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Redesigning Secondary Courses to Improve Academic Outcomes Related to Higher Standards for Students with Disabilities and Other Underperforming Students

SRI International, in collaboration with the Alameda Unified School District (AUSD) and the Culpeper County Public Schools (CCPS), proposes an i3 development grant responding to Absolute Priority 3 to develop an innovation that increases the effectiveness of supports needed to improve academic achievement for students with disabilities (SWDs) in general education science (SC) and social studies (SS) classes.

A. Significance

The extent to which the design addresses the absolute priority. SWDs have made progress in terms of access to general education over the last 20 years (Blackorby et al., 2010). As a group, they spend 75% of their instructional day in general education settings with general education peers and are included in school accountability systems (Thurlow, Moen, & Altman, 2006). At the same time, SWDs continue to have unacceptable academic outcomes as measured by the National Assessment of Educational Progress (NAEP) and state accountability tests (Mullis, Martin, Gonzalez, & Chrostowski, 2004). In addition to dismal academic progress, these students often are not successful in making the transition between middle school and high school and are at a high risk of dropping out (Allensworth, 2005).

As SWDs struggle with existing learning expectations, the Next Generation Science Standards (NGSS) and Common Core State Standards (CCSS) raise the stakes even further by increasing the demands on students to develop higher-order reasoning skills. The NGSS expect students to learn science concepts and use their understanding to investigate the natural world through practices of scientific inquiry or to solve meaningful problems. In parallel, the CCSS expect students to integrate knowledge and ideas using primary sources, use causal reasoning to understand the chain of events, delineate and evaluate claims, and assess the reasoning used in arguments. Ultimately, the goal for both sets of standards is for students to learn to apply higher-order thinking. In addition, these new standards also place an increased emphasis on learning as a social experience. This emphasis raises expectations for students to become proficient in the

use of social interaction strategies required for learning from collaborative discourse expected in both in-class and out-of-class activities including online environments.

As the new standards raise the bar for all students on multiple fronts and shape learning experiences, they also create challenges for many SWDs. Many SWDs have yet to learn and master the foundational skills, learning strategies, higher-order thinking skills, and the social skills implied by the new standards. The strategies that students require for high-quality collaborative discourse as well as participation in online social communities must be taught explicitly to SWDs (Ciullo & Reutebuch, 2013; O'Brien & Wood, 2011). Research evidence indicates that SWDs are behind their peers in the development of strategies for learning, as well as for interacting appropriately in secondary classrooms (Milsom & Glanville, 2010; Nowicki, 2003). SWDs thus face challenges on several fronts. They must do better in general education content classes where the risk of failure is greatest, especially in courses that rely heavily on processing informational text, using higher-order thinking strategies, and using appropriate social interaction strategies in the learning process.

Extent to which the project would implement a novel approach. We propose a novel approach to the design and delivery of middle and high school SS and SC courses. This project will leverage the evidence on a set of well-researched interventions that have been previously tested in English Language Arts-Literacy (ELA), SS, and SC courses in which SWDs and other low performing students were included, as the foundation for the proposed development work (Boudah, Lenz, Schumaker, & Deshler, 2008; Deshler et al., 2001). Specifically, we will combine the interventions in the Strategic Instruction Model (SIM) developed by researchers at the University of Kansas Center for Research on Learning (KUCRL) with mobile technologies (e.g., laptops and computer tablets such as iPads) to produce a new learning approach that respond to the demands of learning through collaborative discourse in class and in on-line social media experiences (Bulgren & Schumaker, 2006; Schumaker, Deshler, & McKnight, 2001). Key instructional principles and features of SIM interventions will be selected and used to guide the development of high-quality units critical to student success in secondary school SC and SS

courses. The units will: (a) serve as prototypes for developing future lessons and units increase content learning of SWDs; (b) show how CCSS/NGSC can guide lesson design and implementation; and (c) show how mobile devices can facilitate collaboration during classroom and social networking learning. The selection and integration of SIM interventions to enhance units will be experimentally tested individually and as part of a suite of interventions in the unit. Finally, the enhanced units will prepared for use in wider-scale implementation efforts.

Implementation of SIM interventions require teacher direct instruction in and modeling of the learning and interaction strategies that support completion of co-constructed learning and collaborative assignments. Strategies will be taught both in targeted lessons and as part of preparation for completion of in-class assignments that require higher-order thinking, a small-group collaborative discourse structure, and the use of a mobile device to complete the task. After each small-group task is completed, a class-level discussion of the learning outcomes generated by the student groups is led by the teacher to co-construct a collective summary of learning. Each student and group, as well as the teacher, will assess the quality of learning outcomes and the strategies that were used to generate learning outcomes. Assessment data will be used by the teacher to provide both group and individual feedback to students and to set goals related to improving performance.

Some potentially important unit outcomes around which standards-informed assignments could be constructed to incorporate strategic and collaborative instruction includes: (a) building background knowledge, (b) organizing unit ideas, content, and relationships, (c) linking unit content to the world, (d) exploring and answering critical unit questions, (e) gaining insights through analogical, comparative, causal, or inferential reasoning, and (f) developing, evaluating, and supporting arguments. Once assignment outcomes are selected, SIM interventions that support attainment of those outcome will be used to inform the instructional design of the unit, the instruction needed for SWDs provided by the SC or SS teacher, the corresponding supplemental intensive instruction needed for SWDs provided by the SE teacher, and the instructional supports needed for SWDs that could be delivered through the use of a mobile

device. The design features include: (a) strategies specifically designed to address the needs of SWDs; (b) instructional procedures to be used by a SE teacher to teach SWDs how to use the strategies to complete collaborative assignments that incorporate intensive, intentional, and explicit instruction and feedback; (c) instructional procedures to be used by the SC and SS teacher in the inclusive classroom that reinforce strategies previously introduced in special education; and (d) the use of mobile devices used by both the teacher and students to share information and provide learning supports such as video models, organized resources, and explanation and cues tied to the effective use of strategies needed to successfully navigate and complete the assignment.

Once the learning and interaction strategies related to the collaborative discourse are linked to the completion of a particular type of assignment reaches sufficient fluency, the teacher can introduce the social networking application to provide opportunities for students to apply the learning and interaction strategies that support collaborative discourse in an online environment. Instruction is provided in how to adapt the learning and interactive strategies that supported in class collaboration for online collaboration. The key element we predict differentiates in-class collaboration from online collaboration will be in how students interact with those they know, and with whom they can use nonverbal and informal exchanges, from those they don't know, and must rely on a more restricted range of communication options. Therefore, the level of student familiarity within his or her most immediate social community will become the first social networking circle used by teachers. To accomplish this, the teacher and students collaboratively define the criteria for the circle and then invite individuals who meet these criteria to become a member of an "online learning circle" (OLC) established to contribute to learning about an issue that has emerged in the SS or SC curriculum and has become the basis for an assignment designed to use both in-class and online forms of collaborative discourse to complete the assignment. Exhibit 1 illustrates how teacher-mediated online learning circles support the gradual use of social media to enhance learning.

Exhibit 1: Creating the Social Online Circles of Support (SOCS) Environment

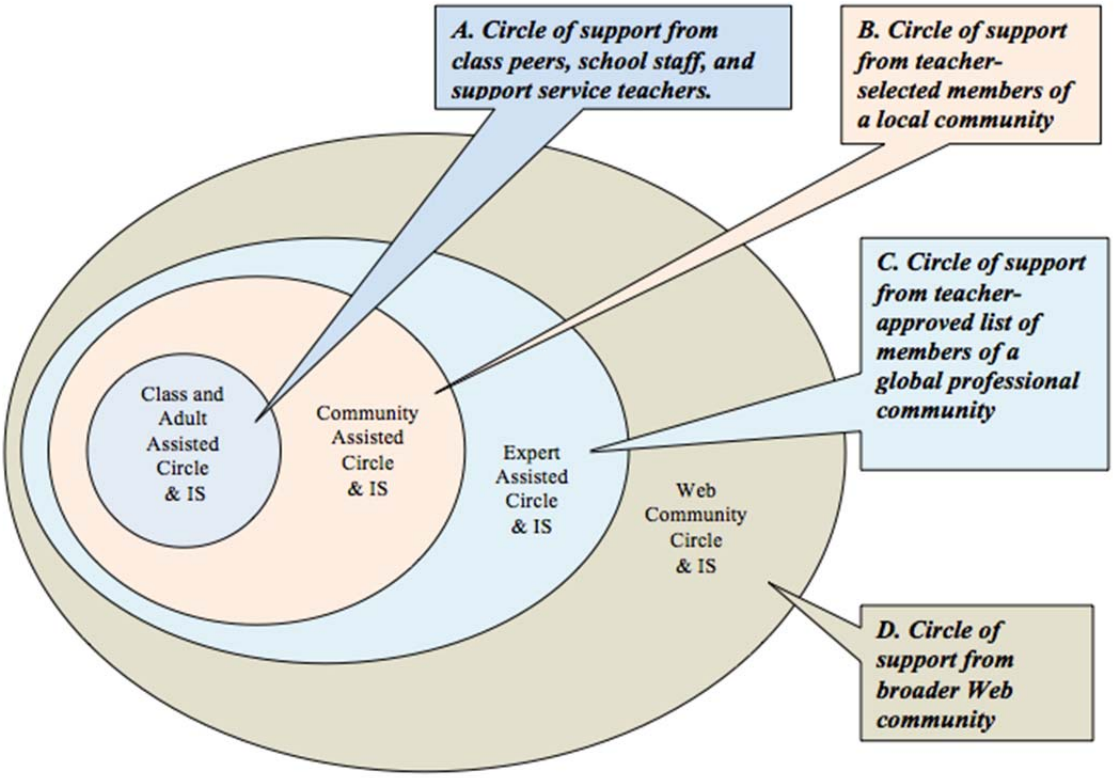

Exhibit 1. Circles of Learning Support and Appropriate Interaction Strategies (IS) to Guide the Effective Use of Social Media to Promote Effective Student Engagement and Learning

Contribution to theory, knowledge, and practice. SIM interventions are based on the application of the principles of systematic, explicit, guided instruction, mastery of critical content and the use of cognitive and metacognitive strategies related to completing academic and social tasks that improve student learning. SIM lessons provide ways to graphically highlight critical content, steps to follow in acquiring content individually and with others, and ways to monitor progress and retention (Deshler & Schumaker, 2006). These elements help students acquire increased levels of background knowledge, vocabulary, higher-order thinking skills, social skills, as well as an ability to understand, remember, and apply content to real-world situations (Hock, Brasseur, & Deshler, 2008). The considerable research base on the efficacy of these strategies makes their application to general education SC and SS courses promising (Chard, Cook, & Tankersley, 2013). Appendix J provides a summary of the empirical evidence on SIM

interventions potentially relevant to this project. Research on SIM interventions has been: (a) conducted across a large number of studies involving a wide range of students, including SWDs and other low-performing students, (b) validated using a variety of experimental and quasi-experimental research designs, (c) conducted on both individual interventions and in combinations, and (d) implemented across a diverse set of secondary schools (Chard et al., 2013; Deshler & Lenz, 1989; Deshler & Schumaker, 1986; Schumaker & Deshler, 1992; Slavin, 2008; Swanson & Deshler, 2003). Effect sizes of these studies on the SIM interventions are promising, having ranged from .20 to .59. To further leverage the power of these interventions, our i3 development effort will enhance SIM strategies through mobile devices (e.g., iPad tablets) to improve learning and collaboration. The rapid adoption of mobile devices (i.e., smartphones, iPads) by schools has opened a new arena of dynamic teaching and learning that has promise to change the ways teachers and students work to learn challenging content, as well as how these approaches can be adopted. The use of mobile devices and social networking applications has changed how young people communicate, network, and share information in their daily lives. Leveraged into the educational context, they have potential to provide real-time support and assistance, increase student engagement, personalize learning, and support higher-order thinking, as well as promote organization, collaboration, communication, and increase understanding.

Three categories of SIM interventions will be used to create the enhanced instructional units. First, SIM includes a category of interventions designed to teach students learning strategies related to how to acquire, remember, and express and demonstrate learning. For example, the design of the enhanced units will include SIM strategies for: (a) *paraphrasing/summarizing* to guide students to identify and record the main ideas and details in paragraphs (Hock et al., 2008), (b) *listening and note taking* to record information, and (c) *inferencing* that enables students to explore deeper meaning (Harris, 2007).

Second, SIM also has routines designed for use by teachers to highlight critical content. Those that will inform unit development include: (a) *curriculum content organizers* designed to structure the content and make explicit the links between the content through and across units;

(b) *concept teaching* supports comparative, causal, and analogical reasoning, and the mastery, manipulation, and application of critical vocabulary (Schumaker et al., 2001); (c) *question exploration* supports the interpretation, exploration, and answering of critical questions (Bulgren, Marquis, Lenz, Schumaker, & Deshler, 2009); (d) *argumentation routines* that help students develop argumentation skills (Bulgren & Ellis, 2012); and (e) a *routine* to ensure the design and use of high-quality assignments.

Third, the SIM includes interventions designed to teach students how to effectively communicate and collaborate. These features to be included in the enhanced units will be SIM informed social networking applications to create a package of *Social Online Circles of Support* (SOCS), as shown in Exhibit 1, that will include: (a) *organizing together* procedures that help students learn how to organize their learning environment and schedule their time, (b) *talking together* procedures that help students learn the rules of turn-taking in social exchanges, (c) *following instructions together* procedures that help students learn to work together to follow instructions, (e) *taking notes together* procedures that help students take notes and work together to check their quality, and (f) *socially wise* collaboration strategies. These SIM interventions will be central to the social networking applications supporting co-creation, sharing, and responding to fellow students, teachers and others in online communities.

The enhanced units will rely on two types of technology designed specifically for the needs of teachers and students, and are particularly beneficial to SWDs. For teachers, existing interface called the *Graphic Interactive System for Teaching* (GIST) will be used to design the enhanced units. GIST helps teachers be more effective in strategically planning and delivering content visually and in a more explicit and organized manner. In addition, GIST can be used to provide the structure and information needed to strategies. For students, mobile technologies (e.g., tablets and smartphones) can be used with applications to support learning. First, a student version of GIST linked to the teacher version will be developed for use on mobile devices, so that students have access to the same visuals and information available on their tablet that the teacher is using to present content via a smart board. By enabling the teacher and student to share instructional

plans using GIST, increased opportunities for co-construction of content and communication will be provided. Second, social networking will be used as a tool to facilitate communication and collaboration about SS and SC content. SIM interventions will be used as the basis for embedding the interaction structures intended to promote learning in the design of the applications that will be delivered through mobile technologies so that advancements can be leveraged in the use of social learning networking in the school environment.

Potential for Broader Adoption. The development and testing of these enhanced units will set the stage for broader adoption in at least three ways. First, the final versions of the enhanced units will be supplemented with implementation guidelines and professional development (PD) resources that will be iteratively developed and revised in the same manner as the enhanced units. The enhanced units then become prototypes for use in PD efforts to guide the application of the instructional practices to the design of new units. Second, PD resources for special education teachers that will provide them with the knowledge needed to prepare SWDs to use of SIM strategies and mobile devices. Third, the enhanced units and PD resources will be made available to the KUCRL's network of over 1,500 SIM professional developers for use in their work to facilitate high-quality implementation of SIM in schools and ensure that the needs of SWDs are met as part of continuous school improvement efforts.

Number of students affected and cost. The development and testing of the enhanced units will involve 10,500 students over 3 years at an average per student cost of $286 per student.

B. Project Design

Project goals and logic model. We will work with 6th and 9th grade SS and SC teachers to select two topics of critical CCSS or NGSS content that represent challenges to SWDs and other low-performing students. Two versions of the lessons in each unit will be created for each grade. One version will represent typical instruction and the second will be enhanced with SIM strategies and networking technologies. Each unit will cover about 2 weeks of instructional time including a summative assessment. For each enhanced unit, SIM strategies will be used to highlight and communicate critical content and support individual and small-group collaboration

through the use of mobile technologies. While the SIM interventions have been individually designed and validated in previous research, this project will be the first to implement co-design with educators regarding how these interventions can be integrated with mobile technologies and used interactively by teachers and students. In addition, this project will be the first to develop and evaluate the approach supporting appropriate in-class as well as online environment collaboration strategies. The learning and social interaction strategies used in social media applications and will allow the teacher to define the "online social circles."

We will address the following eight goals: (a) Researcher-practitioner design teams use Design Based Intervention Research (DBIR) methods and identify the NGSS/CCSS-aligned content for two SS and two SC topics at 6th and 9th grades. (b) Enhanced units that integrate instruction in relevant SIM learning and interaction strategies designed to promote higher-order thinking and reasoning around content to co-construct understanding through collaborative discourse. (c) Units are enhanced further by incorporating the use of mobile technologies that collect immediate assessment information and provide for teacher-mediated opportunities for students to apply interaction strategies in online communities. (d) PD modules to prepare SS, SC, and special education (SE) teachers to teach the strategies and implement the enhanced units are created by the design teams. (e) Evaluation data will demonstrate the effects of the instruction provided by teachers using the enhanced units compared to the instruction that they provided in the non-enhanced units on the learning, engagement, and motivation of SWDs and other subgroups of students in 6th and 9th grade SS and SC classrooms. (f) Enhanced units and PD modules are iteratively refined by the design teams based on the results of each study conducted each semester as well as the ongoing feedback collected teachers and students. (g) Evaluation data demonstrate the effects of the revised enhanced units when they are used with fidelity by SC and SS teachers and supported by SE teachers in a second year of implementation of the enhanced units compared to typical instruction and support provided in non-enhanced units. (h) Final versions of the enhanced units and PD modules created by the design teams based on Year 3 evaluation results and feedback from teachers and students are disseminated to key

stakeholder groups in the field to plan next-step applications.

The logic model presenting inputs, features, outputs and outcomes is presented in Exhibit 2.

Exhibit 2: Logic Model

Input	Design Features	Output	Outcomes
• Supportive district/ schools • Supportive students/parents • Collaborating researchers/ teachers • Research-based practices • Critical/difficult SS and SC enhanced units • Valid/reliable assessments	• Collaborative research study groups • Standards aligned units • SIM strategies • Mobile technologies • Embedded strategies for motivation • Highlighted critical content • Collaboration instruction for classroom and social media uses	• Enhanced units • Fidelity measures • Mobile device (e.g., iPad) collaboration supports • Structural implementation procedures • PD and coaching model	• **Proximal**: Teachers more effective in teaching SS and SC units to SWDs/low performing students; high-fidelity implementation • **Distal**: SWDs score higher on measures of content, engagement, motivation, & collaborative contributions

Settings. Alameda Unified School District (AUSD) in Alameda County, California, and has 10 elementary, 3 middle, and 2 high schools serving 10,500 students. Its racial/ethnic composition is 32% Asian, 29% White, 12% Latino, and 11% African American; 34% are socioeconomically disadvantaged, 11% are SWDs, and 38% are English language learners (ELL). Culpepper County Public Schools (CCPS), in Culpeper, Virginia, comprises 6 elementary, 2 middle, and 2 high schools serving 7,683 students. The racial/ethnic composition is 2% Asian, 64% White, 13% Latino, and 17% African American; 34% are socioeconomically disadvantaged, 10% are students with disabilities, and 19% are ELLs.

Teachers. 6th-grade and 9th-grade general education teachers of SC and SS courses and the supporting special education teachers in the AUSD and CCPS will be asked to participate in the development, implementation, integration, and evaluation of the units. We plan to recruit at least one 6th grade SC teacher and one 6th grade SS teacher from each middle school and at least one 9th grade SC and one 9th grade SS teacher from each high school, resulting in a total of at least 20 SC teachers and 20 SS teachers. The participating teachers will teach at least two sections of each inclusive SC and SS course.

At least one teacher providing instruction in an inclusive SC or SS course at each grade level at each school in each district recommended by their principals as highly qualified and effective

will be invited to participate as a member of the design team formed in the first year of the project. At least one special education teacher from each school supporting SWDs enrolled in SS and SC courses at each school recommended by their principals as highly qualified and effective also will be invited to participate as a member of the design team.

Students. Three cohorts of 6th-grade and 9th-grade students (spring 2016, fall/spring 2016–17, fall 2017) enrolled in the inclusive SC and SS courses will be asked to participate in this study. Students with and without disabilities will play a central role in the iterative design process for the units and their evaluation. Project staff will confirm the eligibility of SWDs and students judged to be under performing for the study. The criteria used in California and Virginia for eligibility for special education services used by the AUSD and CCPS will be used to confirm initial eligibility. A team of three experts in educational evaluation will review the special education identification and placement records, and further confirm eligibility and classification decisions, and if necessary, identify the need for additional screening. Students who have received a "D" or "F" in any two previously completed grading periods in SC or SS will be judged as eligible for classification as a member of the under-performing students (UPS) subgroup. Students whose grades have all been "C" or above will be judged eligible for classification as a member of the typically performing students (TPS) subgroup.

Student Input Groups. To obtain more detailed and subgroup-specific feedback, each semester Student Input Groups will be created. Subgroups of six students, comprised of two SWDs, two UPS, and two TPS, from one SS and one SC class implementing an enhanced unit, at each grade, at each school, and in each district in each the three cohorts will be asked to participate in a more intensive data collection effort related to the evaluation of the enhanced units. Recruitment will be based on recommendations from participating SS and SC teachers that nominated students who, in their judgment, best reflected the overall learning characteristics of the subgroup of students in which they participated. A total of 48 students representing eight groups will participate in each of the three cohorts. Pooling students from three cohorts from 2 districts, we estimate at least 144 students (16 SWDs, 16 UPS, and 16 TPS) will participate in this level of evaluation of the units.

Research Design

Randomized controlled trial (RCT) design. The proposed RCT will randomly assign sections within each teacher to either the enhanced units condition or non-enhanced (i.e., business-as-usual) units condition for all three cohorts of students in spring 16, 2016–17, and fall 2017 (Exhibit 3). We will follow three steps to conduct randomization. First, we will work with school class schedulers to make sure SC and SS teachers will have identical rosters so that each SC-SS section pair will have the same students.

Exhibit 3: Randomization, Unit Development, Unit Test Administration

Key Components	Spring 2016 Cohort	Fall/Spring 2016-17 Cohort		Fall 2017 Cohort
# of 6th grade teachers* # of 9th grade teachers*	AS: 4 SC/4 SS; CS: 4 SC/4 SS AS: 4 SC/4 SS: CS: 4 SC/4 SS	AS: 4 SC/4 SS; CS: 4 SC/4 SS AS: 4 SC/4 SS: CS: 4 SC/4 SS		AS: 4 SC/4 SS; CS:4 SC/4 SS AS: 5 SC/5 SS: CS: 4SC/4 SS
# of treatment sections # of control sections	32 sections enhanced units vs. 32 sections non-enhanced units	32 sections enhanced units vs. 32 sections non-enhanced units		32 sections enhanced units vs. 32 sections non-enhanced units
A & B Units taught to 6th graders for SC and SS	A Unit Topic 1st Iteration	B Unit Topic 1st Iteration	A Unit Topic 2nd Iteration	B Unit Topic 2nd Iteration
C & D Units taught to 9th graders for SC and SS	C Unit Topic 1st Iteration	D Unit Topic 1st Iteration	C Unit Topic 2nd Iteration	D Unit Topic Version 2
Unit test administration	Spring 2016	Fall 2016	Spring 2017	Fall 2017

***Across two school districts AS=Alameda Schools; CS=Culpeper Schools.**

Second, blocking on schools, grade levels, and teachers, half the sections of a SC-SS pair will be randomly assigned to the enhanced unit condition, and the other half will be randomly assigned to the non-enhanced unit condition. Therefore, students will receive double dosages of the enhanced units in SC and SS courses.

Third, we will notify SC and SS teachers about which of their course sections they will use the enhanced units and which sections will use the non-enhanced units. The SC and SS teachers in the enhanced unit condition will agree to implement the enhanced units in the treatment sections; the same SC and SS teachers will apply the business-as-usual non-enhanced units in the other sections. The contrast between students with the same SC-SS teacher is that the students receiving the enhanced units will receive a double dosage of the enhanced units in SC and SS classes and the students receiving the non-enhanced units will receive regular SC and SS instruction.

Necessary Sample Size: Power Analysis. We conducted a power analysis showing the minimum detectable effect size (MDES) for hierarchical linear modeling (HLM) analysis using

the methodology in Schochet (2008). The MDES on each unit test pooling students across two districts is 0.18, 0.47, and 0.26 for all students, SWDs, and UPS, respectively. The power analysis assumes a minimum of 32 treatment and 32 control sections, 25 students per session, 3 SWDs per session, 10 UPS per session, an intra-class-correlation (ICC) at the session level of 0.05, 49% of the variance can be explained by level-2 covariates, and 80% power.

Measures and Data Collection

Teacher and student data will be collected from a variety of sources. (a) The summative assessments created and validated for the sets of units for each subject and each grade level (i.e., one test for the enhanced unit and non-enhanced units). Therefore, our tests will be developed and validated and reliability determined for use in evaluating the eight units developed (four enhanced; four non-enhanced). (b) The checklist scores generated from the evaluation of permanent written and digital student products created from student completion of unique content assignments, content mapping, comparing and contrasting, cause and effect reasoning, argumentation, social competencies for collaborative discourse, and on formative assessments. (c) Surveys collected from students and teachers related to the use of the enhanced and non-enhanced units, the grades received. The measures to be used and the data collection process are described below (Exhibit 4). Inter-observer and inter-scorer reliability will be established before the study and will be monitored and maintained at 95% accuracy level or higher.

SOCS system analytics. As a Web application, *SOCS* will be able to capture user behaviors during system use. The system will record and enable review of keystroke patterns, mouse movements, navigation, feature use, video, and audio. It also will capture artifacts of student work on the system, including content organization, questions, arguments, comments, and dialogue. We plan to collect and analyze the following types of data: (a) total time on the system, (b) time spent on each function, (c) frequency of use of functions, (d) order of use, and (e) student work. In addition, we plan to embed content tests in the system for efficient assessment of learning.

Teacher feedback form. We will develop a form that records implementation of the content and instructional practices associated with each unenhanced and enhanced unit. Each activity in a

Exhibit 4. Sources of Data and Relevant Outcomes

	SOCS System Analytics	Teacher Feedback Form	Teacher & Student Interviews	Class Observa-tions	Student Think Alouds	Teacher & Student Surveys	Formative Assess-ments and Assignments	Science Content Tests	Social Studies Content Tests
Use of SOCS Environment	X	X	X	X		X			
Perceived usability of SOCS environment	X	X	X			X			
Quality of instructional practices related to SIM learning and interaction strategies	X	X	X	X					
Comprehension of SIM learning and interaction strategies	X		X		X				
Quality of in-class collaborative social exchanges & discourse	X	X	X	X		X			
Quality of out-of-class SOCS social exchanges & collaborative discourse	X					X			
Perceived usability of enhanced unit practices and the SOCS environment	X	X	X			X			
Quality of formative assessments and assignments	X	X				X	X	X	X
SC and SS learning	X	X	X			X	X	X	X

unit will be listed, with a place for a teacher to comment and a checklist of critical behaviors. This measure will serve as a feedback tool from the teacher's perspective on implementation of the SIM learning and interaction strategies and the instructional activities.

Classroom observation checklists. Both teacher and group observation checklists will be used to measure the quality of implementation of the learning routines. Observers will use previously developed SIM checklists to record how well instruction provided for each unit reflects accurate implementation of the SIM learning and interaction strategies. The teacher observation checklists also will be a primary means of measuring intervention and implementation fidelity across the Years 2 and 3. A checklist to record the discourse features observed will also be used to assess the intensity and quality of classroom participation and contributions. This measure will include: (a) counts of students participating; (c) counts of vocabulary words relevant to the learning routine; (b) the frequency and quality of teacher models, explanations, and prompts; and (d) the frequency and quality of student explanations.

Teacher interviews. Using a teacher interview guide, we will interview each teacher at the end of each unit and record comments. Standard questions will include: What worked well? What challenges did you encounter? What suggestions for improvement do you have? Overall, how important do you believe the instructional practices, strategies, and content to be? For which students did the unit work well? Not so well? How is this instructional approach different from what you've done in the past?

Student interviews. Observers will use a student interview guide to interview and record the comments of the students in the Student Input Groups regarding their feelings, attitudes, and perceptions about the enhanced units and to identify any challenges or barriers in the instructional environment that impeded learning.

Strategy-use think-aloud. Think-aloud protocols will be designed and used to determine students' acquisition of the strategic steps and application to the higher order routines for each unit (Ericsson & Simon, 1993; Hanna, Risden, & Alexander, 1997; Kucan & Beck, 1997). This type of ongoing feedback from student think-aloud interviews will enable us to determine how students' approaches to learning higher-order reasoning skills related to collaborative discourse in SS and SC both during in-class activities and the SOCS environment and how students' strategic thinking changed throughout the year. Each of the students in the Student Input Groups will be prompted to do a think-aloud after completing each unit.

Teacher and student surveys. Participating teachers and the six sampled students in each SS and SC class will be surveyed yearly to ascertain their perceptions of the enhanced units and the SOCS environment, including their perspective on the feasibility and usability of the SOCS environment, comprehension of the learning and interaction strategies, and usefulness of the designs for co-constructing knowledge through collaborative discourse.

SC and SS content tests. A core outcome is the degree to which students develop a deep understanding of challenging SC and SS content via the collaborative discourse promoted by in-class enhanced instructional practices and their participation in the SOCS environment. Similar to the assessments used by Bulgren and colleagues (2013), the design team will create unit end-

of-unit tests aligned with unit formative assessments and that cover each unit's core concepts, vocabulary, and relevant documentation. Our external evaluator, Leaders Network, will oversee ensure that items are juried by content experts and will conduct a validation study to ensure that the tests meet technical adequacy standards set by the What Works Clearinghouse.

Teacher and student demographic data. At the beginning of the project, teachers will complete a profile of their teaching credentials and experiences (e.g., level of education, years of teaching experience, degree held, certification, race, ethnicity, gender, years at current school, and type and number of courses taught). From school or district administrative records, we will gather student data on age, grade, school, gender, race/ethnicity, free/reduced-price lunch status, individualized education program (IEP) goals and objectives, disability category, reading achievement scores, other available achievement scores, and daily attendance.

Project Activities

Year 1 Activities. The first year of the project will entail: (a) developing the practitioner/ researcher/expert design teams; (b) collecting observational and survey data on current teacher instructional practices and uses of technology in targeted classes, (c) targeting the content topics aligned with state standards that require comprehension by using higher-order thinking outcomes and appropriate SIM learning and interaction strategies; (d) constructing and validating the unit tests for each grade and content area; and (e) adopting and modifying the appropriate mobile technologies. At the end of Year 1, 16 sets of units (i.e., one fall unit and one spring unit for both SC and SS at each grade level, 6th and 9th) and formative and summative assessments will be designed for use across courses. One set of units will be targeted for implementation and evaluation starting in the Spring of 2016 and the second set starting in the Fall of 2016.

A key feature of Year 1 activities is the co-development of the units by researchers and practitioners. Design teams will use a type of DBIR methodology in which researchers and practitioners cooperate to identify SS and SC topics, interventions and outcomes aligned to the CCSS and NGSS. Design teams in both school districts will collaborate with SRI researchers to create four SS units that will serve as the typical or business-as-usual condition, and four units

enhanced with SIM strategies and technology that will serve as the treatment condition.

Tests for each unit will be developed by teams representing content expertise in SS or SC, CCSS and NGSS standards, secondary school curriculum design, secondary school teaching experience, special education and test development.

The team will be asked to organize the content of the ten topics into approximately eight daily lessons requiring daily teacher direct instruction of critical information and that is reinforced by an in-class application of the learning activity and individual and team formative assessments aligned with a unit summative assessment. The formative assessments will consist of: (a) end of class exit slips, (b) completion of assignments, (c) completion of graphic organizers requiring higher-order thinking strategies, and (d) individual and team completion of the answers to the critical questions posed for each unit. The students participating in the enhanced unit will complete all activities and assignments electronically using the mobile devices and students completing the typical instruction units will use traditional paper/pencil formats.

Summative assessments will be developed by teams representing content expertise in SS or SC, CCSS and NGSS standards, secondary school curriculum design, secondary school teaching experience, special education and test development using standard measurement development procedures. In the first year, the content validity and item reliability will be determined, so that the test can be used with confidence during the Year 2 and 3 studies. To confirm content validity, team members representing social studies and science disciplinary expertise will confirm that the content and completion of all assignments, tasks, and materials support the mastery of CCSS/NGSS aligned outcomes. To collect data on the reliability of the test items, 5 teachers will be recruited to teach the lessons and administer the tests to their classes during Year 1. We anticipate that at least 100 students will participate in the validation of each of the unit tests. Student responses to the test items will provide data to establish item reliability. Item equivalence will be calculated, and the test will be split so that pre- and post- tests are created to validly and reliably measure changes in student learning as a result of exposure to the units.

Year 2 Activities. The SS and SC units will be evaluated by the participation of teachers

teaching at least two sections of the same course at each of 6th and 9th grades in each school. Each section of each teacher's course will be randomly assigned to either the "typical" or non-enhanced unit condition or to the "treatment" or enhanced unit condition. The evaluation of the first set of units will be conducted in the spring of 2016 with the first cohort of 6th and 9th grade students. Data collected from the spring 2016 study will be analyzed and be used to finalize the second set of enhanced units. The second set of units will be implemented and evaluated in the fall of 2016 with a second cohort of 6th and 9th grade students.

Each intervention will require a 30- to 45-minute content pretest that will be administered to students outside of class time by project staff in order to limit the amount of in-class testing time. The units will be delivered over nine 45 to 50 minute periods. The content posttest will require 30 to 45 minutes at the end of the unit.

This design was specifically selected because it provides the greatest degree of flexibility for school schedules and ensuring the participation of the greatest number of teachers and students in the iterative development and evaluation process. However, there are several issues that should be noted. First, students at each grade level are likely to experience different levels of exposure to the enhanced units or the typical units because they are enrolled in either one or both of the SC and SS courses receiving one of the conditions. Therefore, some students may benefit from instruction in some of the enhanced unit elements in one course and apply these elements in a typical course. To address this concern, we will determine the degree of overlap in the participation of students in each type of unit across sections and take this information into consideration in the analysis of results and the design process.

Second, this design uses teachers as their own controls. As a result, it may be difficult for teachers to withhold instruction included in the enhanced units from students their typical unit. Observations will be conducted in both sections to document the degree to which instruction expected in typical and enhanced units is provided and the degree to which practices from the enhanced units overlap with those in the typical units. However, one variable that can be controlled is the use of technology. The enhanced units will use technology and the use of

mobile devices as a key tool for student participation of all in-class and out-of-class work; the typical units will *not* include the use of technology. However, any contamination of the intervention to the typical condition will be assessed and included in the implementation data and considered during analysis and reporting.

During the fall of 2016, data collected from the spring and fall will inform the revisions that needed to prepare the enhanced units and PD modules for spring 2017 evaluation activities.

Year 3 Activities. In the spring of 2017, an evaluation of a revised version of the first set of units will be conducted. The teachers will be provided with PD and coaching on the revised instructional procedures. In essence, the spring 2017 evaluation will involve the evaluation of the first set of enhanced units, but as the second implementation of enhanced units with the same teachers and students. Therefore, a significant advantage of using the same teachers in the development evaluation is that the teachers will have multiple opportunities to implement versions of the enhanced units, provide feedback, and play a greater role in the final design.

However, the second cohort of students who received instruction in the enhanced units in the fall semester in each of their SC and SS classes will have been exposed to the SIM strategies. Therefore, these students should be more familiar with the strategies and should be able to apply the strategies to new units taught in the spring. However, we will not be able to control the effects of previous exposure to the enhanced units. To address this issue, we will collect pre- and post test data on students recall of strategies taught the previous year. Therefore, one of our research questions will be to evaluate the effects of the double exposure to the enhanced units in both SC and SC courses. However, in the fall of Year 3, a third cohort of 6th and 9th grade students who have not had previous exposure will participate, so the effects of previous exposure will not be an issue. However, 6th and 9th teachers will continue to gain implementation experience with the enhanced units. In spring 2017, the enhanced units will have undergone 3 implementation and revision cycles across 2 cohorts of students to inform revision. Finally, the second set of revised enhanced units will be tested with a 3rd cohort of students in 2017.

Year 4. Activities. The evaluation of the enhanced units will be completed in the fall of

2017. Final project activities for spring 2018 include finalizing the enhanced units, PD modules, and any support materials, dissemination, and preparing manuscripts for reports and articles.

C. Management Plan and Personnel

Overall project oversight will be the responsibility of Drs. Keith Lenz, Jose Blackorby, and Ellen Schiller of SRI in collaboration with Terri Elkin of AUSD and Angela Neely of CCPS; all are experienced in managing development studies. They will be supported by SRI development, data management, programming, and research staff. The external evaluator, Leaders Network, will be responsible for developing the content tests and collecting and analyzing evaluation data. The AUSD and CCPS administrative team will consist of a project director, and SC, SS, special education, and technology managers. Supporting this work will be external consultants who are experts on SIM, GIST, the iPad, and social networking applications.

Matching Funds. Top SRI leaders will be dedicated to securing the required matching funds. Velvet Bridge, LLC, co-owned by Dr. Lenz and manufacturer of GIST, would like to provide a portion of the match to extend project impact and build school capacity via an in-kind donation (Appendix G). A disclosure of Dr. Lenz' private interest is included at Appendix J.

B. Keith Lenz, Ph.D., Proposed co-Principal Investigator (26%, yr. 1; 22% yrs. 2-4) will provide overall leadership to the project and will oversee all development activities. Dr. Lenz is a Senior Researcher in SRI International's Center for Education and Human Services (CEHS). Dr. Lenz has over 30 years of experience in innovative research, development, and training projects to improve instruction and outcomes for students with disabilities. He has contributed to the development and validation of the Strategic Instruction Model, and the Content Enhancement Routines for use in secondary schools. He has guided research initiatives on adolescent literacy reform initiatives and the use of technology-enabled instruction. He has held leadership roles on ED-funded projects on Fusion Reading, the Content Literacy Continuum (CLC), and the Institute for Academic Access, and has created software to improve accessibility of general education content for SWDs and written over 70 articles.

Jose Blackorby, Ph.D., Proposed co-Principal Investigator (13%, yr. 1; 11%, yrs. 2-3;

3%, yr. 4), will assist Dr. Lenz in the oversight of all development activities. He brings more than 25 years of experience designing and managing large-scale projects of national significance in general and special education. He has held leadership roles in development, research, and evaluation. Dr. Blackorby has made important contributions in the areas of technology supported educational tools (NSF funded Dynabook, Intel Reader), experimental evaluations (I3 Evaluation of Collaborative Strategic Reading, Michigan Striving Readers), and accountability assessment for students with disabilities (NCSC, NSAA).

Ellen Schiller, Ph.D., Proposed Research Director (15%, yrs. 1-3; 7% yr. 4), manager of the Disability Policy Program in SRI's Education Division, has over 30 years of research experience focused on instructional interventions for youth at risk of poor school performance, RTI implementation, and program evaluation. As a Principal Investigator, she leads large-scale experimental and descriptive studies (e.g., Study of IDEA Implementation and Impact, Impact Evaluation of RTI Practices, Impact Evaluation of Fusion Reading) and contributes to policy research with analyses of national datasets (e.g., SEELS).

Additional SRI Staff. Dr. Xin Wei, a senior quantitative analyst at SRI, will be lead analyst. Dr. Wei has extensive experience in longitudinal data modeling and experimental designs. She currently directs quantitative analysis of three large ED-funded RCTs investigating the effects of a reading intervention program, an early intervention program, and a teacher-training program. **Andrew Young**, is program manager for SRI International's Center for Software Engineering. He has extensive experience in software computer engineering; product development; and information technology. He will coordinate communication between the software engineering tasks and the design teams. **James Klo** is a Senior Software Engineer, and will lead the technology development efforts. He specializes in working with multidisciplinary teams to design, implement, and disseminate innovative learning technologies.

School Collaborators: Both the AUSD and CCPS have certified SIM Professional Developers which gives them increased capacity to support the proposed innovations.

For the AUSD, **Terri Elkin,** the Director Student Achievement & Assessment**,** provides

leadership in the AUSD for innovation and development and has successfully executed past projects of similar magnitude. She will oversee the development and implementation activities at AUSD. **Steven Fong**, Director of Teaching and Learning, manages the implementation and support of AUSD instructional programs. He will review the work of the AUSD administrative team to ensure that the work completed for this project aligns with the other instructional programs in the AUSD. **Susan Mitchell** oversees the coordination of services provided to students with disabilities in AUSD and will assure that project activities align with AUSD special services.

For the CCPS, **Angela Neely,** Executive Director of Special Education, oversees the coordination of services provided to students with disabilities in CCPS. She will oversee the development and implementation activities for CCPS. E.G. Bradshaw, Principal of Eastern View High School, will oversee the alignment of project activities with CCPS instructional goals.

An administrative team will be created in the AUSD and the CCPS that will meet monthly to ensure that the work completed in the design teams aligns with the districts goals. The administrative team will consist of a Project Director and staff members consisting of SC, SS, special education technology instructional managers, and an administrative assistant. Half-time SS and SC teachers will (a) work with SRI and the KUCRL staff during the development process to assist in the design of the units, (b) provide PD and prepare SS and SC teachers to deliver the initial versions, (c) assist in unit revision, and (d) assist in data collection.

Professional Development and Coaching. PD is planned for the summer and as part of follow-up and coaching activities on revisions to the enhanced units throughout the school year.

KUCRL's Jan Bulgren, Ph.D., Associate Research Professor at KUCRL, will oversee the integration of SIM strategies into the units and will contribute to intervention design, PD activities, data collection and analyses, and written reports. She has directed numerous grant projects, has experience in research on SIM and has been principal investigator for numerous federally funded projects over 20 years. **Jim Ellis,** is an associate professor in science education and has worked for 2 years as a program officer at the NSF. He will serve as the science expert on this project**. Joe O'Brien,** an associate professor in middle/secondary social studies, joined KU's

Curriculum & Teaching will serve as the social studies expert**.**

Leaders Network will serve the role as external evaluator and will be responsible for evaluating the development process, analyzing the test validity and reliability data, SC and SS assessments, and collecting and analyzing the evaluation data. **Dianna Lawyer-Brook, Ph.D.,** the Principal Evaluator, is senior researcher of Leaders Network. She has worked in project evaluation and research for over 25 years, focusing on high-risk students, instructional technology, and data-based instruction. She is currently working on an i3 validation project.

Consultants. Dr. Jean Schumaker, a co-author of the SIM, and developer of the interaction strategies to be used in the design of the interventions related to social media, will be a consultant. In addition, our work will be supported through several external consultants who are experts on SIM, GIST, tablet technologies, and social networking applications. These experts will include **Cathy Spriggs,** a SIM professional developer who provides PD on SIM and **Aaron Sumner,** who is an expert on GIST technologies, SIM strategies, and applications for mobile devices.

D. Project Evaluation

Leaders Network, an evaluation firm with extensive experience in educational evaluation and the i3 program, will serve as the external evaluator. The planned research questions follow.

Development Questions include: (a) Have the criteria established to ensure quality of design, implementation, and evaluation, with valid and reliable student outcome measures, for the four sets of units been implemented? (b) Has selected content been juried and then remain unchanged as revisions in the instructional practices used in the units were to allow an adequate evaluation of the units? (c) Were units ready and arrangements made with administrators, teachers, and students in the AUSD and CCPS for the adequate and authentic testing of the units?

Outcome Questions include: (a) Do students in the enhanced unit condition outperform their peers in the non-enhanced unit condition? (b) Do SWDs, UPS, and TPS in the enhanced unit condition outperform their peers in the non-enhanced condition? (c) Are there differences in the effectiveness of units by student demographics or versions of units?

Implementation Questions include: (a) How are different versions of the enhanced unit

implemented? (b) How are the PD, PD follow-up, and coaching provided to teachers on the implementation of instruction and the delivery of the units associated with student outcomes?

Data Analysis

Implementation Analysis

In keeping with the DBIR methods that will be used in this project, the purpose of qualitative and quantitative data analyses will be to identify factors that enhance or inhibit the implementation of the collaborative discourse promoted in the enhanced units and the SOCS environment and then to develop and implement modifications after each implementation that will increase student learning and teacher implementation.

Qualitative data analyses. In analyzing qualitative data, we will use the constant comparative method (Strauss & Corbin, 1990), relying on class observations and field notes, interviews, and artifacts of student collaboration. We will examine the data to identify common themes (Krueger, 1988; Morgan, 1997) around improving instruction, the SOCS environment and in-class procedures. Identification of and suggestions for the removal of barriers to learning and to improve instruction will be summarized to support refinement (Miles & Huberman, 1994; Rossi & Freeman). Data will be processed by research staff, with the results provided to the design teams for use in their iterative design work. Further, teacher data (e.g., observations, interviews) will be analyzed within and across school sites to confirm or disconfirm crosscutting themes (Firestone, 1993). Students data on will be similarly analyzed to illuminate variations across classrooms within schools. Then data will be analyzed across sites to determine factors that enhance or inhibit the implementation and effectiveness the enhanced units.

Quantitative-descriptive analyses. We will obtain a descriptive portrait of the enhanced units use from its analytics database, closed-ended interview items, and outcome data. We will examine frequencies, distributions, measures of central tendency, variability, and outliers and plan to examine subsets of data and calculate cross-tabulations of usage, interview, and achievement data to provide a statistical picture of how students and teachers interact with the enhanced units and SOCS environment and student and teacher reactions to the instructional

approach and technology in general and by student ability level.

Quantitative association analyses. We will use Pearson correlation coefficients to examine the association between various usage patterns, engagement, and performance on the content tests. We will construct statistical profiles of use patterns that will be compared across students above, at, and below grade level and students with IEPs. Data analyses will provide quantitative information to set content and technology development priorities. The research team will review the statistical summaries to identify development and revision priorities.

Impact Analysis of Enhanced Units on Student Outcomes

Our hypothesis is that the enhanced units promote engagement in collaborative discourse across in-class and the SOCS environments, which should result in subsequent increases in higher-order reasoning skills and learning gains in SC and SS content. To answer outcome questions, hierarchical linear modeling (HLM) will be used to analyze the data to account for the clustering adjusting for important covariates (Raudenbush & Bryk, 2002). For each unit, we will use HLM analyses to test for the effect of unit on student content test scores at the end of each year's implementation. In these HLM regressions, the first level will be student and second levels will be sections, respectively. Effect size of intent-to-treat (ITT) effect will be presented. We will include student characteristics (e.g., cohorts, or demographic characteristics) and school-level characteristics (e.g., school size) in the regressions to reduce residual error:

Student level: $Y_{ik} = \pi_{0k} + \pi_{1k} X_{ik} + e_{ik}$

Section level: $\pi_{0k} = \gamma_{00} + \gamma_{01}\, unit + \gamma_{02} W_{0k} + \mu_{0k}$

$\pi_{1k} = \gamma_{10}$

where

- Y_{ik} is the student-level measure for the i-th student in the k-th section. X_{ik} and W_{0k} are student- and school-level covariates, respectively.
- *unit* is an indicator of the k-section being in the treatment group, and γ_{01} is the treatment effect.
- e_{ik} and μ_{0k} are the student- and section-level residual variance terms.

Similar HLM analyses will be conducted for SWDs, UPS, and TPS. Although the above ITT analyses suggest the average effect of the treatment, they do not yield the effect of the intervention for those students who actually received the intervention.