Center for American Progress

Using the Science of Learning to Redesign Schools

By Ulrich Boser, Abel McDaniels, and Meg Benner October 23, 2018

Policymakers and educators need to reimagine the American school experience in order to better improve student achievement. According to the 2017 ACT college and career readiness benchmarks, less than half of all U.S. students were prepared for college-level math or reading.[1] What's more, nearly half of all first-year college students require remediation in English, costing taxpayers roughly $1.3 billion.[2]

There are promising practices and research that rethink the school experience in order to ensure students are prepared to compete in the 21st century and that foster the tools for lifelong learning. Within pockets of innovation, many schools are being restructured to fit the needs and interests of students—a practice that's commonly called school redesign.[3] In an attempt to improve outcomes for traditionally underserved students, these redesign efforts test new ways for students to experience school, demonstrate their learning, and earn credit toward graduation.

Some of the most successful school redesign efforts embrace timely research on how individuals learn best. This body of research, known as the science of learning, is the application of cognitive science research to education. In this approach, learning scientists develop specific strategies that align with the way the brain best acquires and retains information. The approach has been particularly successful with underrepresented minorities.[4]

School redesign and the science of learning are each at the center of innovative policy reforms and timely research, and the intersection of these movements can help support the kind of education American students need. This intersection is the focus of this brief, which looks at the ways learning science can support school redesign.

This brief builds on the growing momentum for both the science of learning and school redesign. Last month, for instance, the XQ Institute released a policy guide for states on how best to redesign their schools. The document argued, among other things, that students should be able to learn at their own pace, progressing as they demonstrate mastery of key concepts.[5]

Practice makes perfect

Science shows that practice improves learning.[6] Unfortunately, most students don't get enough time to develop what they are learning. Policymakers and educators should rethink how student learning is organized in order to give students more opportunities to hone the concepts and skills they are studying—both during and after class.

There are several ways school leaders can shift the school structure and build in additional time for practice and other more focused forms of learning. As an example, school leaders can arrange schedules so that students have the same class twice a day, essentially providing a double dose of foundational courses. For instance, some high-performing schools will schedule English language arts and math sessions in both the morning and afternoon.[7] This gives students more time to delve into key topics, thus improving the likelihood that the students will absorb and retain important skills and concepts.

The best type of practice is spread out over time, and school leaders should make sure that students regularly relearn material, particularly key ideas, over the course of the school year, not just the school day. Instead of learning the division of fractions for two weeks straight, for example, sixth-graders can learn the topic for a week at the start of the year and again for a week near the end of the year. Teachers can also incorporate fractions into weekly review through independent math centers or as a part of other math topics.

In addition to changes to school schedules and curricula, another way to offer more practice to students is tutoring, which can give students more practice and instruction in areas in which they struggle. A 2011 study found that students who were tutored performed far better on standardized tests than students of similar ability who were not tutored.[8] Another study found that students who were tutored had higher grades and were more likely to pass their classes than those who did not.[9]

Tutoring is not common in many schools due to its costliness, but it does not always have to have a high price tag. For instance, there is some evidence suggesting that even minimally trained tutors can boost student achievement. One study found that community volunteer tutors helped students improve their grades and that, after tutoring, students who had previously received a failing grade in core subjects finished the year with passing grades.[10]

Policymakers can help schools and districts offer more practice. Specifically, they should give schools and districts far more flexibility around designing school schedules. Extending the school day and year, for instance, is an easy way for schools to offer more time for practice. While extended school time can be expensive, districts can reduce the cost by partnering with community-based organizations to offer multiple enrichment blocks during the day and by staggering teacher schedules.[11]

Make time for feedback

Research suggests that feedback is central to learning.[12] In fact, a synthesis of nearly 200,000 studies found that feedback is one of the top influences on student achievement, having a greater effect on student performance than many other interventions.[13] Redesigned schools can strengthen instruction, as well as student outcomes, by creating more opportunities for students to receive feedback—in particular, immediate and individualized advice on how well they do on a given task.

Policymakers can take several steps to reorganize schools in order to improve teaching and learning—and thereby strengthening feedback processes in schools. Most importantly, there should be a greater emphasis on low-stakes quizzes—also known as formative assessments—which have been shown to boost student outcomes.[14]

Assessment policies can help change how schools incorporate and value feedback by emphasizing these low-stakes quizzes. Since 2001, federal and state policies have prioritized standardized, annual assessments that measure proficiency. Students, parents, and teachers often did not receive test scores for months, sometimes not until the next school year. As a result, schools used the tests for accountability purposes rather than for shaping and improving learning.

Federal, state, and district governments must rethink assessment policies to encourage schools to prioritize formative assessments that give teachers and students more near-real-time feedback on learning. As the XQ Institute's policy guide notes, each state should have a plan to rethink their approach to assessment.[15] Rhode Island serves as one example: The state is planning a massive rethink of its approach to testing.

States and districts have many other options around polity to help improve schools and provide more feedback to students. For instance, districts can allow students to retake assessments. This will allow tests to be seen as snapshots of learning as opposed to performances on one specific task on a given day. Another option is for educators to offer narrative feedback on major assignments, in addition to or instead of letter grades.

Learn by doing

Research shows that people more deeply understand and retain information if they connect theoretical ideas to concrete examples.[16] In schools, students need opportunities to apply what they have learned, especially to familiar, real-world contexts.

District- and school-level administrators should adopt curricula that give students time to explore and develop meaning for new concepts. Project-based learning is one popular method, requiring students to apply what they know to solve real-world

problems or to answer complex questions—usually for an extended period of time.[17] For instance, this teaching method might encourage students studying the water cycle to devise a way to sample and test water in their community.

Da Vinci RISE High, Los Angeles

Da Vinci RISE High in Los Angeles embraces the value and flexibility of experiential learning. The school seeks to re-engage disconnected youth—or young adults who have left school and have yet to enter the workforce. To help students succeed, Da Vinci RISE High replaced the current high school structure with a project-based curriculum. Students work with teachers to develop their own learning pathway. They move at their own pace, progressing as they demonstrate mastery of learning goals through projects that occur both in and outside the school building.[18]

Instituting senior-year internships is another approach that high schools can take to encourage their students to learn by doing. A growing number of schools—including those in Minnesota's Brooklyn Center Community Schools—help students synthesize their learning and revisit key topics by giving them the opportunity to pursue educational experiences outside the classroom.[19] These schools have found that year-long internships are more effective than shorter ones.[20]

As noted by the XQ Institute policy guide, policymakers can encourage schools to embrace project-based learning by changing the way they measure student learning.[21] Usually, states and districts use the Carnegie Unit, which requires schools to measure learning based on the amount of time students spend in a given class, rather than mastery of academic content.[22] However, seat time is not the best indicator of how much a student learns, as individuals often don't learn at the same pace. Rather than measuring learning by seat time, schools can require students to demonstrate mastery or competency of learning goals. This not only allows students to move at their own pace, but it also acknowledges the concept of learning anytime, anywhere. As noted in the XQ policy guide:

> *[Competency-based education] isn't about replacing what goes on in the classroom with less-demanding experiences outside of it. This is about integrating innovative approaches to teaching in the classroom with opportunities for students to develop practical, concrete skills in real world settings. And it's about awarding credit for learning—demonstrated learning—no matter where or when the learning takes place.*[23]

In 2005, New Hampshire eliminated the Carnegie Unit. Now, districts in the state can demonstrate student mastery using a locally developed competency rubric.[24] As a result of this shift, schools across New Hampshire allow students to demonstrate academic proficiency through long-term, experiential learning opportunities both in and outside the classroom.[25]

Conclusion

Importantly, policies and efforts to redesign schools using the science of learning are most effective when part of a comprehensive agenda. Longer, aligned school schedules, improved assessment systems, and meaningful guidelines to demonstrate learning are critical policies that will improve school redesign and help schools embrace science-based strategies. Additional policies and funding are also necessary. Teachers and administrators need professional development to understand how to implement effective learning strategies, meaningfully blend formative assessments and instruction, and evaluate student performance based on mastery. Access to technology helps allow for greater personalization and ongoing feedback on student work. Importantly, flexible or additional funding allows districts to restructure learning experiences.

In the end, the nation's schools were not designed with the science of learning in mind. Lagging student engagement and student performance reflect this shortcoming. Yet, educators and policymakers can correct this failure by leading work at the intersection of school redesign and the science of learning, implementing better policy structures as well as improved education programs. Today's students cannot afford another missed opportunity.

Ulrich Boser is a senior fellow at the Center for American Progress. Abel McDaniels is a former associate for K-12 Education at the Center. Meg Benner is a senior consultant at the Center.

Endnotes

1 ACT, "Profile Report – National: Graduating Class of 2017" (2017), available at https://www.act.org/content/dam/act/unsecured/documents/cccr2017/P_99_999999_N_S_N00_ACT-GCPR_National.pdf.

2 Laura Jimenez, "How to Reform Remedial Education," Center for American Progress, January 9, 2018, available at https://www.americanprogress.org/issues/education-k-12/news/2018/01/09/444582/reform-remedial-education/.

3 Craig Jerald, Neil Campbell, and Erin Roth, "High Schools of the Future: How States Can Accelerate High School Redesign" (Washington: Center for American Progress, 2017), available at https://www.americanprogress.org/issues/education-k-12/reports/2017/12/04/443615/high-schools-future-states-can-accelerate-high-school-redesign/.

4 Fernando Rodriguez and others, "How do students study in STEM courses? Findings from a light-touch intervention and its relevance for underrepresented students," *PLOS ONE* 13 (7) (2018), available at https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0200767.

5 XQ: The Super School Project, "High School and the Future of Work: A Guide for State Policymakers" (2018), available at https://downloads.ctfassets.net/35eubtuv0bcm/2NVjaiBHtCsMSkiyaIG2mi/1dc483b4c28b58adbf87aaaaf0375dd3/XQ_PMG_Graphik_08.30.18_DIGITAL_spreads.pdf.

6 Harold Pashler and others, "Organizing Instruction and Study to Improve Student Learning: A Practice Guide" (Washington: National Center for Education Research Institute of Education Sciences, 2007), available at https://ies.ed.gov/ncee/wwc/PracticeGuide/1; Doug Rohrer and Harold Pashler, "Increasing Retention Without Increasing Study Time, *Current Directions in Psychological Science* 16 (4) (2007): 183–186, available at http://www.pashler.com/Articles/RohrerPashler2007CDPS.pdf.

7 Claire Durwood, Emily Krone, and Christopher Mazzeo, "Are Two Algebra Classes Better Than One? The Effects of Double-Dose Instruction in Chicago" (Chicago: Consortium on Chicago School Research, 2010), available at https://consortium.uchicago.edu/sites/default/files/publications/Double%20Dose-7%20Final%20082610.pdf.

8 Terri Rothman and Mary Henderson, "Do School-Based Tutoring Programs Significantly Improve Student Performance on Standardized Tests?", *Research in Middle Level Research* 34 (6) (2011): 1–10, available at https://www.amle.org/portals/0/pdf/rmle/rmle_vol34_no6.pdf.

9 Anna Allen and Nancy Feyl Chavkin, "New Evidence that Tutoring with Community Volunteers Can Help Middle School Students Improve their Academic Achievement," *The School Community Journal* 14 (2) (2004): 7–18, available at https://files.eric.ed.gov/fulltext/EJ794820.pdf.

10 Ibid.

11 Meg Benner and Lisette Partelow, "Reimagining the School Day: Innovative Schedules for Teaching and Learning" (Washington: Center for American Progress, 2017), available at https://www.americanprogress.org/issues/education-k-12/reports/2017/02/23/426723/reimagining-the-school-day/.

12 John Hattie and Helen Timperley, "The Power of Feedback," *Review of Educational Research* 77 (1) (2007): 81–112, available at http://journals.sagepub.com/doi/abs/10.3102/003465430298487.

13 Ibid.

14 Neal Kingston and Brooke Nash, "Formative Assessment: A Meta-Analysis and a Call for Research," *Educational Measurement: Issues and Practice* 30 (4) (2011): 28–37, available at https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1745-3992.2011.00220.x.

15 XQ: The Super School Project, "High School and The Future of Work."

16 Harold Pashler and others, "Organizing Instruction and Study to Improve Student Learning."

17 Buck Institute for Education, "What is PBL?", available at https://www.bie.org/about/what_pbl (last accessed September 2018).

18 XQ: The Super School Project, "This is Da Vinci RISE High," available at https://xqsuperschool.org/xq-schools/rise (last accessed September 2018).

19 Kelli Hillestad, "Six ways to build a high-school internship program that changes low-income students' lives," The Hechinger Report, September 18, 2017, available at https://hechingerreport.org/teacher-voice-six-ways-build-high-school-internship-program-changes-low-income-students-lives/.

20 Ibid.

21 XQ: The Super School Project, "High School and The Future of Work."

22 Elena Silva, Taylor White, and Thomas Toch, "The Carnegie Unit: A Century-Old Standard in a Changing Education Landscape" (Stanford, CA: Carnegie Foundation for the Advancement of Teaching, 2015), available at https://www.carnegiefoundation.org/wp-content/uploads/2015/01/Carnegie_Unit_Report.pdf.

23 XQ: The Super School Project, "High School and the Future of Work."

24 New Hampshire Department of Education, "State Model Competencies," available at https://www.education.nh.gov/innovations/hs_redesign/competencies.htm (last accessed September 2018).

25 Dale Frost, "How New Hampshire Transformed to a Competency-Based System," iNACOL, May 10, 2016, available at https://www.inacol.org/news/how-new-hampshire-transformed-to-a-competency-based-system/.