An Intervention That Works − SAM Learning®

By
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Executive Summary

Despite increases in required accountability testing in the U.S., there is little evidence that students are learning what they need to know and be able to do in the global economy. Research results show that it is particularly difficult to intervene successfully with struggling high school students who have experienced years of failure in traditional learning environments. SAM Learning® offers a web-native intervention tool that presents scaffolded learning in interactive ways so that these very students are engaged and motivated to learn. SAM Learning is a student-drive system of assessment and instruction that provides content in mathematics and science along a range of complexity including even the most rigorous of high school subjects.

SAM Learning appeals to students all along the achievement continuum. Students who are two or more years behind grade level with no available resources to get caught up, find SAM Learning a powerful aid. Students who are almost on grade level or perhaps just unable to get what is being taught in a traditional classroom, can go into SAM Learning and get scaffolded instruction to learn what they need to learn. Students who are above grade level and who want to reinforce or extent their learning can use SAM Learning as well.

Because SAM Learning is a personal student-driven instructional tool, students face no embarrassment about where their learning breaks down. Students who do not ask questions in class because they know that other students will laugh at them will have a personal, student-drive resource that helps them understand what they did not understand in class. Every student can find precisely where their learning has broken down and remedy that independently through student-driven instruction.

Setting the Stage

While *No Child Left Behind (NCLB)* is the most recent of educational initiatives, the reality is that for decades policy makers and educators in the United States have sought ways to increase achievement for all students. Yet despite increases in required accountability testing and more detailed reporting of performance, there is little evidence that students in U.S. schools are learning what they need to know and be able to do to compete in the global economy. And in mathematics and science, precisely the areas where students will need to achieve mastery for tomorrow's jobs, data on student achievement paint a dark picture.

Trend analyses of student performance on the National Assessment of Educational Progress (NAEP) indicates that reading, mathematics, and science achievement today are at about the same level they were thirty years ago.[1] Most students score at the "basic" level on NAEP.[2] Only 36 percent of grade 4 students and 30 percent of grade 8 students scored at or above the NAEP "proficient" level in mathematics. In science, about one-third of students at grades 4 and 8 scored at or above the "proficient" level and, in high school, that number dropped to 1 in 5 or 20%.

Internationally, U.S. students at grades 4 and 8 scored above the average for the students from various nations participating on the Trends in Mathematics and Science Study (TIMSS, 2003) but ranked 8th out of 12 nations participating on the Program for International Student Assessment (PISA).

While these results would seem to represent a call to arms, the unfortunate fact is that there is disagreement in the U.S. about how 'serious' an issue this is. The general public tends to think that students do not need more mathematics and science preparation, but business, industry, and politicians think that the nation's economic is in danger without more science and mathematics preparation.[3]

A point refuting the complacency of many in the general public – and supporting the position taken by those in business and industry – is the fact that graduation rates for urban districts are around 50%. And, of those students who do graduate from high school and go to college, approximately 40% are required to take one or more remedial classes.[4] Some argue that this gap (i.e., the discrepancy between the skills students often have when leaving high school versus the skills that colleges and universities expect them to have) exists because students need alternatives to higher education that lead to careers but do not require a two- or four-year degree. However, Williamson (2006) has smashed this myth. His research clearly demonstrates that what students must know and be able to do to be successful in college, at work, in the military, or in government are essentially the same. The gap between what is required for success in higher education and the workplace is gone.

As if the picture is not bleak enough, consider the shortages of qualified teachers, particularly in mathematics and science. Ingersoll[5] (2006) reports that 42 percent of districts have problems filling their mathematics positions and 30 percent report problems filling their life science teaching positions.

Finding teachers to fill the classrooms so that students have opportunities to learn is a major challenge, particularly for mathematics and science. Qualified and knowledgeable teachers make the biggest difference in student achievement.[6] But given the reality that there is a shortage of highly qualified teachers, is there a way that instructional technology can spark student learning?

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1 Forgione, P.D. "Achievement in the United States: Progress Since A Nation at Risk," Washington, DC: National Center for Education Statistics, 1998.

2 Practical Information and Analysis about Public Education, Washington, DC: Center for Public Education. 2008

3 Public Agenda, 2006 and Business Roundtable et al., (2005).

4 2005. Barton, P. One-third of a Nation: Rising Dropout Rates and Declining Opportunities. Princeton, NJ: Educational Testing Service.

5 Ingersoll, R. (2006). Understanding Supply and Demand Among Mathematics and Science Teachers, in Teaching Science in the 21st Century. Arlington, VA: NSTA Press.

6 Education Trust (2002). Add It Up. Mathematics Education in the U.S., Does Not Compute. Thinking k-16, 6(1) Summer 2002. Washington, DC: Education Trust.

Donovan and Bransford, in their book *How People Learn: Brain, Mind, Experience, and School* (2005)[7], make a powerful statement about what teaching and learning should be, particularly in mathematics and science. They assert that

> "(m)ore than any other species, people are designed to be flexible learners and, from infancy, are active agents in acquiring knowledge and skills." (p. 1)

Donovan and Bransford focus on three fundamental and well-established principles of learning that are "particularly important for teachers to understand and be able to incorporate in their teaching." First among these is the observation that students come to school with preconceptions that they hang on to unless they are sufficiently engaged by 'correct content' which will cause them to abandon any misconceptions. Second among these is the idea that to develop deep competence in a subject area, students must have a solid foundation, understand facts and ideas they are learning in ways that allow them to retrieve that knowledge and be able to apply it to new situations. The third observation is, perhaps, the most powerful − the idea that students can learn to take control of their own learning by defining learning goals and monitoring their own progress in achieving them.

Surely, this nation needs more highly qualified teachers. And, in an ideal world, all of the educational ills that plague our country might better be solved by making sure that every student is exposed to highly engaging instruction provided by a highly qualified content expert with a magnetic personality and an ability to relate to students on their own level. But, today, high school students in particular have little time to wait for an infusion of those excellent and highly sought-after teachers into the schools.

So, in the absence of highly qualified teachers in many mathematics and science classrooms in the U.S., what can instructional technology offer students that allows them to be "active agents in acquiring knowledge and skills"?

The problems facing schools in the U.S. are clear.

> *Far too few highly qualified teachers in mathematics and science*
> *Far too many students who are not prepared for post-secondary education*
> *Far too many students who never graduate from high school*
> *Overall underachievement in the sense that, when compared internationally, students in the U.S. are not leading the pack*

[7] How students learn : history, mathematics, and science in the classroom / Committee on How People Learn, A Targeted Report for Teachers ; M. Suzanne Donovan and John D. Bransford, editors. Washington, DC: National Academies Press; Internet, http://www.nap.edu

The evidence is beginning to emerge that will help schools better meet the needs of high school students. One essential component is to provide teachers with real-time information about what students know and can do and what they are or are not working on. Wenglinksy[8] suggests that it is quite simple ─ train teachers to diagnose students' weaknesses and focus on strengthening those areas.

The National Science Board adds to this that all students must have access to computers.[9] High Tech High Schools[10] adds one more important component and that is to emphasize technology.

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Putting It All Together

What is the bottom line for helping students learn what they need to know and be able to do to be successful in whatever career they choose? What can high schools do to better prepare students and to keep them in school making progress towards graduation?

One potential solution involves SAM Learning. Sam Learning has combined the delivery of mathematics and science content in a web-native interactive tool that is much like the video games students play for hours on end. The content is delivered in an interesting way. Students get immediate feedback on how they are doing and can see progress towards their own goals. And teachers can monitor what each student is doing and how well they are progressing towards goals in real-time without interrupting student engagement. If a student is off-track on what he or she is working on, the teacher can guide the student back on track.

SAM Learning is a student-driven product. It links instruction to gaming to maximize both learning and engagement. It allows teachers to be the instructional guide as students take more and more responsibility for their own learning. And, because the content is aligned to state standards, teachers can monitor progress towards grade-level proficiency.

For students who have not been successful in traditional learning environments, being able to take control of what they are doing – and when ─ can empower them. When this is coupled with immediate recognition of success, students can begin to like learning. When students feel some sense of independence and control, they will be more motivated.

SAM Learning makes no judgments about students as learners. Sam Learning allows students to move through the content as rapidly or as slowly as they wish. It allows students to return again and again to the same content without penalty or consequence. This approach represents a major change for schools, teachers, and students. This paradigm shift will take some adjustment, but the principle is sound — if students are involved in decision-making regarding the critical elements of what and when they learn, they are more likely to "step up."

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[8] Wenglinsky, H. (2002). How Schools Matter: The Link between Teacher Classroom Practices and Student Academic Performance. Educational Policy Analysis Archives, 10(12). http://epaa.asu.edu/epaa/v10n12/ and Wenglinsky, H. (2004). Closing the Racial Achievement Gap: the Role of Reforming instructional Practices. Educational Policy Analysis Archives, 12 (64). http://epaa/asu/edu/epaa/v12n64/

[9] National Science Board (2006). Science and Engineering Indicators 2006. Arlington, VA: National Science Foundation.

[10] High Tech High Schools (2006). http://www.hightechhigh.org

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Of course, supporting students in their effort to take control of their own learning does not in any way diminish the important role of teachers in the instructional process − Student-driven does not mean teacher-abdication. It just means that by integrating SAM Learning into the instructional program, teachers can know immediately which students are on track and which are not. Teachers can then intervene as appropriate.

Teachers need to know what each student knows and can do and where those students' learning weaknesses are. Teachers need to know this in real-time and to be able to provide interventions for students that are tailored to each individual student's needs. But teachers need more than this. They need a tool that will engage and motivate students − especially those students who have struggled to learn in school their entire life. For students who have neither the foundational skills in mathematics and science nor the strategies to study, engaging and motivating them to do traditional school work is problematic. To turn these struggling learners into scholars requires innovative instructional programs that ensure success, build on existing knowledge quickly to get students on grade level, and are viewed by students as fun to use. Finally, students must get some immediate sense of satisfaction from their work. They need to know if they are "winning the game" of learning and are likely to be prepared for whatever assessment is tossed their way.

In combination, instructional tools that have these components will be effective in helping all students − not only those who struggle but those who generally have a history of succeeding − learn important content and ultimately stay in school, graduate from high school, and be prepared for college, the world of work, the military, or government.

Teachers' roles will change with SAM Learning. They will begin analyzing and utilizing real-time data to truly drive instruction and learning. They will have an empirical basis for conversations about interventions and instructional accelerations. Data will not be five days old, three weeks old, or two months old. It will be real-time information, every day. This is a cultural change from the way schools have done business for the last two generations and will require teachers and administrators to champion this paradigm shift.

An Effective Instructional Solution for Struggling (and Succeeding) High School Students

One technology product that does all of this is SAM Learning. SAM Learning is a web-native learning program that makes sure students know and can do what is expected of them so that they perform well on accountability tests and, more importantly, are prepared for whatever academic challenges they will face.

Built in the United Kingdom, SAM Learning has been used by more than 1 million students in five countries. In every school, students demonstrated increases in achievement, with the lowest-achieving students showing the strongest improvements on standardized tests after using SAM Learning.

What is SAM Learning?

SAM Learning is a web-native tool that can be completely student-driven or used by teachers to provide specific instruction to students based on their high-need areas. With intuitive navigation, students quickly begin exploring the content within a subject area. They answer questions with an engaging drag and drop technique and immediately know whether they got each question correct. If they select an incorrect answer, they get immediate feedback and continue to work through the answer choices until they get the correct answer. With each selection, students know if they have selected the correct answer. And, when students access the Improve Activities, they get spoken instructional feedback when they select an incorrect answer. This feature is like having a private tutor for those areas where students are struggling most. This combined system of feedback helps students work through common misconceptions, inaccurate information, and incorrectly applied rules, principles, formulas, etc.

Students can elect where they want to work ─ either relative to content standards or complexity. And, with each skill identified as aligned to specific state standards and to ones that are included on the state accountability tests, students can optimize their time by focusing on the critical skills required to be proficient or advanced on their NCLB measure.

Students can also elect to allow the software to guide them through the content based on their performance. Depending on how students perform on the assessments, SAM Learning can direct the student on a path of success and increasing content complexity. This scaffolded learning experience prevents frustration, improves learning, and gives students immediate feedback.

SAM Learning presents content in fine-grained chunks. At each level of complexity, students experience content broken down into its small components and then, based on student performance, the content rolls up into more and more complex questions. This engaging interactive system with immediate feedback keeps students focused and on-task.

SAM Learning helps all students learn more. High-need students report success. High-achieving students report success. Because of the wide range of complexity and difficulty in each subject, SAM Learning can support learning for high school students who are behind grade level, on grade level, and also for students enrolled in honors or Advanced Placement classes.

SAM Learning can be accessed anywhere there is access to the Internet─ home, school, or libraries.

How is SAM Learning Being Used in the U.S.?

Introduced in the U.S. in 2008, a select group of urban high schools have participated in pilot programs to examine the effectiveness of SAM Learning. The response has been extremely positive.

Alignment to state content standards will survive the rigorous review of teachers and the scaffolded presentation of content with immediate feedback to students ensures that the learning is meaningful even for the least academic of students. Mistakes are private and feedback helps get students on the right path to learning immediately. There is no wasted time and no frustration for students or teachers.

The U.S. pilot schools are using SAM Learning in three different ways. Some teachers are using SAM during class time for students to strengthen, deepen, and broaden their knowledge and skills. Some teachers are assigning homework using SAM Learning. Others are using SAM Learning for students in make-up credit situations where the students need credits to graduate but the schools do not have faculty to provide individualized learning experiences. SAM Learning provides individualized instruction for every student.

SAM Learning is appropriate and effective for every student who wants to improve his or her understanding. And, because the student experience is private, concerns about making mistakes tends to be diminished as the only ones who know whether or not items are answered correctly are the student and the teacher. Because SAM Learning is student-driven, the student can move up or down the difficulty spectrum, thereby ensuring some positive feedback while, at the same time, removing deficits and growing knowledge and skills.

The content coverage within mathematics and science is described in three levels: foundational, intermediate and advanced. Foundational content covers what is typically included in the curriculum for grades 3 through 5. Intermediate content covers what is typically included in grades 6-8. The advanced content covers what is typically included in the high school curriculum, including Algebra II and pre-Calculus in mathematics, and biology, chemistry and physics in science.

U.S. Implementation of SAM Learning

DeWitt Clinton High School in New York City (the Bronx)

One of the U.S. pilots for SAM Learning began at DeWitt Clinton High School in the Bronx in the summer of 2008. DeWitt Clinton High School has approximately 4500 students. The administrative and instructional leadership initially had one specific goal for SAM Learning − to help students at risk of not earning scores at or above the "proficient" designation on the New York State NCLB accountability tests.

In the summer of 2008, 161 students participated in the SAM Learning pilot over six weeks. Ninety-nine students were rising tenth graders, 43 were rising eleventh graders, and 17 were rising seniors. Every student was trained on the use of SAM Learning. Fifty-two of these students actively engaged in SAM Learning, logging in for an average of 3.98 hours during school time. Thirty percent of these students worked on SAM Learning outside of school for an average of 18 minutes.

The administration and instructional leadership at DeWitt Clinton High School saw students who had literally never before been actively engaged in learning work on this technology and learn what they had not learned in traditional instructional settings. With these results from the summer program, they established a second goal and extended their SAM Learning pilot into the 2008-2009 school year.

Their second goal was to provide an effective learning tool for a group of students for whom every other method and tool used previously had failed. Included in this group were approximately 400 students who had been enrolled in high school for more than one year yet did not have enough credits to be counted as freshmen. These students seldom attended class, preferring to walk the halls. They typically came to school late, left early and were not inclined to sit in classrooms where traditional instruction has failed them for years.

During the first semester, 104 of the eligible 270 students actively engaged (more than the one hour of training time) with SAM Learning. Between September and the first two weeks in January, students logged a total of 1030 hours or an average of 9.9 hours per student. Of these, 92% were outside of school hours.

Because the struggling students at DeWitt Clinton High School were so engaged in this technology, the faculty extended access to students across the achievement continuum.

As reported in Table 1, while a combined total percent of 30.17% of these students were engaged in the foundational content ─ thereby working significantly below grade level, 40.90% were engaged in intermediate content. And 27.94% were working at the high school level. These data indicates that many students are working on below-grade level content but also that some students are progressing into on-grade high school content.

Table 1: DeWitt Clinton Engagement Time in SAM Learning by Subject and Level

Subject	Total Hours	Percentage of Overall Hours
Math Foundation	281	27.26%
Math Intermediate	410	39.77%
Math Advanced	283	27.45%
Science Foundation	30	2.91%
Science Intermediate	22	2.13%
Biology Advanced	5	.49%
Total	1031	100.00%

While the DeWitt Clinton implementation of SAM Learning initially was targeted toward students for whom traditional learning had not worked, the administration and instructional leadership quickly saw that students across the achievement range wanted to use the technology and benefitted from this experience with SAM Learning technology. The data reported in Table I indicate the level of engagement. The ultimate measures of effectiveness will be known after the New York State accountability tests are scored and reported and after end-of-year, SAT and ACT scores are known. What is promising now, however, is the level of engagement with SAM Learning across content areas and complexity of that content.

Expansion of SAM Learning into the Orange County (Florida) High Schools

The Orange County School District has 27 high schools. Of these, 8 implemented SAM Learning in November of the 2008-2009 academic school year. This research study focuses on four of these high schools: Cypress Creek, Freedom, Jones, and Ocoee.

Background information, reported on the Florida Department of Education website, on these four high schools shows that for the 2007-2008 academic year, Cypress Creek, Freedom and Jones each received a letter grade of "D" from the Florida Department of Education. Ocoee High School received a letter grade of "C".

Jones High School had the lowest percentage reaching high standards in either mathematics or science (60% and 21% respectively). The other three high schools fared better with 73-74% reaching high standards in mathematics and 30-43% reaching high standards in science.

Each of these four high schools have students who are on or above grade level and are likely to be prepared for college and the world of work. But each of these schools also faces the same challenges found at DeWitt Clinton High School, where for some students, the traditional instructional models have never worked. Each of these schools had as their first priority to intervene effectively for students who were likely to drop out, who were two or more years below grade level, and for whom traditional interventions either had not worked or were not likely to work.

Cypress Creek High School

The SAM Learning technology facilitator implemented a "train-the-trainer" model at Cypress Creek High School. Only one teacher was trained who then, in turn, trained 12 more mathematics and science teachers. No student training was conducted at Cypress Creek High School, only one teacher training for 12 math and science teachers. The implementation for the students proceeded quickly.

As reported in Table 2, between November 8, 2008 and January 9, 2009, 601 of the 3617 students enrolled at Cypress Creek High School logged into SAM Learning for 1094 hours over 2.5 months (excluding the holiday break). This is an average of 437.60 contact hours per month. Of these, 88.8 % of the hours were outside of school.

Table 2: Cypress Creek High School Engagement Time in SAM Learning by Subject and Level

Subject	**Total Hours**	**Percentage of Overall Hours**
Math Foundation	45	4.11%
Math Intermediate	22	2.01%
Math Advanced	10	.91%
Science Foundation	456	41.61%
Science Intermediate	141	12.87%
Biology Advanced	235	21.44%
Chemistry Advanced	141	12.86%
Physics Advanced	46	1.20%
Total	1096	100.00%

Across mathematics and science, 45.72% of the students are working in the foundational areas, 14.87% in the intermediate areas, and 39.42% in the advanced areas.

Freedom High School

Training was conducted in a single day for 12 groups of 60-75 students each (not an ideal training setting). As time passed, teachers and administrators began to see real student benefits and, as a result, have expanded access to all students. In addition, administrators are making SAM Learning a priority for high-stakes test (FCAT) preparation in selected classrooms.

Between November 8, 2008 and January 9, 2009, 1259 of the 2948 eligible Freedom High School students logged 2995 hours in SAM Learning for an average of 1198 hours per month. Of these, 94% were outside of school.

Table 3: Freedom High School Engagement Time in SAM Learning by Subject and Level

Subject	**Total Hours**	**Percentage of Overall Hours**
Math Foundation	84	2.08%
Math Intermediate	310	10.34%
Math Advanced	171	5 .07%
Science Foundation	548	18.28%
Science Intermediate	1275	42.54%
Biology Advanced	263	8.78%
Chemistry Advanced	213	7.11%
Physics Advanced	133	4.44%
Total	2997	100.00%

Across mathematics and science, 21.09% of the students are working in the foundational areas, 52.86% in the intermediate areas, and 26.02% in the advanced areas.

Forty-four percent of Freedom High School students participated in SAM Learning and an average of 40.50% of the hours were spent outside of school time.

Jones High School

Training was conducted for 4 groups of 10-15 students each. The Site Coordinator was initially and has remained very enthusiastic about SAM Learning and was present for every training session to encourage students in their work. As reported in Table 4, 225 of the 1106 Jones High School students logged 273 hours in SAM Learning for an average of 109.2 hours per month between November 8, 2008 and January 9, 2009. Of these hours, 9.75% were outside of school.

Table 4: Jones High School Engagement Time in SAM Learning by Subject and Level

Subject	**Total Hours**	**Percentage of Overall Hours**
Math Foundation	16	5.88%
Math Intermediate	13	4.78%
Math Advanced	3	1.10%
Science Foundation	115	42.30%
Science Intermediate	108	39.71%
Biology Advanced	11	4.04%
Chemistry Advanced	6	2.21%
Physics Advanced	<1	0.00%
Total	272	100.00%

Across mathematics and science, 48.16% of the students are working in the foundational areas, 44.49% in the intermediate areas, and 7.36% in the advanced areas.

Ocoee High School

Training was conducted over two days with 7 sessions for approximately 25 students per session. At this high school, 372 of the 2779 students logged 473 hours in SAM Learning between November 8, 2008 and January 9, 2009 (see Table 5). Of these hours, 31.6% were outside of school.

Table 5: Ocoee High School Engagement Time in SAM Learning by Subject and Level

Subject	**Total Hours**	**Percentage of Overall Hours**
Math Foundation	203	42.92%
Math Intermediate	65	13.74%
Math Advanced	37	7.82%
Science Foundation	51	10.78%
Science Intermediate	57	12.10%
Biology Advanced	46	9.73%
Chemistry Advanced	5	1.02%
Physics Advanced	9	1.90%
Total	437	100.00%

Across mathematics and science, 53.70% of the students are working in the foundational areas, 25.79% in the intermediate areas, and 20.51% in the advanced areas.

The differences in student use of SAM Learning across schools needs to be studied. However, like any innovative program introduced into an environment, there need to be champions to encourage use. Additional research should be conducted to evaluate ease of access to computers for students, inclusion of SAM learning in student assignments, and expectations and encouragement of student use on the part of teachers.

What are the Implications of SAM Learning Use in These Schools?

Most interesting are the usage statistics themselves, given that for the Florida high schools, training was held during the second week of November just as the holiday season was beginning. Typically, schools would not launch new programs mid-semester and especially not just before the holidays. The heavy use of mathematics and science foundational content also suggests that students who are enrolled in high school have learning needs in the content taught in grades 3-5. These are precisely the students whose learning needs are not been met in high school. SAM Learning allows these students to begin their learning program precisely where their needs are, in a private experience with a scaffolded learning product that ensures student success.

What do Teachers Say About SAM Learning?

Teachers who have piloted SAM Learning are re-upping for more. They are broadening the use models and expanding the base of students in the school with access to the technology. Principals are excited about what they observe. They see students taking responsibility for their own learning and apparently being successful at mastering important content. Teachers find the tool simple to use and require very little training.

What do Students Say About SAM Learning?

During a meeting with at-risk students enrolled in an afterschool program to make up freshman credits so that they can return to school as sophomores, one student said she "…got 100 for the first time" on a mathematics test. Others explained SAM Learning as a tool that breaks down the information into understandable chunks and then builds it all back up again. This description of the cognitive model behind SAM Learning is exactly appropriate. This is a student's definition of scaffolded learning that perfectly fits.

What Should You Expect When Implementing SAM Learning?

There are three distinct changes you are likely to see in students working with SAM Learning. First, more students than before will do school work and will complete their assignments. Second, students will master content and ultimately be at grade level. Third, if the UK experience can be proven in the United States, students who work with SAM Learning for at least 10 hours will show significant improvement on high stakes tests because they will be better prepared. Additional research reports will be written to confirm these findings in the U.S. based on state accountability scores.