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SunBay Digital Mathematics: A Scalable Collaboration

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Abstract

By leveraging the strengths and commitments of each of the partners, a university, a private non-profit, and a middle-sized urban school district, collaborated to impact student learning of key concepts in middle-grade mathematics and to change mathematics teaching. The project targeted middle grades mathematics because success in it is the greatest predictor of later school achievement. In well-researched learning modules, students visualize, interact with, and analyze mathematical representations connected to dynamic simulations of real-life phenomena in a curricular learning system comprising dynamic technologies, curriculum replacement units, and professional development. Through planned professional development, teachers have the technological skills, pedagogical skills and mathematical content knowledge required to engage their students in an interaction between the software, the curriculum materials, and the mathematics. Student learning gains and changes in teacher pedagogical, technological, and mathematical content knowledge provide evidence of the project's continued success after three years. Concomitant institutional changes in each of the partnering organizations attest to the project's sustainable impact.

SunBay Digital Mathematics: A Scalable Collaboration

SunBay Digital Mathematics (SunBay Math) represents a unique public-private collaboration among SRI International (SRI), the USF St. Petersburg College of Education (USFSP), and the Pinellas County Schools (PCS). Designed to address the national crisis of young people with insufficient mathematics skills unable to enter or complete college or attain high-paying, high-value jobs, this partnership has been positively impacting student learning of key concepts in middle grades mathematics since 2009. By engaging teachers in a coherent sequence of professional development, SunBay Math has also been changing how middle grades mathematics is taught.

Leveraging the strengths and commitments of each, the partners embraced the opportunity to create the first implementation site for a research-based project on middle grades mathematics, since SRI completed a year-long random-control study in Texas, with results showing learning gains for all students in the treatment group (Roschelle, et al., 2010). As a result of the success of the yearlong randomized control group research project, SRI was seeking a site in which to assess the viability of the project in a non-controlled research setting.

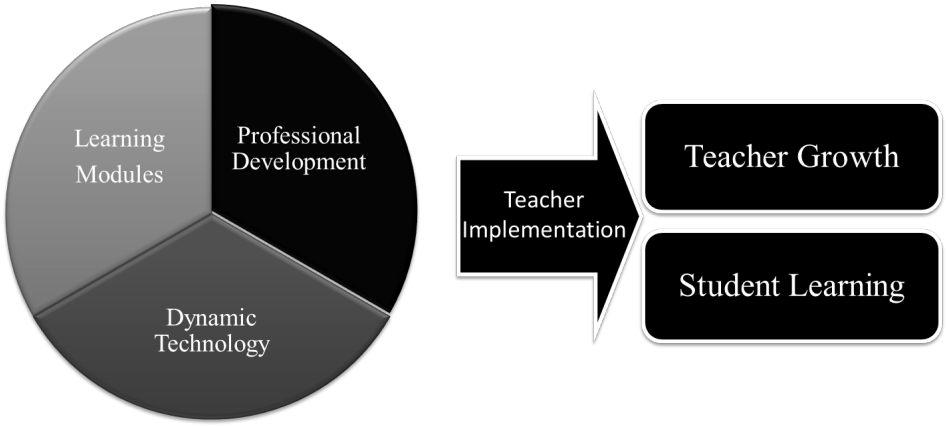
During the 2009-2010 school year, the project, now known as SunBay Math, was implemented in PCS, the 25th largest school district in the US (Sable, Plotts, & Mitchell, 2010), following a series of engaged conversations among the CEO of SRI International, the President of St. Petersburg's Downtown Partnership, the PCS School Superintendent, and the Dean of the USFSP College of Education. SunBay Math began as a pilot project with all volunteer teachers in seven middle schools with 13 teachers and 246 middle grades students. The project team modified a set of technology-based algebra materials and related assessments used in Texas to meet the needs of Pinellas County and provided ongoing professional development to all of the teachers in the effective use of these materials (Roy, Vanover, Fueyo, & Vahey, 2012). In a personal communication, SRI's CEO Curt Carlson asserted the preeminence of the digitally-enhanced mathematics project for SRI (Carlson, personal communication, 2009).

> Only by dramatically revamping how we teach mathematics can we prepare more students to succeed in and contribute to our emerging *innovation economy*. The importance of our children's education cannot be overstated; indeed, the SunBay education program is the most important endeavor at SRI.

In 2010-2011, the project developed a second track of professional development for those teachers wanting the opportunity for deeper professional growth. USFSP initiated a graduate certificate in Middle Grades Digitally-Enhanced Mathematics Education (MGDEME) to more fully engage SunBay teachers in both the pedagogy and the mathematics required to teach innovative, digitally-enhanced mathematics (Mishra & Koehler, 2006). In 2011-2012, SunBay Math was implemented in nine middle schools, with 25 teachers and more than 2000 middle school students in the Pinellas County Schools. Since its inception in 2009, the project has served 11 middle schools, 39 middle grades mathematics teachers, and more than 3000 PCS middle grades students.

What is SunBay Math?

Within a curricular activity system (Roschelle, Knudsen, & Hegedus, 2010) represented in Figure 1, SunBay Math systematically integrates curriculum modules tied to mathematics content standards, technology-based dynamic representations that deepen mathematics learning, and teacher professional development. Students build mathematical meaning by thinking critically to solve complex problems and understand rate, proportionality, and linear functions in a connected and coherent way. By leveraging technology, students visualize, interact with, and analyze mathematical representations (i.e., graphs, tables, algebraic expressions, verbal descriptions, and pictorial representations) connected to dynamic simulations of real-life phenomena. Through a planned sequence of professional development, teachers are engaged in mastering essential knowledge and skills in mathematics. As a result, when teaching the learning modules, the teachers have the knowledge and skills to engage their students in this interaction between the software, the materials, and the mathematics that lead to increases in student learning (Vahey, Roy, and Fueyo, in press).



Curricular Alignment and Replacement Modules

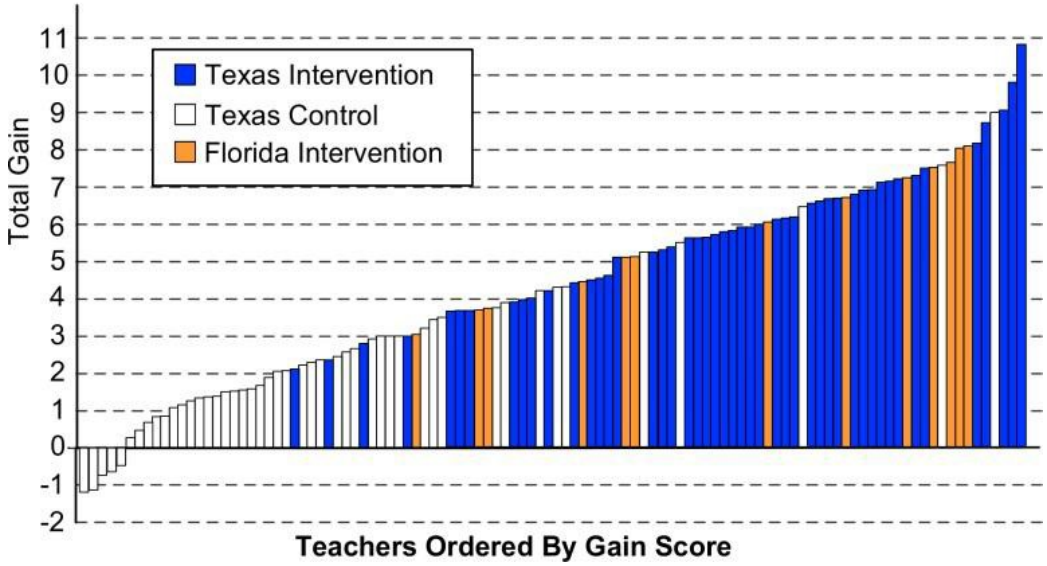
There are currently three SunBay Math replacement learning modules for grades six through eight: *Managing the Soccer Team,* a module on rate and proportionality; *Captured in St. Petersburg,* a module on geometric similarity; and *Designing Mobile Games,* a module on linear functions. The mathematics content of the units aligns with both the Next Generation Sunshine State Standards (Florida Department of Education, n.d) as well as Common Core State Standards for Mathematics (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). The methods of instruction in the learning modules align equally well with the mathematical practices called for in the Common Core. In addition, the SunBay learning modules are also carefully aligned with the FCAT 2.0 reporting categories. The project's goal is to develop two replacement modules for each of the middle grades--two for sixth, seventh, and eighth grades.

Because of the project's goal of sustainable change, the modules are designed as replacement units. SunBay is neither interested in developing nor seeking to develop a textbook series. As replacement units, the SunBay modules can be used with a district's adopted textbook series to teach mathematics in the middle grades. It is the teachers, all of whom have been engaged in extensive professional development, who will select which sections of the existing mathematics textbook to replace with the SunBay learning modules. The timing and curricular coherence is determined by the professional teacher who knows best his or her students. The project's intent is to provide well-researched and proven methods and materials and leave it up to the teachers when best to implement the modules. SunBay's well-researched learning modules and teacher professional development directly address Carnine's lament: "Education is the only profession in which its professionals are not guaranteed the effectiveness of the tools they have been given to work with" (1992, p. 13).

Pilot Results in 2009-2010

In 2009-2010, the project's pilot year, the SunBay team showed the effectiveness of the SunBay Digital Mathematics approach across a range of teachers, topics, and student characteristics in the Pinellas County Schools. The team recruited and trained 13 middle school mathematics teachers from Pinellas County, and each has had significant and ongoing participation in the program. Table 1 shows the classroom mean gain scores for all the teachers who participated in Florida, as well as all the teachers who participated in SRI's earlier successful experiment in the state of Texas. This graph shows that students of teachers using the SunBay intervention, in both Texas and Florida, to teach the key mathematical topics of proportionality and rate showed consistently higher learning gains than students in Control classrooms who were taught by more traditional means.

Table 1: The spread of mean classroom student gains shows the consistent effectiveness of the SunBay approach in both Florida and Texas



Our analysis also shows that learning gains were consistent regardless of prior math

achievement and student ethnicity, providing evidence that the SunBay Digital Mathematics materials can be effective for the wide range of students and teachers found in Pinellas County. The approach was also found to be effective for a new geometry unit developed to meet the needs of PCS. The SunBay team is currently analyzing results for 2011-2012, comprising both pre- and post-test gains and comparison scores for non-SunBay teachers and students on the state's high stakes assessment.

Sustainable Institutional Changes

Each of the partners has implemented institutional changes to sustain the impact and viability of this educational intervention known as SunBay Digital Mathematics. USFSP created a graduate certificate in Middle Grades-Digitally Enhanced Mathematics Education to serve the teachers' needs for more in-depth learning. To ensure the opportunity was available to as many teachers as possible, USFSP engaged a long-standing, community partner, the Progress Energy Foundation, to provide funding for the teachers' tuition. Since 2010, this public-private partnership continues to support the graduate certificate in Middle Grades-Digitally Enhanced Mathematics Education, the enhanced teacher development component of SunBay.

The local school district also demonstrated its institutional commitment to SunBay Math by making it one of its strategic priorities for the middle grades strategic plan. The third partner, SRI International, has invested more than a decade of research into the development of the learning modules; and SunBay remains a strategic initiative for SRI.

The partners continue to seek external funding to support the needed research to develop the remaining learning modules and evaluate the most effective teacher professional development models. Our shared goal is to develop a comprehensive "package," comprising the learning modules, the professional development, and the dynamic technology, to offer interested districts in Florida and throughout the United States. As a result of this remarkable, synergistic partnership, SunBay Digital Mathematics is closer than ever to achieving its goal.

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