COVER PAGE
Student Centered Holistic Open Online Learning (SCHOOL)

- **Contact Information**

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- **List of Participants (*Letters Attached)**

University of California at Irvine
California State University at Fullerton*
Capistrano Unified School District
Saddleback Valley Unified School District*
Saddleback College
Irvine Valley College
South Orange County Community College District
Society of American Military Engineers*

- **Application Abstract**

The Student Centered Holistic Open Online Learning (SCHOOL) website is an Online Supplemental Instruction Tool Array (OSITA); a framework that organically developed over several years using an action research methodology guided by student feedback. The SCHOOL website is open source and is a new concept modeled after the award winning Algebra2go® website developed by math faculty at Saddleback College. SCHOOL is much more extensive than Algebra2go® and includes recently developed learning resources that leverages cell phone and Smartpen technology to enhance student learning. Additionally, SCHOOL solicits input from local K-12 institutions to ensure that learning resources are developed in line with common core standards. The SCHOOL concept also includes a social component requiring regular activities that promote communication between students and teachers as well as between students and working professionals. These activities help ensure that development methodology remains student centered and relate to real world applications. Recently developed activities that promote communication are the "Week of Workshops" (an in-service for students), tutor generated content, and the formation of the Society for American Military Engineers student chapter. Content contributors to SCHOOL include students, college faculty and administrators, as well as K-12 faculty vested in common core standards. This newly developed website will host a great deal of content not limited to community college math curriculum and will support student learning both academically as well as non-academically by embedding humanistic elements into the learning resources that will promote positive student attitude and behavior conducive to student success.

- **Assurance and Signature**

"I assure that I have read and support this application for an award. I understand that if this application is chosen for an award, my institution will be required to submit, for approval by the Committee on Awards for Innovation in Higher Education, a report indicating proposed uses of the award funds and, as the fiscal agent, will be responsible for distributing funds to any other participating entities. I also understand that, if this application is selected for an award, my institution will be required to submit reports to the Director of Finance by January 1, 2018, and by January 1, 2020, evaluating the effectiveness of the changes described in this application."

Tod A. Burnett
President, Saddleback College

1-8-15
Date

CONTEXT

1. Institutional or Programmatic Goals Set by Participants – 2014-2020 institutional goals described below were born out of the 2013 institutional strategic planning processes of partnering organizations driven by a collective desire to enhance student and organizational success. These goals reflect several factors including: student need, California Community College Chancellor's Office objectives and those of the applicant college and their district, partner districts, institutional student data; and other data describing student issues and challenges, particularly historically underserved student populations (HUSP), related to enrollment, college preparedness, completion, persistence, transfer, including an overwhelming number of students having difficulty with "gate keeper" courses in math. The goals below align with priorities of the *Awards for Innovation in Higher Education* as they directly support the attainment of bachelor's degrees and support accelerated learning and progression as well as ease of transfer especially as they relate to math.

Coordinating approaches that improve student outcomes starting at the K12 level are essential to improving student success. Historically, education improvement is isolated to either K-12 or the higher education sector. The lack of coordination between K-12 and postsecondary sectors impedes successful transition between systems and diminishes educational opportunity for students. Problems related to this disconnect are noticeable in areas such as access to college-prep courses, placement into remedial college coursework, and a lack of early and timely college counseling and support. Providing linkages of support and accelerated learning at the community college and at the high school improves student success at the community college as well as BA/S attainment. It is the SCHOOL's long term goal to implement learning, strategies, and outcome data to better prepare students for success at the community college so as to improve their chances of transferring to attain a BA/S degree. Participant goals are listed below.

Institutional Goal #1 - IMPROVE STUDENT PREPAREDNESS
• **Ensure students gain foundational skills** necessary to complete college level work and achieve career goals; i**mprove progression rates of students in Math** sequence from 300 to 200 and from 200 to transfer;
Institutional Goal #2 - INCREASE TRANSFERS TO 4-YEAR COLLEGES & UNIVERSITIES
• **Establish systems to identify and support** student populations who have been unsuccessful in transferring.
• **Expand and utilize technological resources** to increase number of transfer ready students;

Programmatic Goal #1 - INCREASE MATH PASS RATES
• Increase # of students assessed at below transfer level that **pass college math within their first 2 years** (critical milestone); Develop **Online Supplemental Instruction Tool Array** to increase student's math success rates.
• Increase student success rates in math; Accelerate student's math progression rates.

How Achieving These Goals Will Help Students Succeed

The National Education Longitudinal Study indicate that of students who complete a bachelor's degree, more than 70% successfully complete credits in transfer level math during their first 2 years of enrollment.[i] Providing students with innovative support to pass college level math during this important time frame helps to ensure persistence and completion so that students successfully transfer to the UC/CSU system and obtain a BA degree.

Technology allows for innovative methods to improve the performance of students in foundational mathematic courses. A **number of researchers have reported the connection between performance in college-level mathematics and retention and graduation**.[ii] A large-scale study seeking to identify the determinants of freshmen retention found that successful completion of a first-year math course with a "C" or better, among other factors, increased the probability of re-enrolling, and reduced the chances of student "transfer, stop out, or drop out."

2. Statistical Profile of Students Served

Gender - Saddleback College records an approximate unduplicated annual student headcount enrollment of 39,822 for 2013-2014.[iii] Of these, 58% responded as female; 40% responded as male; and 2% declined to state.[iv]

Saddleback College Ethnic and Racial Categories and Other Student Populations			
Ethnicity	**Percent**	**Ethnicity**	**Percent**
American Indian/Alaskan Native	<1%	Pacific Islander	<1%
Asian	11%	Declined to State/undefined	5%
Black/African American	2%	**Student Population[v]**	**Percent**
White (Non-Hispanic)	58%	Current or Former Foster Youth	<1%
Hispanic/Latino	10%	Students with Disabilities	9%
Middle Eastern	<1%	Low Income Students[vi]	18%
Mixed Ethnicity	13%	Veterans	3.5%

Factors That Affect the Ability of Students to Succeed

Lower persistence and transfer rates at the community college disproportionately affect HUSP impacting their ability to graduate within 4 years and earn a bachelor's degree. This application focuses on the completion of transfer level math. This is not intended to minimize the influence of other factors such as peer/family pressures, previous academic achievement, lack of institutional transitional support, enrollment challenges, or economic factors.

- ***Math – The College Gate-Keeper***

Inconsistent academic standards in secondary education leave many students thinking they are prepared for college, only to discover they need remediation.[vii] Over 40% of full time four-year college students fail to earn a bachelor's degree within six years, and many never complete their education. Policies aimed at increasing postsecondary degree attainment by encouraging college enrollment are likely to be unproductive, given that students who are enrolling into college have low predicted probabilities of completion, due to their low academic preparedness – notably in math.[viii] Despite these challenges, Saddleback College completion rates across ethnicity groups have increased from fall 2009 to fall 2013 averaging an increase of 5.8%.

Course Completion Rates[ix] by Ethnicity

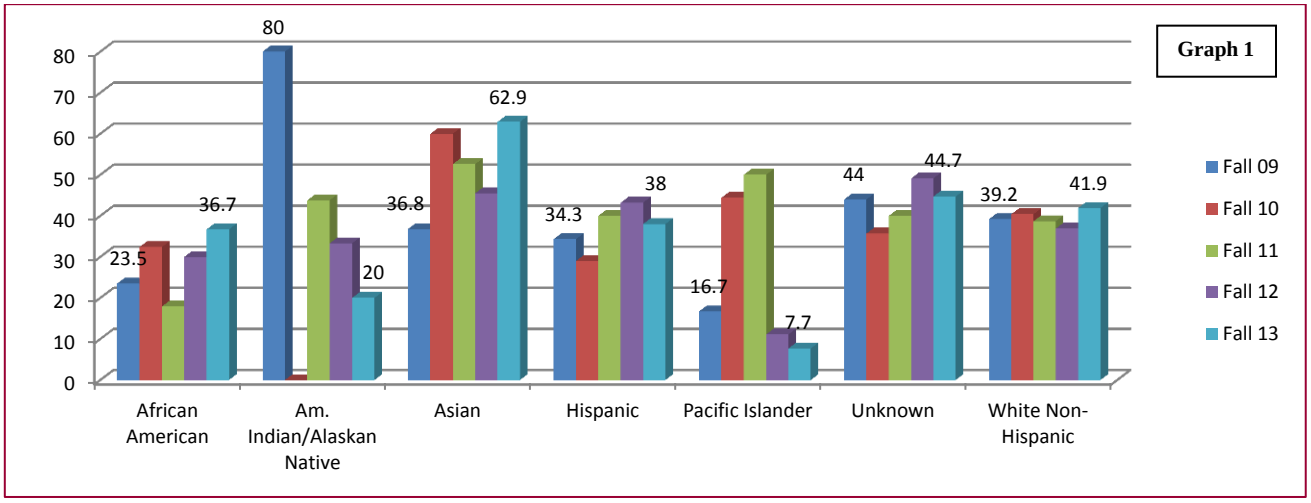
Ethnicity	Fall 2009	Fall 2010	Fall 2011	Fall 2012	Fall 2013	% Increase
African American	54.9%	58.7%	57.4%	60.1%	59.1%	**+4.2%**
Am Indian/Alaskan Native	60.9%	69.6%	62.9%	71.9%	77.3%	**+ 16.4%**
Asian	68.8%	74.7%	75.3%	77.6%	75.0%	**+ 6.2%**
Hispanic	62.7%	66.4%	67.6%	67.6%	67.9%	**+ 5.2%**
Multi Ethnicity	62.4%	67.6%	67.7%	71.2%	67.8%	**+ 5.4%**
Pacific Islander	66.2%	67.4%	58.3%	66.9%	66.5%	**+ 0.3%**
Unknown	58.1%	74.2%	74.6%	76.2%	74.3%	**+ 16.2%**
White Non-Hispanic	67%	72.1%	72.6%	74.3%	73.5%	**+ 6.5%**

Institutional changes described herein focus on math completion leading to higher transfer and B.A./S. degree attainment rates as well as cost savings to students, educational partners and the state. Community college students who complete two math courses are 19% more likely to transfer. Passing a college level course within a student's first two years is a vital point in determining student success and bachelor degree attainment. Academically unprepared students who pass college-level math are more than four times as likely to transfer as a similar student who did not.

In fall 2013, among first time Saddleback students aged 17-18, 80% of those who entered the matriculation process were placed into remedial math (math courses below transfer level). Despite

the overwhelming number of students that experience difficulties passing math, Saddleback math completion rates across ethnic minority groups have increased from fall 2009 to fall 2013.

Math Completion Rates[x] by Ethnicity – Percent



Addressing Factors that Inhibit Student Success

Below are two key practices initiated prior to January 10, 2014 to help address barriers and to achieve the goals identified in Item #1 above. Saddleback College is addressing inconsistent academic standards and lack of college readiness in math by integrating innovative approaches that show high potential for student success (especially as they relate to math) including the development of technological tools and the integration of new technologies into the learning culture of the college.

- ***Developing Innovative Pedagogical Approaches to Learning.*** An Online Supplemental Instructional Tool Array is a tool that provides students with an array of resources allowing them to create individualized learning schemes in math. A large-scale study seeking to identify the determinants of freshmen retention found that successful completion of a first-year math course, among other factors, increased the probability of re-enrolling, and reduced the chances of student "transfer, stop out, or drop out."[xi] Technology ushers in fundamental structural changes that can be integral to achieving significant improvements in productivity. Used to support both teaching and learning, technology infuses classrooms with digital learning tools, such as computers and hand held devices; expands course offerings, experiences, and learning materials; supports learning 24 hours a day, 7 days a week; builds 21st century skills; increases student engagement and motivation; and accelerates learning.

- ***Technology Supported Learning to Accelerate Progression.*** Accelerated learning focuses on increasing first time and minority student math pass rates early as possible in their college career. Doing so greatly increases student success outcomes across several categories including transfer and degree attainment. Acceleration in developmental education is a strategy to reduce the amount of time students spend in remediation and allows them to enroll more quickly in courses leading to certificates or degrees. Acceleration requires rethinking the content to be taught, in addition to the time frame in which the learning occurs.[xii] The development of a comprehensive Online Supplemental Instruction Tool Array can be used as part of an institutionalized accelerated course or enable self-directed students to accelerate their course progression by placing into higher level math courses.

INNOVATION

3. Key Practices and Systems in Place Prior to January 10, 2014

***Online Supplemental Instruction Tool Array* (PPT)**

Saddleback College math faculty developed Algebra2go® which is an Online Supplemental Instruction Tool Array (OSITA) to improve student's preparedness in math as well as increase the number of students passing college level math during their first two years at community college. This OSITA has been hosted by Saddleback College since 2006. Student performance data and feedback is continuously used to improve this online learning environment. The tool array's goal is to improve student success in math and math related disciplines by optimizing learning while simultaneously providing a means of self-preparation so students place higher on math assessments. Accelerated progression is achieved by passing math courses and fulfilling math pre-requisite requirements for STEM courses.

The pre-algebra course within Algebra2go® gives students full control of their learning experience and the opportunity to develop individualized learning schemes. Hand written lecture notes (currently being re-typed using a cursive font) provide a natural less threatening portrayal of mathematics. Worksheets that mirror video presentations promote active learning. Video presentations include both professor and student to create a unique learning experience designed to maintain focus, alleviate anxiety, and draw students into the presentation. Homework with solutions provides extra practice. Online quizzes give students the opportunity to test their skills. Currently the other courses within Algebra2go® are being expanded to include the same features as the Pre-algebra course.

The idea for Algebra2go® began in 1999 when a newly hired math faculty member began investigating the barriers which prevent developmental math students from succeeding. Finding that note taking skills presented a barrier, the faculty member began purchasing lecture notes from top performing algebra students and used these student voiced documents to guide the development of supplemental learning resources. By observing that student notes could be used to capture the mutual exchange of information between student and teacher, it became evident that this form of communication could be used as a guideline to create supplemental learning resources in the voice of the student. This approach eventually evolved into an action research methodology where student feedback functioned as the mechanism of design. The results led to the following communication model which outlines the research in action for developing learning resources for Algebra2go®.

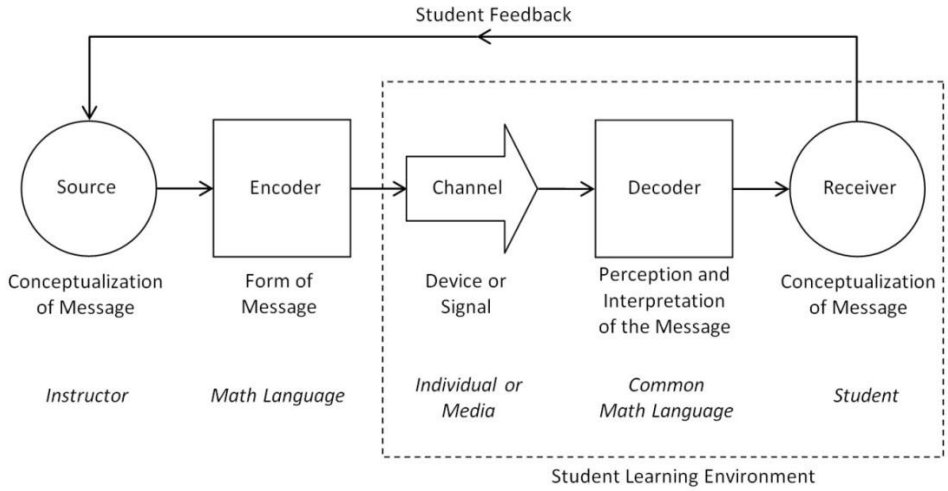


Figure 1: A common communication model modified for a developmental math classroom with examples of components and a defined student learning environment.[xiii]

Communication theory suggests there are five elements identified in the transmission of a message (Bagin, Gallagher, & Morre, 2008). These elements are a source which sends the information, an encoder which gives form to the message, a channel which carries the message, a decoder that perceives and interprets the message, and a receiver who emotionally reacts to the interpretation of the message. Figure 1 demonstrates the arrangement of these five elements and includes a descriptive labeling related to a mathematics academic classroom along with a defined student learning environment. Here we can see that once a learning resource enters the student learning environment, its author loses control of it. In this case, it becomes apparent that student affect, learning modality, as well as readiness can distort the intended message. Thus the design of one learning resource targeting a single learning modality cannot accommodate the diversity of today's student learners. Being that Algebra2go® offers an array of learning resources, students can construct an individualized learning environment that best suits their individual need.

Smart Worksheets: Contextualized Remediation with QR Code Architecture

Smart worksheets are normal worksheets with QR Codes® embedded at key conceptual points. These codes transform smartphones or tablets into tools that help students remediate specific skills within the context of a larger problem. Like traditional worksheets, Smart Worksheets are inexpensive to create, easy to deliver, and have a format familiar to students. But they also have the flexibility and interactivity of modern technology. Some of the resources that can be delivered are audio lectures, video presentations, touch-screen manipulatives, and formulas, definitions, or procedures. QR Codes® allow us to seamlessly integrate the well-established technology of worksheets, with the most modern digital technologies to create a supportive and stimulating learning experience. Smart Worksheets

Smartpen Documents: Enhanced Adobe Acrobat PDF Documents

The Algebra2go® team developed an innovative approach to enhance and humanize online pdf documents using Smartpen technology. By layering a watermark behind a pencast presentation, online pdf documents can deliver content in a manner that is more engaging to the viewer. With the included voice element, the presentation becomes more human. The Algebra2go® team uses the innovative approach to improve student success not just by providing academic related content but to introduce students to college support services. Secondly, because pdf documents allow for embedded URL's, they can provide links to college related services. Tutor Introduction Sample

Impact and Lessons Online Supplemental Instruction Tool Array[xiv] Effective Practice Award

- Significant reduction in student anxiety over math; improved motivation;
- Increased willingness to transfer to a 4 year school or pursue a STEM career;
- Sizeable increase in willingness to enroll in an online math class;
- Students with high levels of "math fear" (targeted group) found the OSITA most engaging;
- Ongoing direct student participation in the development of student aids is essential;
- Developing online environments requires contextualization and humanization;
- Faculty self-assessment is effective in improving practice;
- Multiple supportive learning environments help to ensure that the widest spectrum of learning styles is addressed;
- Based on student feedback, additional needs were identified and accommodated using new technology resulting in innovative smart worksheets and Smartpen documents;

4. Key Changes to Practices/Systems that have been Initiated Since January 10, 2014, Intended to Achieve the Goals Identified in Item 1.

GOALS - Improve Student Preparedness
Improve and accelerate progression rates of students in math
Increase number of students that pass college level math in their first two years
Develop online supplemental instruction tool array to increase student's math success rates.

Research informs how the college uses technology, curriculum, and pedagogy/andragogy to influence changes to college practices. As the amount of data, faculty self-assessment and student feedback increase, college faculty and staff are able to continuously assess what works best and what may not work as well. The speed at which changes to key approaches and systems described in Item 3 evolve is quick as practice and new technology informs improvement.

Key Changes Intended to Achieve the Goals Identified in Item (1)
Creation and Expanded Use of Smartpen Technology
Development and Use of Smart Worksheets Integrating QR Code and Touch Screen Technology
Week of Workshops (WOW)
Development of Online Tutoring Service
Creation of Student Chapter of the Society for American Military Engineers (SAME)

Creation and Expanded Use of Smartpen Technology
Changes were initiated with the intent of achieving the goals listed above by training more teachers in the use of Smartpen technology; providing a greater number of students with these enhanced learning tools; and supporting the development of best practices using this particular technology.

A great number of students struggle with college-level mathematics. According to the December 1, 2011 report of the California Community Colleges Student Success Task Force, "Of the students who enter [college] at one level below transfer-level in Math, only 42 percent ever achieve a certificate, degree, or transfer preparation." Saddleback's Smartpen program was designed and implemented with these struggling students in mind. Saddleback College's changes to initial programs implemented prior to January 2014 were expanded to include district faculty, high school instructors, students, and learning specialists with the mission of integrating assistive technology into high school and college classrooms. This consists of providing teachers and students with teaching and learning tools through a system of tutors, and teacher training.

The use of Smartpen technology will help achieve the goals stated herein and will have the greatest impact on the way teachers teach, the way students learn, and the way students process information. The Smartpen computing platform includes:

- **Software Applications** - a breadth of solutions that leverage audio/ink capture, handwriting recognition, and internet connectivity to enhance personal productivity, learning, communication and self-expression;
- **Livescribe Desktop and Online Community** - allows users to backup, search, and replay notes from their computer. Users can upload and convert notes to interactive Flash movies or PDF files and share them online;
- **Dot Paper/Dot Positioning System (DPS)** - technology that enables interactive "live" documents using plain paper printed with microdots. The Smartpen's high-speed infrared camera reads dot-patterns and enables a wide range of paper based applications;

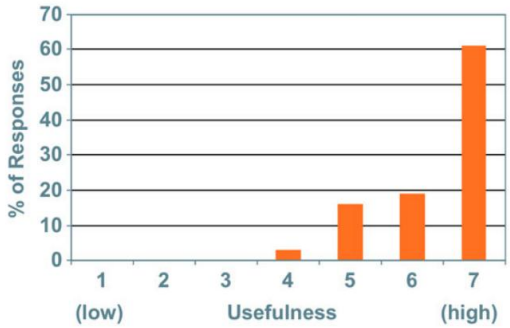
Providing students struggling in math with the highest and most effective level of intellectual and emotional support is key to helping them progress. Saddleback College's leveraging of Smartpen technology in addition to the "Online Learning Array" provides students with 3 major benefits (https://www.livescribe.com/en-us/media/pdf/education/Livescribe_K-12_Research_Support.pdf):

1) Smartpen Note Taking – Students that struggle with math often produce notes that are incomplete and ineffectively organized.[xv] This often leads to students' failure to record important lecture points. Given the information processing challenges these students face, it is not surprising that they have trouble taking lecture notes that are required to increase the effectiveness of studying – contributing to poor math completion rates and progression.

Two important Smartpen features include its built-in microphone and speaker. "Paper Replay" synchronizes what is being recorded during a lecture with what is being handwritten as notes by the student. Later, as students review their notes to prepare for a test they can tap on any written word or phrase to play back what the instructor was saying at the moment they wrote that particular phrase. The audio playback function can be sped up or slowed down. Low achieving students who have the opportunity to rehear a lecture that they attended by viewing a videotape of it are able to annotate their notes (i.e., fill in the gaps), *bringing the accuracy and completeness of the notes up to the level of the highest achieving students.*

2) Homework Support– According to the U.S. Department of Education (DOE), the average length of the school day across all grades levels is 6.75 hours. The DOE also reported that 37% of students spend 8-10 hours each week on homework, with an additional 26% spending between 5 and 10 hours per week. Given these facts, a conservative estimate suggests that homework accounts for one fifth of the time that students spend on academic activities. Yet students work on their homework in environments where teachers have no control and are not available to support their students. Since many students experience difficulties, this creates a serious issue for concerned teachers and parents.

The Smartpen provides the means for students to capture a complete record of their teacher's in-class instruction as well as their teacher's directions for homework assignments. Without requiring any modifications to standard practice or additional effort on the part of teachers, students, or parents, *Smartpen is able to provide an effective and efficient means of communication and instructional support.*



3) Accelerated Listening - A Brigham Young University study investigated the benefits associated with software used to playback classroom lecture recordings. One of the key measures of the study was user satisfaction. The usefulness of the software for the 256 participants who reported using playback is shown here.[xii] Sixty-one percent of students rated the usefulness at the top of the scale at 7 (very useful). The remaining 35% rated the software usefulness highly at 5 and 6 on the scale.

Accelerated listening technology allows for faculty to capture in-class data to assess class participation. The Smartpen provides a means for teachers to record classroom discussion – linked to a system of simple marks on a seating chart – allowing them to return to the recording later for the explicit purpose of evaluating performance. Maintaining a record of in-class participation allows teachers to share examples of in-class contributions with each student and fellow teachers to demonstrate progress toward goal attainment.

In the past, for the purposes of assessing student learning outcomes, the Algebra2go® team was videotaping students demonstrating a specific learning objective while they verbally explained their approach. This was a labor intensive process and in some cases students did not like the video aspect of observing themselves work through problems (Sample Video - **non-audio version**). With the advent of Smartpen technology, assessing student learning using this technology became much less labor intensive and eliminated the sometimes uncomfortable video component from the assessment. Students became more comfortable verbally explaining learning outcomes with the Smartpen.

The Smartpen is an integrated system including the Smartpen, dot paper, applications, and development tools designed to enhance personal productivity, learning, communication, and self-expression. Because of its low cost, ease-of-use, and built in functionality, it is naturally appealing to students and teachers. *The Smartpen is a pen sized computer with advanced processing power, audio and visual feedback, as well as substantial memory for hand writing capture, audio recording, and additional applications* (https://www.livescribe.com/en-us/media/pdf/education/Livescribe_K-12_Research_Support.pdf).

It was soon realized that students are not only consumers of information, they have become developers and authors of their own content and owners of their learning domain. Furthermore, by requiring our tutors to demonstrate their abilities using a Smartpen, we can use this tutor created content to assess the quality of their services and also use the content to train future tutors. Further investigation has led us to the idea of having students take un-proctored exams/quizzes at home using Smartpens. This provides another layer of protection against academic dishonesty by allowing online proctors to identify the student by analyzing the hand writing style and voice of the person performing the exam (sample pencast document).

Development and Use of Smart Worksheets Integrating QR Codes

Saddleback College's Smartpen program also added the use of an additional online enhanced component that includes a customized iPad application with videos plus various tools for teaching needed math concepts. "Smart" worksheets or online learning environments are integrated with the Smartpen technology along with Quick Response (QR) code architecture (pictured to the right) to provide remediation within the context of a specific type of problem to be solved. QR technology can also be used to connect with answer keys, helpful tips to solve math problems, or other text that may be helpful to the student.

Week of Workshops (WOW)

Most Community Colleges offer an in-service training program for faculty prior to the start of each semester. The event generally offers a series of short workshops that disseminates information focusing on student success, support, and retention. This provides the opportunity for professional development among faculty, staff, and administration. These events generally do not

offer workshops specifically designed for student attendees, but rather offer workshops designed for college employees to improve student outcomes.

The WOW (Week of Workshops) event takes a different approach. These workshops are specifically designed for students. Student success information is presented to students in such a way that they can see it as a viable approach to mastering course content. The structure of individual workshops vary from lecture format to facilitated student driven discussions. The topics of workshops vary from academic preparation for coursework, to non-academic preparations related to study skills, transfer requirements, familiarity of campus resources, etc.

An example of an academic related workshop is a case where pre-algebra instructors offer workshops to their registered students the week prior to the start of the semester. This workshop centers on class expectations, study skills, and the use of the assigned text. This provides the opportunity for the instructor to present themselves more as a mentor rather than just an instructor. In addition, a student driven discussion is facilitated by the instructor to discuss student concerns related to negative emotions that sometimes accompany students taking developmental math courses. Additionally, students who recently successfully completed the course are invited to participate.

In a cross-curriculum approach, math faculty meet with physics instructors to define calculus skill sets that are often weak among first semester physics students. The math faculty then offer a workshop to students entering first semester physics to review these defined skill sets. Lastly, workshops offering a review of trigonometry, graphing rational functions, and techniques of factoring is offered for students who will soon be enrolling in pre-calculus or any course in the calculus sequence.

The Week of Workshops is certainly not limited to the inclusion of math course content. Other ideas include a workshop that provides students assistance in writing personal statements required for 4-year college applications. Another is a tour of the college's Learning Resource Center. In this case, prior to the start of the semester is optimal timing since the semester has yet to begin and students can see the center in a quiet relaxed environment. In another case, a two hour orientation could be held to inform students regarding the rigor of a challenging micro-biology or organic chemistry course. Inviting local high school students to attend workshops describing the differences between high school and college academics may provide these students with insight to getting a good start on academic work here at the college. Lastly, campus support services can engage students prior to the start of the semester describing how their services contribute to student success.

Development of Online Tutoring Service

The Learning Resource Center is planning to implement a free Online Tutoring Service for students in 2015. So this year a number of software packages were explored and a protocol for online tutoring was developed. Options for integrating the OSITA into the tutoring process were explored. One potential concern is limited access to tutors during peak hours. As a means of keeping waiting students engaged, content from the OSITA could be delivered while they wait to speak live with a tutor. This would hopefully reduce the negative impact on affect caused by feelings of isolation.

Creation of Student Chapter of the Society for American Military Engineers (SAME)

In 2012, the Orange County Bridge to Engineering Program, a U.S. Department of Labor funded program at Saddleback College, initiated a partnership with the Society for American Military Engineers (SAME). This collaboration provided an avenue for equipping students with the

motivation, resources, and foundational skills to complete college level work. Industry professionals from SAME shared their work projects and linked math and science concepts in their presentations to students with a heavy emphasis on requisite study skills. Two students were sponsored in the amount of $1,250 to attend a certified SolidWorks software training. They learned how to use the solid modeling CAD (computer-aided design) software which resulted in both students obtaining summer internships at NASA Jet Propulsion Laboratory. SAME also sponsored eight students to attend the Federal Business Symposium on civil and construction engineering opportunities. One student received a SAME scholarship award of $2,500 to help with the cost of college attendance.

In 2014, as a result of these successes with SAME, SAME and Saddleback College decided to pursue the next step in *institutionalizing* the partnership through the formation of a student chapter. A three-person, cross-disciplinary faculty advisor team was identified from the Math and Physics departments and the Division of Math, Science, and Engineering has agreed to house the student chapter. SAME has student chapters located at 51 colleges and universities throughout the nation. The student chapter at Saddleback College will be the first community college chapter in SAME and most likely will be the only one in the network to have a focus on developmental coursework. This institutionalized partnership will provide the opportunity to create contextualized math and physics curriculum which will allow students to better understand and apply math and physics skills through real life problems and situations in engineering.

Impact of Most Recent Changes

Saddleback College believes these most recent changes will achieve previously specified goals and mitigate stated challenges by providing students with technologically based learning supports that are student focused, data driven, continually assessed, and updated to reflect faculty self-assessment, research, and student feedback.

Technology ushers in fundamental structural changes that can be integral to achieving significant improvements in productivity. Used to support both teaching and learning, technology infuses classrooms with digital learning tools, such as computers and hand held devices; expands course offerings, experiences, and learning materials; supports learning 24 hours a day, 7 days a week; builds 21st century skills; increases student engagement and motivation; and accelerates learning. Technology has the power to transform teaching by ushering in a new model of connected teaching. Saddleback College's technology supported learning links teachers to their students and to professional content, resources, and systems to help them improve their own instruction and personalize learning.
Online learning opportunities and the use of open educational resources and other technologies can increase educational productivity by:

- **Accelerating** the rate of learning;
- **Reducing** costs associated with instructional materials or program delivery; and
- **Better utilizing** teacher and student time.

Experts continue to be optimistic concerning the continual development of technology enhanced learning opportunities.

Much research supports our efforts of focusing on math as a major milestone to success, transfer, and degree attainment. Of students who began their studies in either a community college or a university and **completed a bachelor's degree, more than 70% had successfully completed credits in math courses during the first two years of enrollment**.[i.] One study using similar data from an earlier national survey (High School & Beyond [HS&B]) found that **completing college-level math courses increases the probability of bachelor's degree completion**.[xvi] And an analysis of data in one large public university found that **freshmen who took no math courses were five times less likely to return the following year**, and that performance in the first-year math course was the second strongest predictor of retention after first-year GPA.[xvii]

Saddleback College has led the trend in improving student performance in math courses by relying less on lecture-based teaching methods and more toward integrating student-centered learning. Such practices promote active, cooperative, and inductive learning among students as opposed to passive learning that typically takes place in a the context of a lecture. The integration of technology and mathematics instruction, particularly through the use of interactive math software, provides an effective means of engaging students with course material. Instructional software supports allow students to work through problems, receive immediate feedback on their progress, and follow guided solutions if they are unable to find the right answer.[xviii]

Clearly prescribing a supportive pathway from high school to college has also shown to greatly increase persistence, retention, and overall BA attainment rates amongst community college students.

Research is clear on the connection between high school coursework and success in college. The more academically advanced and rigorous a student's coursework is in high school, the more likely the student will in enroll and complete college. Several studies have found that the more challenging classes, such as math, a student takes in high school, the greater the probability of four-year college attendance. Importantly, when low-income and minority students take more rigorous [math] courses their chances of completing a bachelor's degree increases significantly.[xvi] College bound students who do not succeed in "high school math likely diminish their odds of bachelor degree completion by about 20%.[xix]" Simply stated, secondary mathematics is [a] predominant predictor of bachelor degree completion using two national longitudinal data sets – High School and Beyond (HS&B) and the National Education Longitudinal Study (NELS).[xvi]

Recent efforts to connect SCHOOL with Saddleback College's current High School Partnership Program, which provides an array of services and programs connecting feeder high school students with the college starting in 9th grade, will help further develop and add content and data to SCHOOL's efforts.

5. Changes that will be implemented <u>after</u> January 9, 2015, that are intended to achieve the goals identified in Item 1.

Changes to Technology Supported Learning in Math		
Update/Change	**Timeline**	**Expected Impacts**
Continue creation and refinement of smart worksheets integrated with QR code technology.	Jan. 2015 – Dec. 2017	• Additional Smart Worksheet technology content • Larger repository of content to support student learning and provide training for future tutors • Formal tutorial guidelines consisting of most effective and successful tutorial content • Increased ability to address additional learning styles and needs
Train additional tutors on the use of Smartpen technology and smart worksheets. Use Smartpen technology to **capture the talents of strong tutors before they leave Saddleback College.**	Jan. 2015 – Jun. 2015	• Additional content using Smartpen technology • Larger repository of content to support student learning and provide training for future tutors • Formal tutorial guidelines based on most effective and successful tutorial content
Integrate the OSITA into the new online tutoring protocol.	Jan. 2015 – Dec. 2015	• Delivery of content to students as they access online tutoring services.
Expand tool array to offer more resources for self-directed students to self-prepare for math placement exams.	Jan. 2015 – Dec. 2015	• Ability to address more learning styles and needs • Increased number of students assessed at college level math; decrease completion time by eliminating need for remedial math
Align tool array content with common core objectives.	Jan. 2017 – Dec. 2017	• Common understanding earlier with high school (HS) and middle school (MS) teachers/students • Increase HS student success in math (a predominant indicator of BA attainment) and # of students comfortable with technology supported resources
Increase production of recorded **college radio shows** addressing student success and math.	Jan. 2015 – Dec. 2017	• Reaching a broader local audience. • Integrating these programs into the OSITA. • Inspire academically challenged students.
Expand **Society for American Military Engineer (SAME) student chapter** to tap into the support of professional engineers for contextualized curriculum development, field trips, guest speakers, and scholarships.	Jan. 2015 – Dec. 2017	• Increased pool of students motivated and prepared for careers in STEM and transfer to a 4-year university • Create repository of math and physics curriculum contextualized within real life engineering projects to support student learning • SAME scholarships to defray cost of college attendance
Integrate program design with current HSs participating in the HS partnership program.	Sept. 2016 – Sept. 2017	• Content aligned with common core objectives and from MS through post-secondary education and university. • Increased pool of students prepared for college • Increase HS student success in math (a predominant indicator of BA attainment) • Increased parental, teacher, counselor participation in pre-existing HS Partnership Program (pipeline to college program)
Utilize SHERPA to proactively connect with students prior to the beginning of the course.	Sept. 2016 – Sept. 2017	• Coordinate targeted delivery of course materials for preparation or remediation. • Deliver instructor specific learning resources before instruction begins.
Disseminate findings and ideas with 4 year university, HS and MS teachers.	Jan. 2016 – Dec. 2016	• Increase content aligned with common core objectives from MS through post-secondary education and university. • Increased pool of students prepared for college • Increase HS student success in math (a predominant indicator of BA attainment)

Expand and Revise the Existing Tool Array

Applying the same methodology that created the original tool array, we plan to add materials to new courses such as statistics and trigonometry, as well as expand and revise current course materials. Additionally, we intend to incorporate Smartpen and QR Code technologies into the tool array. By training instructors, tutors, and students in the techniques to create these resources, we will be able to provide students with a wide range of instructional styles to choose from. The revised tool array will be utilized within the protocol of the new online tutoring system, and like the current version, will be available online for free to anyone.

Radio Broadcasts

Since 2011 we have utilized the college's radio station, KSBR, to broadcast interviews on the topics of math anxiety, applications of math, and techniques for success in math courses. This platform allows us to reach individuals in the local community who have hesitated to come back to school for fear of taking math. Recording of past shows are hosted on the BlogSpot component of the current OSITA website. The Algebra2go® Team plans to continue these shows and integrate their content into the learning resources of the tool array.

SHERPA

In the Week of Workshops students choose the presentations that they believe are most relevant to them. We would like to use SHERPAS's ability to individually contact students to deliver content that we believe is most relevant to them. Prior to the start of the semester, SHERPA (recommendation engine developed by the South Orange County Community College District) would deliver content from the tool array to prepare students for their enrolled course. Secondly, it would deliver individualized orientation and preparation from the instructor of each course.

STEM Outreach

The tool array currently includes several modules that provide contextualized instruction for non-math STEM courses. This was created working with faculty from other departments. Through our student chapter of SAME, we have access to working engineers, CEO's of engineering companies, and military officers. We plan to use this relationship to develop more extensive, real-world, contextualized learning resources that are relevant to community college students who show interest in STEM majors. SAME also provides us access to over 50 four-year college and military chapters. We want to use our relationship with SAME to disseminate these materials to a broader audience.

Articulation with Secondary Schools

In the past, the Algebra2go® team has contacted high school and middle school teachers for the purpose of training them to create learning resources. The team plans to expand on this idea in the future. Just as in college, high school math success greatly increases chances of BA/BS completion, particularly for low income students. Technology based learning, increased instructional time, and personalized approaches have been shown to improve high school algebra scores, including students who enter high school underprepared in math.[xx]

The tool array was originally created before common core standards existed. With an increasing realization of the importance of connecting secondary education with community college institutions, we plan to align the revised tool array with the common core standards so that they are more easily utilized by secondary school instructors. Once the tools are properly aligned, we plan to increase our outreach to local school districts as well as other school districts, such as LAUSD, who currently link to the OSITA.

6. How changes described in your responses to the previous items will impact the average cost to award a bachelor's degree.

Technologically enhanced teaching methods, online learning opportunities, and the use of open educational resources and other technologies all have the ability to save student and institutional resources by:

- Increasing student and faculty educational productivity by accelerating the rate of learning;
- Increasing progression rates allowing students to transfer in a shorter period of time;
- Reducing the costs associated with instructional materials or program delivery;
- Better utilizing teacher and student time;
- Technological innovations create new educational models that can transcend the time and space restraints of traditional academia. They increase productivity, generate revenue, and save students and their families;
- Faculty can spend more time on analyzing data instead of collecting and compiling it
- Students using the tool array are eligible to apply for scholarships through the Algebra2go® Foundation lessening the burden of educational costs;

All of the tools described herein are/will be registered open use resources which promote broad impact across the state and beyond. These resources allow for valuable savings by expanding choice, reducing duplication of resources related to teaching, learning, assessment and class materials. Additionally, exposure to a world-wide library of open resources inspires innovation in practice and student learning.

The Student Public Interest Research Group (SPIRG) reports that the economic benefits and potential efficiency and economic gains associated with open education learning technology are clear citing that:

- The direct cost per institution of developing high quality learning materials released under open content licenses is cheaper when shared across multiple institutions, when compared to the cost of doing this alone.
- Open textbooks will reduce the cost of study for learners. SPIRG reports that open textbooks can reduce the average amount spent by 80%.
- In a digital world where the marginal cost of replicating digital knowledge is near zero, the systemic benefits of sharing the costs of production are indisputable.

Pragmatically, savings are realized by students as a result of reduced need for extended remediation, decreased time to completion, and improved retention, persistence, completion, and transfer.

7. Risks or tradeoffs involved in the changes you are implementing and the way in which you will monitor and mitigate them. In particular, please address any potential adverse effects on student groups that are underrepresented in higher education.

At the cornerstone of the Algebra2go® team's teaching philosophy is recognizing that students are as important to the teaching process as are the teachers. With this in mind, the team's main objective is to create a learning environment that supports a variety of learning modalities while strategically dismantling barriers that exist between the student-teacher relationship.

Some students may not do well with online learning for a variety of reasons such as feelings of isolation, poor time management skills, and apprehension about communicating with peers or the instructor. At the same time, some students flourish academically in face-to-face traditional classrooms due to the absence of isolation from faculty and peers, the demand to attend class on a regular schedule, and the feeling of being part of a cohesive group. But yet online learning is an important alternative to many community college learners whose busy lifestyles demand such freedom in choosing when to learn. Therefore to develop new content for the OSITA, the Algebra2go® team's approach is to capture the advantages of the online learning environment while being mindful to the student perception of the cold and mechanical nature sometimes perceived by students learning from a computer screen. Thus, providing learning resources in this environment requires both contextualization and humanization in an effort to re-create the social-emotional experience similar to what exists in the traditional classroom setting. It is the team's **vision** that this strategy will create a bridge leading to an online learning environment that alleviates this negative student attitude. It is the team's **mission** to transform non-directed learners into self-directed learners who can succeed in both traditional and online learning environments. The ultimate **goal** is to provide a means to accelerate student progression towards educational goals.

To accomplish the team's goal, new content will be created by both faculty and students and will be evaluated for both effectiveness and quality by students enrolled in traditional classroom settings. Particularly, students that are underrepresented in higher education will be encouraged to participate.

Modules will be developed for each of the course objectives, and within each module, will be an array of learning tools designed to function individually or collectively. **This gives students full control of their learning experience and the opportunity to develop individualized learning schemes that best fits each student's individual learning style.**

For the most part, the tool array will provide resources demonstrating pedagogical approaches commonly used in texts printed by major publishing companies. But it is not uncommon for faculty to use personalized pedagogical approaches within their lectures that differ from the pedagogy demonstrated in the text assigned to the course. When students use OSITA modules where the pedagogy varies widely from what the instructor demonstrated in class, there is a high probability that a student will become confused since a common math language no longer exists. In these specific cases, instructor specific modules will need to be created to ensure that students receive learning resources from the OSITA that are consistent with the pedagogy the instructor used in class. To reduce these types of occurrences, faculty will be encouraged to mirror their lectures as much as possible to the pedagogical techniques used in the assigned text.

When using modules from the OSITA to support technical education courses or other STEM related curriculum such as Biology, Chemistry, Computer Science, and Physics, differences in the math

language sometimes arise. There are sometimes curriculum specific approaches to solving applied problems as well as field specific representations of numeric quantities. One example comes from the Allied Health field where students perform dosage calculations. When using dimensional analysis to make the calculation, the language used in the Allied Health field differs from the pedagogical approach used in most accepted math text books. In this case, modules from the OSITA will need to be modified to become field specific to ensure students can connect the requisite mathematical language used in the specific field to language learned in their pre-requisite developmental math courses. In these cross-curriculum efforts, faculty from differing disciplines will work collaboratively to ensure the modules within the tool array support field specific learning.

As secondary education institutions move toward common core standards, community colleges are being encouraged to work directly with local K-12 partners to align developmental math courses to secondary curriculum to smooth the transition for recent high school students entering college. At this point in time, most community college math professors teach using community college text books that are far from being aligned with common core. Secondly, community college math courses generally run at twice the pace of equivalent high school math courses and in accelerated courses, the pace is even faster. These differences in standards and pacing make it challenging for community college math faculty to work collaboratively to develop learning resources that can help recent high school graduates transition to college.

To mitigate this challenge, the Algebra2go® team has shared their innovative ideas with local high school teachers to start a conversation that focuses on how technology can be used to share ideas centered on the common core standard schema. With the use of Smartpens, K-12 teachers can capture their lectures on pdf documents for the purposes of creating a repository of resources to be shared with community college faculty as well as other K-12 faculty. With regards to high school students who are interested in pursuing teaching careers, these students can also use the technology to create learning resources aligned to common core curriculum for their high school peers, thereby replicating the work being performed by Saddleback College tutors. By depositing all the generated resources into shared repository, Saddleback College and local K-12 math faculty can have access to the different pedagogical approaches used at each other's institution. As common core takes hold, groups with vested interests can work collaboratively to refine supplemental learning resources so they may better support future high school graduates as they transition to college. Common Core Sample

The new SAME student chapter at Saddleback College will be somewhat problematic in that, unlike four-year institutions, the community college accommodates students that are interested in STEM fields but are enrolled in developmental math courses. **It will be a challenge to deliver engaging STEM content to underprepared STEM students. To resolve this, math faculty who are qualified to teach physics will teach conceptual physics, a physics course with emphasis on understanding concepts rather than mathematical aspects.** The math faculty will then take basic physics concepts from this course and create physics related worksheets containing mathematical calculations appropriate for each of the lower level math courses. These specialized resources will be integrated into the OSITA and shared with other interested educational institutions.

In cases where students do not have internet access, the entire OSITA can be loaded onto a memory stick and be fully functional without an internet connection. In this case, the student would only be required to have access to a working computer. Being that the OSITA will contain only content that is open sourced, there are no proprietary issues.

Sustainability

8. Key strengths and Assets for Encouraging a Culture of Innovation and Adaptability

Developmental math is an insurmountable barrier for many students, ending their dreams of higher education. To earn a degree or transfer, community-college students usually must complete a college-level math course. Some students must take as many as four developmental courses before they are considered "college ready." Recent studies report that between 60% and 70% of students placed into developmental math either do not successfully complete the sequence of required courses or avoid taking math altogether and therefore never graduate.[xxi] As such, math has become known as a "***gatekeeper***" course to college success.

For over a decade, the individuals and organizations invested in the technological tools described herein have been committed to helping students succeed in making math a "***gateway***" to higher education. The South Orange County Community College District is committed to these future changes as they have **adopted student success, math completion, and increased HUSP participation in STEM as their primary strategic objectives.** Specifically, their goals are to A) Improve Student Preparedness by improving progression rates of students in math; and, B) Increase transfers to four year colleges/universities by establishing systems to identity and support student populations that have been unsuccessful in transferring, and: C) expand and utilize technological resources to increase number of transfer ready students.

For the past three years, Saddleback College has **assertively pursued grants and partnerships aimed at increasing student success by linking efforts between K-12, the community college and four year universities with particular focus on increasing access and opportunities for HUSP and increasing the support and curricular innovations to the benefit of students.** Total grant funding awards for Saddleback College has more than doubled since 2012 from $4 million to over $8.5. Over 70% of this funding is aimed at improving student support, student success, increasing the participation of HUSP in STEM, and providing accelerated learning and completion opportunities in math via technology and contextualized learning. Recent grant awards include funding for the Trade Adjustment Assistance Community College and Career Training Grant, Bridge to Engineering, and the California Career Pathway Trust which provide for technological supports for student learning in math including contextualized learning and bridge preparation courses. As depicted above in Graph 1, math completion rates across ethnic minorities have increased steadily since fall 2009.

Recent grants, in large part, were made possible through a **history of collaboration and commitment from partnering educational institutions** as well as developing transitions and pathways from K-12 to community college to the CSU/UC system. Saddleback College and participating partners have another $7 million in pending grant applications to help achieve these objectives. Additionally, Saddleback College and participating partners have numerous memorandums of understanding in place committing to collaboration for the next 5 years.

When investigating barriers to developmental math student success, the Algebra2go® team found that financial barriers were not uncommon. To address this particular issue as well as reflect the teams commitment to student success, when the team won a $15,000 Orange County Teacher of the Year Award for its pedagogical approach to engaging developmental math students, it donated $10,000 to the Saddleback College Foundation to establish a developmental math scholarship. The donation was twice matched allowing the Algebra2go® Scholarship fund to yearly provide a total of $2,000 to developmental math students who are in need.

Saddleback math faculty has met with the department chair from our local University, UC Irvine, to discuss differences, similarities, and level of rigor in STEM calculus courses. Notable results revealed that at UCI the pre-calculus courses are taught entirely online while at Saddleback College they are only offered in a traditional format. Secondly, course offerings at UCI follow a quarter system where Saddleback follows a semester system. This collaborative discussion will continue to ensure that developed resources for the SCHOOL website can accommodate the cultural differences between the UC and Community College systems.

At the heart of the SCHOOL project is the relationship between the Algebra2go® team and the Learning Resources Center (LRC). The LRC employs student tutors who after a year or two develop valuable tutoring skills as a result of engaging a wide variety of student learners seeking learning assistance. Unfortunately, many of these well-seasoned tutors eventually transfer to four-year institutions taking their honed tutoring skills with them. Before these tutors leave Saddleback College, the Algebra2go® team will train these students to produce content for the OSITA thereby capturing their well refined abilities in the form of a learning tool. The content these tutors produce will be integrated into the OSITA and will also serve as a model to train future tutors.

All of the projects and learning tools described in this application have been **student driven and faculty facilitated**. Faculty and the original developers of these programs are committed to ensuring that future changes take place with our without award funding. As a matter of record, the Algebra2go® team project has not received any funding since 2008 but continues to expand and has earned several awards since; most notably a 2010 Sloan-C Effective Practice Award. The dedicated team will continue on with its student centered work. However, funding would allow for broader participation, accelerate updates, and surely add to the impact and breadth of the project.

Our commitment to these changes is further characterized by **inclusion of these objectives into our Student Equity Plan** (The Plan). The Plan directly speaks to student success, transfer, BA/S attainment, and the realization of goals as described in item #1 above. The plan has set specific objectives including: a) increasing access to HUSP, students with a disability, and economically disadvantaged students; b) increase amount and quality of data on completion and transfer rates of HUSP and identify barriers for course completion; c) and increase the number of students participating in SCHOOL to better prepare students before they matriculate.

A key strength for encouraging a culture of innovation and adaptability is the inclusion of student success and technology in respective strategic plans within applicant and partnering organizations. Effective planning connects institutional priorities with student needs, technological trends and state and institutional goals. Our collective planning processes are part of an overarching goal that ensures:

- Plans are consistent with district and colleges' statements of vision, mission, and goals
- Collaboration with district and college technology ensure alignment of technology initiatives with institutional priorities
- Dissemination of knowledge about technology needs and constraints
- Key institutional academic and business needs are addressed via technology

Various district plans including the District's Master Plan, District Strategic Plan, and Technology Plans all support the innovations herein.

**See Appendix F for support of student success in various plans as mentioned.

9. Strategies for engaging stakeholders and achieving commitment to the goals described in Item 1 and the changes to policies, practices, and/or systems described in the items in the Innovations section.

The **student driven and faculty facilitated** content development strategy for the SCHOOL website solely relies on student feedback and faculty participation to safeguard its expansion. **Top performing students** will participate as content creators while **struggling students** provide input to guide the design of the created content. Content will be refined semester upon semester based on a faculty analysis of student performance defining weaknesses, gaps, and common errors demonstrated by students on semester exams and quizzes. Additionally, these defined deficiencies will be used to construct "preparedness packages" to be disseminated to students prior to the start of the semesters through either the "Week of Workshops" event or through the SHERPA medium.

The "Week of Workshops" event offers faculty the opportunity to engage their students prior to the start of the semester. The event also offers the opportunity for local business leaders who employ Saddleback College students to offer workshops defining their hiring process as well as describe what they are looking for in prospective student employees. Secondly, students who have recently participated in STEM focused internships can also perform a workshop discussing the rigor of the internship and describe the expectations of student participants. The information from these types of workshops will be captured and disseminated to students through a "looking for work" section on the SCHOOL website. This is an important component to members of the SAME student chapter as internship participation within the STEM field will be highly encouraged.

In close proximity to the college is a large immigrant population where Spanish is the primary spoken language. A relatively small percentage of this adult population comes to Saddleback College as ESL students to improve work force skills. It was found that when these student were engaged in developmental math courses, their barriers to success were related to English language skills and not necessarily to math skills. To address this particular obstacle, the Algebra2go® team mirrored its English written notes in Spanish for the purposes of helping these students improve their English language skills within the language of mathematics (sample notes). This appeared to improve their likelihood of success in their developmental math courses. An unintended consequence of providing notes mirrored in Spanish is related to the fact that many of these ESL students were parents of children enrolled in the secondary school system. After completing their developmental math course, several of these adult ESL learners indicated that as they began to understand the math language in English, they developed the ability to help their children with their secondary school math homework. Beforehand this was not possible because the language barrier prevented it. Having notes mirrored in Spanish for developmental math courses will be integrated into the new SCHOOL website and local educational institutions surrounded by Spanish speaking populations will be informed of these available resources.

As common core directs community college developmental math curriculum to align with secondary school curriculum, a mutually beneficial relationship will likely develop between community college faculty and secondary education teachers. This will open the doors allowing for collaborative work between the two entities ensuring that free open sourced resources are developed, refined, and designed to support learners at both institutions.

10. Please describe how the changes described in this application will be sustained within your existing financial resources.

Once content is developed to support the math curriculum at Saddleback College, it will remain on the SCHOOL website indefinitely or until content creators replace the content with a refined version. Maintenance of the college server hosting the SCHOOL website will be the only cost to the college.

Equipment such as Smartpens will remain in the hands of LRC tutors and they will be required to become proficient in the use of this technology as part of their duties and responsibilities as an LRC tutor. Well qualified seasoned tutors would be offered the opportunity to refine content on the SCHOOL website and create new content as part of their job description. This is to ensure that smartpen documents and smart worksheets continue to evolve for many years to come. Tutors proficient in video creation will also be included in this process. An ongoing training program for LRC tutors will include tutors proficient in a variety of curriculum. This will ensure that tutors will be available to create content for any subject allowing the LRC to leverage funds from other sources to pay qualified tutors to create additional learning resources not yet available on the SCHOOL website. Such would be the case where field specific content is required.

Some career fields such as those within the Allied Health field have curriculum specific pedagogical approaches to performing calculations which may not necessarily match up with the pedagogy demonstrated in the content delivered by the SCHOOL website. In this case, new content may need to be created to ensure Allied Health students can make better sense of the skill set demonstrated in the learning resource. The LRC would provide a trained tutor familiar with the Allied Health curriculum to create Smartpen documents, smart worksheets, or video content demonstrating the desired pedagogy.

Because the SCHOOL website will be developed modular in form, its resources will continuously be repurposed to support a variety of learning environments. In terms of vocational training programs, it is not uncommon for students to be underprepared, lacking basic math skills that are required for successful completion of the program. These math skill sets range from basic arithmetic to college level algebra. For example, with automotive technology students often need to self-remediate on reading decimal numbers. With nursing students enrolled in a basic chemistry course for health pre-professionals and non-science majors, these students often require remediation with conversion calculations, the metric system, scientific notation, and logarithms. In cases like these, modules from the SCHOOL website representing these necessary skills sets would be organized and delivered to the students via the internet prior to the start of the semester. This would allow students the opportunity to self-remediate before engaging the program's curriculum.

In the long term where a funding mechanism no longer exists, the LRC tutor program would take over the responsibility of maintaining the SCHOOL website. Here students are not only consumers of information, they have evolved to become developers and authors of their own content and owners of their learning domain. This is what the SCHOOL project is all about.

Evaluation

11. Quantitative and Qualitative Evaluation

Evaluation Overview - The Online Supplemental Tool Array (OSITA) is an innovative approach designed to actualize participant's goals to improve preparedness, to increase transfers to 4-year colleges and universities, and to increase math pass rates. A robust evaluation plan was developed to assess the impact of changes described in the Innovations section of this application as they relate to the achievement of the previously mentioned goals. The evaluation will encompass a set of mixed methodological tools appropriate for understanding the program's effectiveness. This comprehensive evaluation plan aims to collect data from multiple sources, including students, higher education faculty, and K-12 teachers. The selection of data collection tools was driven by their potential ability for systematic assessment of students' progress toward each of the identified goals. The specifics of the collection and analytic process are found below.

Mixed Methods Study and Administration Procedures - The OSITA is comprised of two elements, the first of which (online supplemental instruction) significantly reduces student's math anxiety, enhance motivation, and elevate aspirations – three outcomes closely tied to the achieving the goals described in item 1. A previously developed and validated psychological inventory of students' math anxiety will be administered to students in each incoming cohort during the award timeline. The inventory, comprised of a pre- and post-randomized presentation of items will be administered to both a treatment group and a matched sample control. Through multiple administrations, this inventory represents the first of three regularly monitored quantitative measures. Other inventories will include miscellaneous measures of engagement, self-efficacy and confidence, and attitudinal items related to specific programmatic elements and academic behaviors. The second and third intermediary quantitative measures (Table 1) will include students' earned course percentage grades and persistence rate. Long term measures will include completion rates and survey follow-up. The majority of the study's evaluation inventories will be administered between the two groups, with the exception of any items related to specific programmatic elements, designed to tease out relationships with specific aspects of the intervention.

Table 1. Central Outcome Variables and Corresponding Assessment Methods

Variable Name	Assessment Method
Math Anxiety Scale	Student score on validated measure
Academic Self-Efficacy	Student score on validated measure
Course Performance	Final class grade and mathematics pass rates
Persistence	Advancement and progressive re-enrollment in college level mathematics
Completion	Transfer rate to 4-year colleges and universities

Additionally, students will be randomly selected at several points of time to participate in a semi-structured in-person interview, at which point the evaluator and research assistant will record and transcribe student's feedback regarding specific changes to technology supported learning in math (e.g., expanded tool array, refinement of smart worksheets, and SmartPen technology). Other students, in groups of 5-10, will be recruited for focus group participation.

Analytic Strategy - The study's analytic strategy will call upon a mixed methods research approach. At a level of pure description, the transfer, course completion, and reported aspirations will be inspected between and within participants. For the quantitative evaluation component, and given that the broader study design will be quasi-experimental with continuous outcomes, propensity score matching methods will be used. Propensity score matching will connect a "treated" student to one or more students in the control group by relying on a rich set of covariates. As part of the qualitative approach, data will be analyzed according to themes, assessed for breadth and depth, and coded to evaluate changes and progress toward the original goals.

12. Targets

Derivation of Baselines and Anticipated Targets - As outlined in item 11, the evaluation portion of this award explores students' outcomes across a validated inventory of math anxiety, in addition to other latent measures, a measure of course performance, and persistence. While the psychological scales will be employed as auxiliary outcome estimates geared toward a more multidimensional programmatic effect estimate, baseline figures for the remaining dependent variables are available. Figures were extracted from Saddleback College's data warehouse to construct baseline outcomes of performance and persistence, both aggregated and by subgroup. Building performance baselines was a multistep process with each element of the evaluation framework nested within Saddleback College's strategic plan and student equity plan with the longer aim of significantly reducing subgroup disparities.

We looked to forecast a baseline and target estimate for persistence. Students' perseverance and tenacity can be conceptualized in multiple ways, and so we grounded our estimation in data from the California Community Colleges Chancellor's Office (CCCCO). The CCCCO offers a college profile of students' persistence generated from three robust momentum points in students' academic lives that reflect forward scholastic movement. The three momentum points are labeled as remedial, persistence, and 30 units. As the label suggests, the remedial measure looks at the percentage of credit students tracked for six years through 2012-13 who started first time in 2007-2008 below transfer level in English, mathematics, and/or ESL and completed a college-level course in the same discipline. The persistence measure identifies the percentage of degree, certificate and/or transfer-seeking students starting first time in 2007-2008 and tracks the group for six years through 2012-2013 who enrolled in the first three consecutive terms. The last momentum measure we explored to develop a general persistence baseline was 30 units, which looks at the percentage of degree, certificate and/or transfer-seeking students starting first time in 2007-2008 tracked for six years who achieved at least 30 units. The CCCCO's Scorecard momentum measures were used to derive the baseline and target blended persistence measure by averaging the College's statistical profile of each student subgroup across the three persistence measures. At which point, the standard deviation of the blended persistence measure was calculated and 1 unit was added to the baseline percentage of each subgroup to arrive at the target persistence estimate. It should be noted that while a full standard deviation increase in persistence is used as a general benchmark for programmatic success as a result of treatment participation, this estimate is considered ambitious when contrasted with general estimates of effect size frequently used in social research. This large treatment effect projection, or target, was developed, in part, as reasonable control due to the weighting of the Scorecard's first persistence measure (remediation). The CCCCO's Scorecard estimates, baseline percentages, and target persistence measures are showcased in Tables 2, 3, and 4. While the statistical profiles differ between tables, the baseline percentages and target persistence measures are consistent across tables as they compose the blended measure.

Table 2. Percentage of students across ethnicity requiring remediation who completed a college-level course

Subgroup	Statistical Profile	Baseline %	Target Persistence Measure
African American	36.7	67.8	76.5
American Indian/Native	20.0	46.7	55.4
Asian	62.9	74.3	83.0
Filipino	13.0	57.0	65.7
Hispanic	38.0	63.4	72.2
Pacific Islander	7.7	60.1	68.9
White	41.9	64.9	73.7

*Students in remedial math starting in 2007-08 were tracked for six years through 2012-13.

Table 3. Percentage of students across ethnicity who enrolled in the first three consecutive terms

Subgroup	Statistical Profile	Baseline %	Target Persistence Measure
African American	86.7	67.8	76.5
American Indian/Native	60.0	46.7	55.4
Asian	77.6	74.3	83.0
Filipino	84.6	57.0	65.7
Hispanic	76.9	63.4	72.2
Pacific Islander	72.7	60.1	68.9
White	75.6	64.9	73.7

*Students starting in 2007-08 were tracked for six years through 2012-13 and were deemed college prepared.

Table 4. Percentage of students across ethnicity who achieved at least 30 units

Subgroup	Statistical Profile	Baseline %	Target Persistence Measure
African American	80.0	67.8	76.5
American Indian/Native	60.0	46.7	55.4
Asian	82.4	74.3	83.0
Filipino	73.4	57.0	65.7
Hispanic	75.4	63.4	72.2
Pacific Islander	100.0	60.1	68.9
White	77.3	64.9	73.7

*Students starting in 2007-08 were tracked for six years through 2012-13.

Next, we attempted to derive measures of course performance and math anxiety scale scores. Class performance in the fall of 2014 for math 7 (college algebra) was explored by students' ethnicity and fail rates were as follows: Asians (16.7%), Latino's (39.3%), other minority (10 students) (22.8%), and whites (9.6%). Just as in the blended persistence measure computation, these figures served as baseline measures and targets were set at 1 standard deviation higher than baseline (standard deviation = 12.7). The process of deriving math anxiety scale scores differed from other computations in order to harvest the benefits of the tool's publication history with the Sloan Online Learning Consortium[1] and previous empirical evidence. Based on previous findings, we expect that students receiving the math intervention will report an average decrease of 0.399 in anxiety scores. This target reduction will be tested both within groups (pre- and post-test detection) and between groups (treatment versus control).

Finally, as outlined in item 11, to further assess programmatic impact and the achievement of targets, a robust qualitative component will augment numerical interpretations. The reduction and thematic coding of qualitative data obtained through one-on-one interviews and focus groups serves both to further assess the assumptions of this evaluation framework and to potentially explain any intervening or alternative explanations to findings.

[1] The publication can be found at: http://olc.onlinelearningconsortium.org/effective_practices/online-supplemental-instruction-tool-array

Footnote/References

[i] Adelman, C. (2006). The tool box revisited. Paths to degree completion from high school through college. Washington, D.C.; U.S. Department of Education

[ii] Moore, C. and N. Shulock. "Student Progress Toward Degree Completion: Lessons from the Research Literature." Institute for Higher Education Leadership & Policy. September 2009. p. 4. http://www.csus.edu/ihelp/PDFs/R_Student_Progress_Toward_Degree_Completion.pdf

[iii]2012-13 School Year

[iv]South Orange County Community College District's data warehouse (inFORM), Fall 2013 term student enrollment data.

[v]CCCCO MIS Data Mart, November 4, 2014

[vi]Pell grant eligible students

[vii] "Transition Matters; Community College to Bachelor's Degree." Advisory Committee on Student Financial Assistance, May 2008. Page 6.

[viii] America's College Drop-Out Epidemic: Understanding the College Drop-Out Population Erin Dunlop Velez CALDER Working Paper No. 109 January 2014.

[ix] Percent complete is the percentage of courses that were successfully completed with a grade of A, B, C, Pass, Incomplete A, Incomplete B, Incomplete C, or Incomplete Pass.

[x] The percentage of credit students who attempted a course designated at "levels below transfer" in Math and successfully completed a college level course in Math within six years.

[xi] Moore, C. and N. Shulock. "Student Progress Toward Degree Completion: Lessons from the Research Literature." Institute for Higher Education Leadership & Policy. September 2009. p. 4. http://www.csus.edu/ihelp/PDFs/R_Student_Progress_Toward_Degree_Completion.pdf

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[xiv] Researchers assessed impact of tool array on student affect through 5-point Likert scale pre and post surveys as well as through open ended questions. Seventy-nine students completed both surveys.

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[xvii] Herzog, S. (2005). Measuring determinants of student return vs. dropout/stopout vs. transfer: A first-to-second year analysis of new freshmen. Research in Higher Education, 46(8), 883-928.

[xviii] *Innovative Practices for Improving Student Performance in College Level Mathematics*. Hanover Research, 2011.

[xix] Secondary Mathematics: What Maximizes College Readiness?" The Mathematics Educator. 2010, Vol. 20, No. 1, 78-21.

[xx] See John F. Pane, Beth Ann Griffin, Daniel F. McCaffrey and Rita KaramPane et al, "Effectiveness of Cognitive Tutor Algebra I at Scale," Educational Evaluation and Policy Analysis, 2013; Stephen J. Pape et al, "The Impact of Classroom Connectivity in Promoting Algebra I Achievement: Results of a Randomized Control TrialClassroom connectivity in Algebra I classrooms: results of a randomized control trial," Effective Education, 2013; Robert Balfanz, Vaughan Byrnes, Nettie LegtersBalfanz et al, "A Randomized Trial oOf Two Approaches To to Increasing Mathematics Achievement For for Underprepared Freshmen," Johns Hopkins Center for Social Organization of Schools.

[xxi] (http://chronicle.com/article//65056#sthash.1vrhCAlS.dpuf).

Appendix A – Letters of Support

CALIFORNIA STATE UNIVERSITY, FULLERTON

Office of the Provost and Vice President for Academic Affairs
P.O. Box 6850, Fullerton, CA 92834-6850 / T 657-278-2614 / F 657-278-5853

January 7, 2015

California Department of Finance
Education Systems Unit—Innovation Awards
915 L Street, 7th Floor
Sacramento, CA 95814

RE: LETTER OF SUPPORT FOR SADDLEBACK COLLEGE - AWARDS FOR INNOVATION IN HIGHER EDUCATION APPLICATION

Dear Selection Committee:

California State University, Fullerton would like to extend its support for Saddleback College's application to the California Department of Finance for their *Awards for Innovation in Higher Education*. Saddleback College, Irvine Valley College, and South Orange County Community College District have demonstrated educational excellence and a commitment to improving educational outcomes for the greater Orange County community.

The colleges in the South Orange County Community College District (SOCCCD) have a history of technological innovation that has garnered state and national attention. The District is known as a pioneer and leader in introducing game-changing technology aimed at developing systems that help support and guide students toward their goals more quickly and efficiently. Their Student Success Suite (S^3) is a construct of technological tools that assist students with the sometimes arduous task of enrollment, matriculation, registration, and academic advisement. Students are guided thoughtfully toward their goals using a focused, student-centered approach.

Saddleback College's approach to using technological tools to improve student performance in foundational math courses, for which Saddleback College faculty earned the *Sloan Consortium's Effective Practice Awards for Online Teaching*, has been recognized by the National Association of Developmental Education (NADE). Higher education research has identified a direct connection between success in college-level mathematics and student achievement, and Saddleback College's innovations have led to the development of mathematics teaching tools that can help students throughout the state to succeed in math and attain higher education degrees.

California State University, Fullerton has a long history of collaboration with the colleges in our surrounding community. Some of our most recent partnerships county-wide include the Rancho Santiago Community College District and the North Orange County Community College District.

We look forward to our continued work with colleagues throughout the region to continuously improve student success and transfer rates. If you require additional information, please feel free to contact me at (657) 278-2614.

Sincerely,

José Cruz / sm

José L. Cruz, Ph.D.
Provost and Vice President for Academic Affairs
California State University, Fullerton

SADDLEBACK VALLEY UNIFIED SCHOOL DISTRICT

25631 Peter A. Hartman Way · Mission Viejo, California 92691 · (949) 586-1234 · www.svusd.org

Board of Education
Suzie R. Swartz, President · Ginny Fay Aitkens, Vice President
Dolores Winchell, Clerk · Dennis Walsh, Member

Clint Harwick, Ed.D.
Superintendent

January 9, 2015

California Department of Finance
Education Systems Unit—Innovation Awards
915 L Street, 7th Floor
Sacramento, CA 95814

RE: LETTER OF SUPPORT FOR SADDLEBACK COLLEGE - AWARDS FOR INNOVATION IN HIGHER EDUCATION APPLICATION

Dear Selection Committee:

Saddleback Valley Unified School District (SVUSD) supports Saddleback College's application to the California Department of Finance for their Awards for Innovation in Higher Education. Saddleback College has demonstrated leadership and a passionate commitment to the educational success of the greater Orange County community. They have a history of innovation that has been recognized at both state and national levels including recognition for the development, implementation, and use of technological approaches to improve performance of their students in foundational mathematical courses. A number of research studies have shown the direct connection between performance in college-level mathematics and retention and graduation. An award to Saddleback College will help further the development and refinement of content knowledge, pedagogy, and technological tools that can be disseminated to colleges throughout the state to help ensure students succeed in math and continue to B.S/A degree attainment.

Saddleback College's district is also known as a pioneer and leader in introducing "game changing" technology aimed at developing systems that help support and guide students through the sometimes arduous task of enrollment, matriculation, registration, and receiving timely academic advisement. Their Student Success Suite (S3) is a construct of technological tools that provide personalized support systems that help students overcome a multitude of barriers essential to student success as described in item # 1 of their application. S3 continuously improves as the district seeks to mitigate or resolve several of the systemic barriers faced by students. These barriers include lack of specific academic plans and academic support; the need to provide students with information on behaviors and steps to enhance persistence and transfer; the need for on-going personalized and easily accessible information and prompting; and the lack of guidance on college enrollment process.

SVUSD has a long history of collaboration with Saddleback College. Saddleback College and SVUSD have most recently been working on their High School Partnership Program (HSPP). The HSPP seeks to improve student postsecondary performance by establishing a 360-degree partnership between Saddleback College, students, parents or guardians, and high schools, that will help students prepare for success after high school. By following recommended pathways and collaborative roles identified in the HSPP, Saddleback College can guarantee that a student will succeed in fulfilling their goals at an institution of higher learning, the workforce, or the military.

We look forward to continue working with Saddleback College as they seek to continuously improve student success and transfer rates for the students we mutually seek to serve. If you require additional information please feel free to contact me at (949) 580-3200.

Sincerely,

Clint Harwick, Ed. D
Superintendent

SAME SOCIETY OF AMERICAN MILITARY ENGINEERS

January 7, 2015

California Department of Finance
Education Systems Unit—Innovation Awards
915 L Street, 7th Floor
Sacramento, CA 95814

RE: LETTER OF SUPPORT FOR SADDLEBACK COLLEGE - AWARDS FOR INNOVATION IN HIGHER EDUCATION APPLICATION

Dear Selection Committee:

The Orange County California Post of the Society of American Military Engineers (SAME), which is a National Professional Engineering Society, would like to extend its support for Saddleback College's application to the California Department of Finance for their *Awards for Innovation in Higher Education*. Saddleback College has demonstrated educational excellence and a commitment to improving educational outcomes for the greater Orange County community.

In the spirit of the SCHOOL project, SAME and Saddleback College plan to garner support through the student chapter to provide student mentors for the Department of Defense STARBASE 2.0 Program. STARBASE 2.0 combines STEM activities with a relationship-rich, school-based afterschool environment to provide the missing link for at-risk youth making the transition from elementary to middle school. It extends a positive learning environment through a team mentoring approach which solidifies student's attachment to and engagement in STEM.

SAME looks forward to its continued work with Saddleback College colleagues to continuously improve student success and transfer rates. If you require additional information please feel free to contact me at 949-375-4084.

Sincerely,

Scott

Scott Pringle, PhD
SAME Board of Directors
College Outreach Committee.

District-wide Strategic Plan (2014-2020)
Goal 1 - SOCCCD will foster an environment characterized by creativity, innovation, respectful interactions and collaboration.
Goal 2 - SOCCCD will promote students' success by enhancing the teaching and learning environment.

District-wide Technology Plan (2014-2020)
Goal 1 - SOCCCD will remain a national leader in creative educational technology solutions.
Goal 3 - SOCCCD will continue to be a leader in technologies supporting student success and enhancing the teaching and learning environment.
Goal 4 - SOCCCD will advance its technology and data collection to better understand our community and career pathways of our students.
Goal 5 - SOCCCD will continue to strengthen institutional efficiencies through technological infrastructure.

Student Equity Plan 2014
Objective I.1. – Saddleback College will work to ensure needs of adult learners will be identified and that staffing and programming will be provided to enable this population the opportunity to meet their educational goals.
Objective I.2 - Outreach activities and materials will be designed to reach out to those individuals who are economically disadvantaged in order to support increased awareness of resources and assistance with application for financial aid opportunities. Research will provide precise data about age, employment status, ethnicity, and average income, active military and veterans, and college access points.
Objective I.4 - Further research to determine the possible reasons for the disproportionate impact for White, Non-Hispanic Students.
Objective II.1 - Saddleback College will work to ensure that the educational needs of African-American students have been researched and identified. That targeted outreach, training and other support programs have been identified and implemented to assist this population of students with the best possible learning environment that supports course completion.
Objective IV.1 - Expand student services targeted to "gap" students (those students who took one or more years off after graduating high school before entering college for the first time) and extensively publicize these services.
Objective V.1 - Students of all ethnicities showing behavioral intent to transfer will be given opportunities to meet their goals.