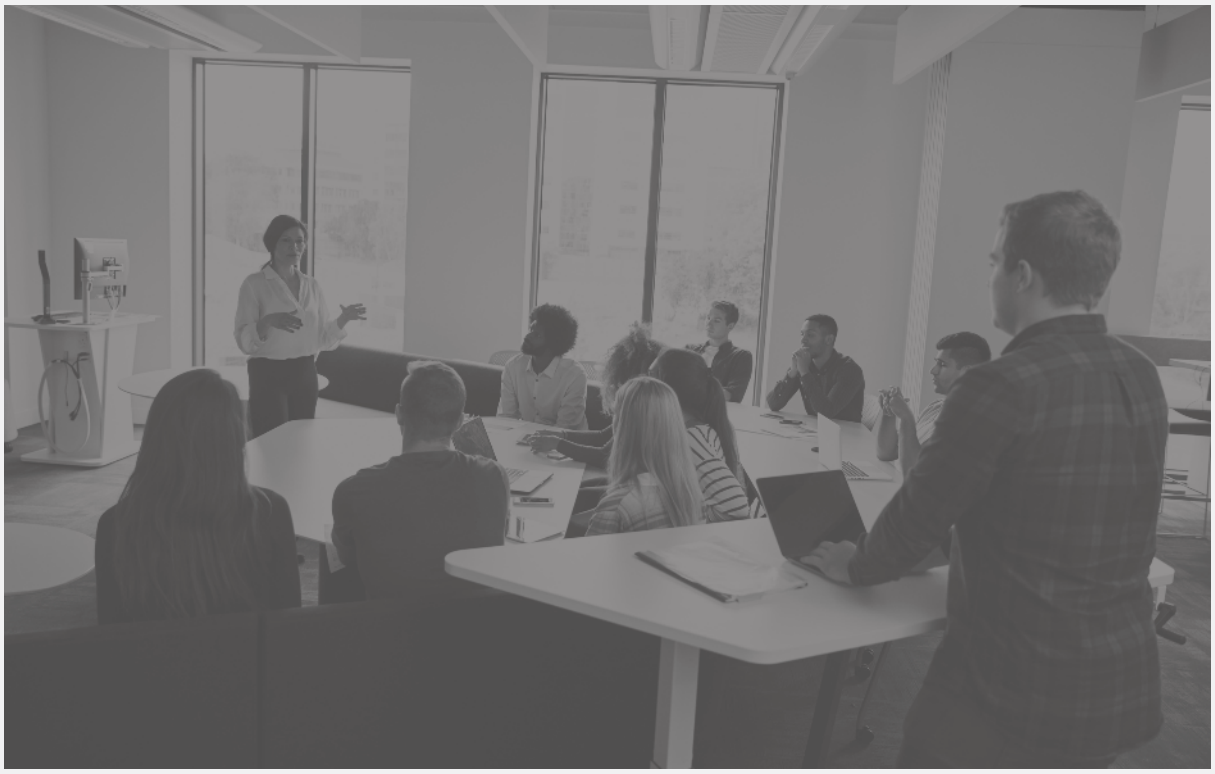
- The first is they can get assistance from a learning assistant directly in the classroom. The faculty member is the first line of teaching and will sit down with the student and solve the problem
- The next is to seek help from student assistants/tutors who help out in freshman study algebra
- The third is the tutoring center where students get additional help outside of the classroom
- The final is traditional office hours where students can get direct attention and feedback from the instructor

An additional benefit to the flipped classroom approach is that it builds employability skills while students are learning the technical math concepts. Per the corporate perspective shared earlier in this paper, it is not just a need for technical aptitude that employers seek, but how employees are able to take those technical concepts and apply them to critical problem solving using analysis, teamwork, communication, and creativity. Students work together in the classroom to solve problems and to understand how they apply in real-world contexts outside of the platform itself.

For teachers, adaptive learning is proving not to be a threat to their job but an asset. "I thought I was ready but it took me two years to understand I could actually do my job as a teacher instead of just be a spouter of information," shared Dr. Eliza Gallagher, Assistant Professor at Clemson University. "That shift – there is a fear of being replaced by a computer, being obsolete and wondering if you're not as good as you thought you were – it was really freeing when I let go of that and realized that's where I become the most valuable. I need to have a deep understanding of how students understand the content and how it fits together and make the connections and move forward. The nature of teaching has to change in order to really leverage the full power of what is out there. It frees up time to know your students as individuals and better understand how to support them and what you can do to push."

Long-Term Impact

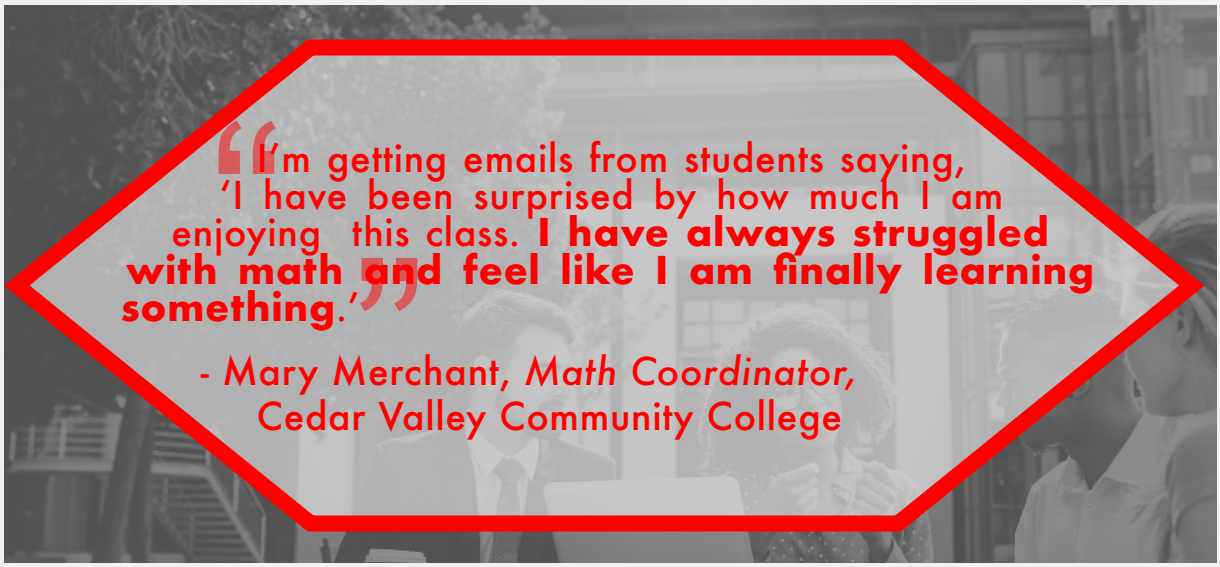
Adaptive learning does not only pose solutions for immediate math skill development. Schools that are using this technology are finding that students who use these platforms are equally as successful in advanced math courses as students who began college farther ahead in math, even in courses where the technology is no longer there. (Teachers have expressed an interest in adaptive courseware for more advanced courses like Calculus; however, currently the platforms only go through Pre-Calculus and more foundational science courses in biology, physics, chemistry, etc.) For example, ASU used to have a failure rate of 42% for college algebra and couldn't move the needle for decades. Within two years of using intelligent adaptive courseware, that number is now down to 21%. At Cedar Valley Community College, math coordinator Mary Merchant reports that not only are they seeing great improvements in developmental math compared with courses not using adaptive software, but the students' change in attitudes is also stark. "I'm getting emails from students saying, 'I have been surprised by how much I am enjoying this class. I have always struggled with math and I feel like I am finally learning something.'" That confidence is translating into more students majoring in subjects that require advanced math and succeeding in earning those degrees.



At Clemson University, Eliza Gallagher shared that previously, they had a 45% pass rate for Pre-Calculus and a much higher proportion of students needed extra support in those classes. “Right off the bat we were telling 55% percent of our students that they could never have a STEM major because they hadn’t gotten through Pre-Calculus.” Out of those who passed, only half were going into Calculus 1. So out of students starting at Clemson planning to go into STEM majors, only 25% ended up even in Calculus 1 – a prerequisite for most STEM majors. Even out of those who passed, most were earning Cs and Ds and thus were not really prepared for advanced math courses further into their major. “We were seeing that out of 100 students who started in Pre-Calculus, only 3 were continuing on and succeeding in advanced math courses.” Once Clemson switched to the ALEKS platform, 70% of students were passing Pre-Calculus and 80% of those continued on to more advanced math. And beyond that, the students who did enter Calculus 1, perform at approximately the same level as students who tested directly into that course.

Even before entering college, high schools such as Bronx High School of Science in New York are finding that using intelligent adaptive courseware encourages success and readiness for advanced college math courses.

This impact is even further reaching than just supporting students to access more advanced STEM majors. It provides the foundational knowledge required for students to be successful even in non-STEM majors, and also helps build the confidence necessary for those students to combat the Belief Gap and pursue prosperous careers from which they would have previously been weeded out.



STUDENT SUCCESS STORY

Shantel Butler didn't have the kind of background one expects to see from engineers. Growing up in a low-income single parent household, Shantel did not have access to high level math courses at her school, or the kind of tutors and additional supports usually required for a student to pursue an advanced STEM degree. She had attended an engineering camp throughout high school – a program called Partners for Minorities in Engineering and Computer Sciences – and it inspired her to want to become an engineer herself. "I had never had any other exposure to anyone who worked in STEM, especially not women of color." But there were significant barriers in front of her.

When her mom was diagnosed with breast cancer during the summer before she was supposed to begin her first year at Clemson, where she had received an academic scholarship, she almost considered not going at all. "I ended up going, but I was really depressed and worried my first semester. I was so distracted thinking I could lose my mom while I was away." When Shantel shared with her math teacher, Dr. Eliza Gallagher, and her general engineering advisor what was going on, they did everything they could to support her and keep her on track.

"My math program was really interactive. We used ALEKS, and that was really new for me, being able to see my own results and move along when I felt confident in an area. Plus, Dr. Gallagher made it really fun. She made math come to life," Shantel shared. "That math class was the pillar to my success at Clemson. Dr. Gallagher pushed me out of my comfort zone and helped me gain the confidence I needed to succeed in math. She really broke it down for me and having the adaptive learning platform helped her do that. Plus, I had the ALEKS training and courses online to help me in the professor's absence."

Shantel realized she could apply the methodology she was learning through her math courses to her other courses as well – and to her own life. "I gained confidence in my ability to troubleshoot - to critically problem solve, step by step."

Shantel not only earned an A in that first math course, but she went on to take 6 Calculus courses throughout college and earned a degree in Electrical Engineering and a minor in mathematical sciences. She is now a project engineer at UPS, where she continues to apply the analytical & problem solving skills she gained at Clemson through the adaptive learning platform - and her mom is also doing well in recovery.

"I'm enjoying my role as a project engineer with UPS. But I think my true purpose is in inspiring others to become involved in STEM regardless of their background, emphasizing that where they come from and how they grow up does not have to determine whether they can succeed in math or STEM. You just have to break the problems down step by step, believe in yourself, and surround yourself with those who believe in you."

Shantel is currently a project engineer with UPS, and every year continues to use a week of her own vacation time to volunteer at the engineering camp she attended in high school that inspired her on her path way to where she is today.

SOLUTIONS IN ACTION: ARIZONA STATE UNIVERSITY

The Situation

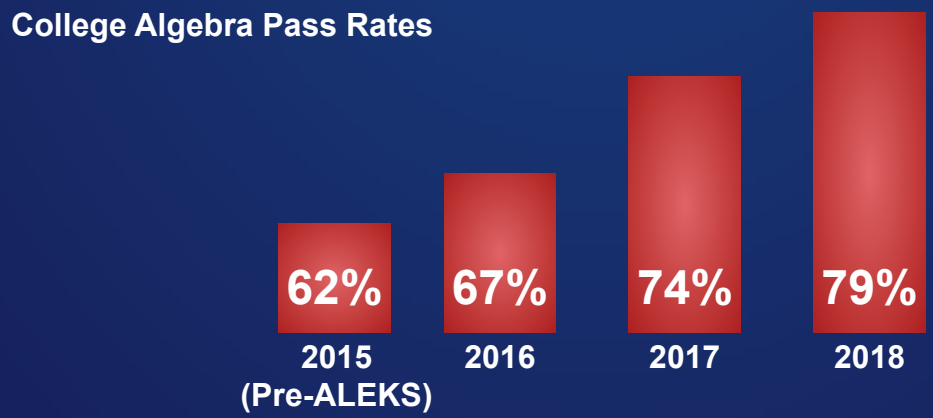
In 2013, Arizona State University (ASU) identified a growing trend of more students placing into their developmental, non-credit mathematics course, namely Freshman Enhanced Mathematics (MAT 110). While ASU was dedicated to supporting these students, they were also concerned that their success in MAT 110 was not translating into success in College Algebra (MAT 117). Pass rates in College Algebra were stalling at around 60 percent. This led faculty to reconsider the learning tools for Enhanced Freshman Math and College Algebra.

The Solution

After evaluating the courseware options and pedagogical considerations, faculty decided to pilot McGraw-Hill ALEKS in the College Algebra course for the summer of 2016 and eliminate Enhanced Freshman Mathematics. The adaptive system would be used to remediate students who lacked prerequisite skills in College Algebra.

The Results

College Algebra pass rates increased after the first semester from 62% in the fall of 2015 to 67% in the fall of 2016 to 74% in the fall of 2017 and 79% in the fall of 2018 in spite of students who would have placed into Enhanced Freshman Math being mainstreamed into College Algebra. Moreover, among underrepresented minorities, the pass rates increased on average by .5 (on a 4.0 scale). The success rate for the fall of 2017 increases to 78% once the adjustment is made for students who chose a Z grade and then completed the stretch course successfully.



For a more detailed analysis of the ASU case study, visit: https://s3.amazonaws.com/ecommerce-prod.mheducation.com/unitas/highered/platforms/aleks/aleks-case-study-asu.pdf

SOLUTIONS IN ACTION:
CEDAR VALLEY COMMUNITY COLLEGE

The Situation

The state of Texas changed the placement test and rules governing it, resulting in more underprepared students in mathematics classes, both developmental and college-level. Students with weak prerequisite skill and low confidence continued to struggle.

The Solution

Cedar Valley implemented ALEKS because of its ability to roll prerequisites into the course and meet students where they are mathematically. Using a blended/lab and online model, ALEKS has allowed teachers to more effectively work with students at their level and target individual concepts where students need the most support.

The Results

For the past 3 years, pass rates have increased in all three course areas. Overall, Elementary Algebra saw an increase of 17.7%, Intermediate Algebra has increased by 15.8% and College Algebra by 13.9%. Teachers report in addition to the improvements in their pass rates, students are more confident and appreciate the non-punitive approach to learning, keeping them more engaged in class.

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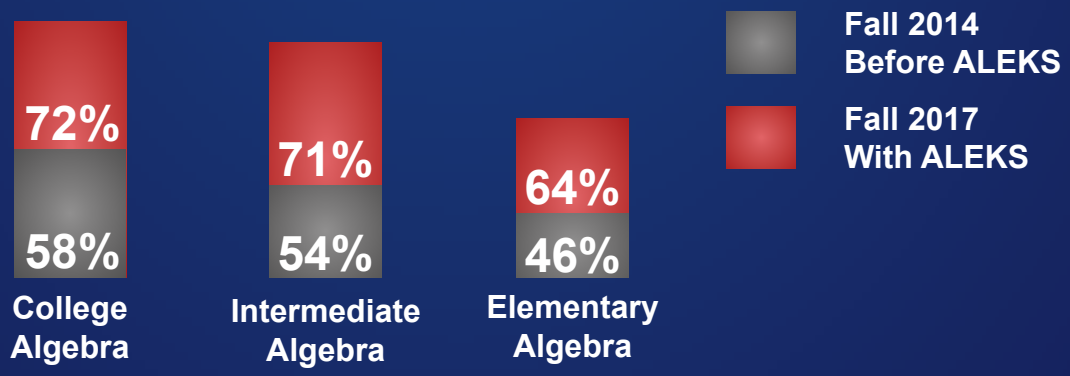
Pass Rate Increases Across Courses



For more a more detailed analysis of Cedar Valley's case study, visit: http://alt.cedarvalleycollege.edu/Documents/ALEKS_CaseStudy_CedarVallCollege_Dev_Merchant.pdf

SOLUTIONS IN ACTION: CLEMSON UNIVERSITY

The Situation

The Clemson Pre-Calculus course exclusively enrolls students intending to major in STEM but don't have the math background to place into Calculus. The majority of these students are underrepresented minorities, and many of them are first-time college students. In order to complete a STEM degree, students need to pass Pre-Calculus and take at least two semesters of Calculus.

Prior to adopting ALEKS, Clemson's Pre-Calculus pass rate was 45%. Of the students who passed, only half of them went on to take Calculus 1. When they did take Calculus 1, 65% of them failed it.

This translates to 3 out of every 100 Pre-Calculus students reaching Calculus 2.

What happened to the other 97? Some retook the course they failed. Many switched majors, and sadly, some left college altogether. After 6 years, only 18% of Pre-Calculus students intending to major in engineering actually completed an engineering degree. 34% of Pre-Calculus students intending to major in STEM ultimately graduated with a STEM degree.

The Solution

In 2010, Eliza Gallagher was charged with "fixing Pre-Calculus." The administration and department were unhappy with the amount of students leaving math and STEM for other majors. After considering a variety of options—including a new textbook, flipping the classroom, and reducing their class size—she decided on ALEKS in a modified emporium format.

Once they implemented ALEKS, pass rates immediately increased, as did retention into Calculus. Currently, their pass rate is about 70%. Of the students passing, 81% take Calculus 1 and 76% of them pass it—and they're even outperforming students who placed directly into Calculus. Now, for every 100 students in Pre-Calculus, 43 enroll in Calculus 2.

The Results

This May, the first group of students that started in the ALEKS redesign is graduating, and more of them will be doing so with STEM degree. 43% that started in Pre-Calculus will graduate with a STEM degree, and 44% of the students intending to major in engineering earned that engineering degree. And because their pass rates and Calculus retention have increased each year since implementing ALEKS, Clemson expects the STEM retention rates to climb further over the next few years. They are also taking steps to boost their Pre-Calculus pass rates another 10-15 percentage points.

For more a more detailed analysis of Clemson's case study, visit: https://s3.amazonaws.com/ecommerce-prod.mheducation.com/unitas/highered/platforms/aleks/aleks-case-study-clemson.pdf

CONCLUSION

A majority of the most prosperous and available jobs of today and the future increasingly require a strong foundation in STEM skills combined with the ability to synthesize data and information and collaborate, communicate, and problem-solve around complex challenges. Sheer demand alone requires a larger and more prepared STEM talent pool, which means creating more opportunities for individuals from underrepresented backgrounds and traditionally overlooked communities to access STEM degrees and subsequent jobs.

Foundational knowledge in math has proven to be a major barrier to entry for youth from underrepresented backgrounds looking to pursue STEM degrees. Intelligent adaptive learning platforms have shown to be a promising technology solution to build equity for those entering college behind their peers in math, allowing for reparation of skill and confidence deficits often resulting from systemic educational inequities, and for eventually majoring in STEM degrees and succeeding in STEM jobs. While college degrees themselves are not an end goal, increasing access and opportunity for individuals to take and succeed in more advanced math and science courses will open doors for those individuals to find themselves in fulfilling STEM careers, greatly increasing the STEM talent pool overall, and making it easier for corporations to hire the diverse talent required to remain sustainable and innovative for decades to come.

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ENDNOTES

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