Preview of Award 1639069 - Annual Project Report

Cover

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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Irene A Lee

Accomplishments

* What are the major goals of the project?

Strategic goal #1: Creation and revision of curricular modules, guides and MOOC.

In year 1 we will revise and refine *Project GUTS* middle school modules to have consistent design and layout. We will revise existing *Project GUTS* handbook and will create a new facilitator guide. We will create a workshop guide documenting how to plan, prepare, and run a mini-workshop for students. We will revise the Project GUTS online PD course (MOOC) to create a version that features StarLogo Nova. Initially, revision and refinement of these resources will be driven by evaluation of materials by the external peer review and educator advisory boards. This review will entail assessment of content quality and usability. In years 2, 3, and 4, teachers who use the materials in workshops, practicums and classrooms, will be asked to complete short surveys assessing how easy the materials were to use in the contexts in which they were implemented, how useful they were for ensuring the teacher met her/his instructional goals, and how well they engaged students in CT and investigations. Teachers will also be asked for recommendations to make the RMTs more useable and relevant to their classrooms. As an iterative design process, evaluation and refinement of the resources will occur annually. Documentation of advisor and teacher feedback and recommendations will be compiled and provided to the critical friend for review and analysis. The design team will maintain a log or design journal to document adaptations made and their rationale (including response to feedback). Annually, the critical friend will compare documentation of development choices and processes with teacher feedback to ensure the team is responsive. Select members of the advisory and educator groups will review refined RMTs annually to ensure content quality and usability remains high.

Strategic goal #2: Planning, implementation, and refinement of PD workshops, webinars, and conference.

Starting in year 2, a summer intensive workshop will offer one week of face-to-face PD for teachers and facilitator pairs. The annual workshop will be learner-centered; teachers will experience and reflect upon the Use-Modify-Create learning progression that they will ultimately lead for their students. The workshop will conclude with planning for the practicum and school year implementation of CS in Science modules. One-day webinars will be offered in the fall and spring. During these webinars we will review the structure and pacing of a module, review the specific content and base model associated with the module, and discuss ways to support student-driven inquiry using the model as a test bed. We will host a community conference bringing together teachers, facilitators and students to share their experiences and celebrate their accomplishments at the conclusion of each cohort year. Research into the quality and utility of the PD components will focus on teacher learning, opportunities to engage in the Use-Modify-Create process, and teacher self-efficacy. We will use an attitudes, interests, and awareness instrument, a knowledge and skills instrument, and artifact based interviews administered at the beginning, middle, and end of the cohort year to collect data that will be analyzed for evidence of teacher learning, engagement in Use-Modify-Create, and self-efficacy. In years 3 and 4, self-efficacy measures will also be collected over time through self-related sliders found on the member information page on the OPDN. Aggregating the slider responses will be used to identify where PD materials may be incomplete or not fulfilling the promise we believe they hold.

Strategic goal #3: Planning, implementation, evaluation, and refinement of practicum experience

In years 2, 3, and 4, following the summer intensive workshop, participating teachers and facilitators will offer a summer mini-workshop for students. These summer mini-workshops are roughly sixteen hours in duration for twenty students. The goal of this practicum is to familiarize the teacher / facilitator pair with 1) ways to foster student engagement, 2) common issues and bugs students encounter, 3) student-driven inquiry using models and simulation, and 4) assessing student learning outcomes. Teachers will be asked to complete short surveys assessing how easy the materials were to use in this new context, how useful they were for ensuring the teacher met her/his instructional goals, and how well they engaged students in CT and science investigations.

Strategic goal #4: Development and refinement of an Online PD Network (OPDN)

The online network serves the dual function of being a repository for all Project GUTS program and curricular materials as well as the locus for the online community of practice. It was designed to (a) help teachers develop content knowledge about computer models and simulation, about the use of computer models and simulation in modern scientific practice, skills as practitioners of computational science, and pedagogical content knowledge (PCK) and skills; (b) provide tools for sharing expertise within schools, districts, states and the national science teacher community; (c) provide instruments that enable teachers to conduct self-assessments of learning that may lead to student assessments of learning; and (d) provide the ability to customize and share curriculum, thus becoming co-creators of the OPDN, to meet the needs of diverse student populations. The OPDN will be designed according to the specifications generated by Project GUTS community leaders and beta-tested with a focus on functionality, navigability, and user experience. Results from this testing will be used to modify the OPDN during the first year of the project. The second year's assessment will use web analytics to examine what is used, how it is used and by whom. We will solicit user feedback through short embedded surveys to augment the web analytics with data about preferences for use, navigation, and functionalities. As the website materials and user base expand, we will review materials to ensure that information is organized logically and cross-referenced.

Strategic goal #5: Investigation of methods to promote the uptake of CT-rich computer modeling and simulation experiences into regular classroom practice.

In years 2, 3, and 4, we will study teachers' experiences with the resources, models, and tools, (RMTs) and assess how well the RMTs prepared teachers to implement Project GUTS' Computer Science in Science curriculum. We will examine participation in the PD components, interaction with resources and tools, teacher learning, and teacher self-efficacy to gain an understanding of how each contributes to teachers' implementation of high-quality CT curricula in their classrooms. We will conduct observations of teachers' implementation of Project GUTS activities during the practicum and classroom. An observation protocol will be developed that focuses on roles and responsibilities of teacher and facilitator, how struggle and technical glitches are handled, and how teachers manage a classroom full of students engaged in project-based learning activities. Individual artifact-based interviews conducted at the beginning, middle, and end of the cohort year, will be used to collect data on teachers' implementation planning, self-efficacy, and skills in analyzing models, in an effort to understand the changing factors that influence whether or not a teacher implements a module as planned.

Strategic goal #6:

Overall assessment of the promise of Teachers with GUTS. In year 4, data collected to date along with evidence of student learning collected during the last year of the project, will be reviewed and analyzed. Descriptive results will be presented to the external review groups for discussion and reflection with the goal of providing an overall assessment of the initiative and its potential to positively affect student CT learning.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities: Project wide tasks: Strategically timed meetings with advisors took place in year 3. These meetings were conducted individually and covered specific topics of interest. Bill Penuel advised on the inclusion of and potential role for district curriculum and instruction staff in PD workshops. Ricarose Roque provided advice on facilitator training. Eric Snow advised on conducting large scale CS education research across multiple districts. Lisa Milenkovic provided advice on creating partnerships with district STEM directors. Chris and Rebecca Dovi advised on statewide initiatives and facilitation models in VA. Joyce Malyn-Smith and Susan Yoon were consulted on online social network development and productive ways to seed interaction for participants online. Project teams organized by focus area

assembled regularly: the RMT development team met weekly; the OPDN design and development team met weekly during OPDN development sprints; research team met weekly; and the workshops, webinars & MOOC team met weekly leading up to program offerings. Documentation of the design and development processes is ongoing and detailed. Field investigation teams met weekly.

Online Professional Development Network: During year 3, the OPDN was further refined based on community needs and suggestions. Improvements included improved search capabilities, enhanced user profile options, improved user experience of resources and events pages, improved content authoring, and increased site performance when displaying images. Additionally, OPDN features were added to enable site managers to view, sort and download of user and pages reports. Reports can be generated to cover a designated time period, and include members tagged by cohort label.

Curricular resources revision and refinement: Revisions were made to the CS in Science curricular modules 1-4 and associated resources to align with the new StarLogo Nova version 2.0 and deployed in a rolling fashion between September 2017– March 2018. Revisions were reviewed and vetted by the facilitation team and StarLogo Nova developers for usability and accuracy.

Guides: The Facilitator Guide "Learners to Leaders" and existing guides were updated to align with StarLogo Nova version 2.0. Additionally, six new guides were produced: "Debugging Guide", "Debugging Strategies Guide", "Decoding Guide", "Defensive Programming Guide", "Facilitating Student Debugging and Problem Solving Guide" and "Troubleshooting Guide."

Tools revision and refinement: The primary tool featured in the Project GUTS curriculum called StarLogo Nova was revised to utilize HTML5/Javascript rather than the outdated Adobe Flash technology. The new version, known as StarLogo Nova 2.0, is compatible with tablet computers, smart phones, and iPads. Numerous features and refinements requested by teachers were included in StarLogo Nova 2.0 such as better interface for viewing / searching galleries; ability to set an agents visibility; random function that takes the range of possible outputs as the input values; output data in either a data table or plot view; color coding of drawer tabs to match block color; ability to import 3D models; programmatic control of viewport; and on project open view the World page rather than the agent page. Additionally, numerous bug fixes were included in StarLogo Nova 2.0 such as fixing a graphing bug; fixing text entry bug in the information window that prevented backspacing; and camera lock down to prevent accidental zooming.

Workshops and Practicum experience: In year 3, various workshops and practicum experiences were offered to cohort 1 and 2 participants. Cohort 1 participants were offered a second summer workshop called a Design workshop. The Design workshop was held on July 31 – August 4, 2017 in Santa Fe, New Mexico. Cohort 2 fall, winter and spring one-day Saturday blended workshops were held on September 9, 2017; January 13, 2018, and March 10, 2018 respectively. The goals of these follow-up workshops were to refresh and build skills in modeling and simulation; gain comfort with StarLogo Nova 2.0; prepare for implementations; and further develop teachers' skills in using computer models to conduct scientific inquiry. A wrap up workshop was held on May 5, 2018 at which teachers shared their implementation experiences and provided the project with suggestions and recommendations for program improvement. Additionally, Cohort

2 participants were offered a second summer "Design Workshop" on June 19-22, 2018 with the goal of refining lessons and preparing for implementations during the 2018-2019 academic year.

Recruitment for cohort 3 participants took place in Santa Fe, NM, Albuquerque, NM and Richmond, VA. A Cohort 3 summer workshop was offered at University of New Mexico in Albuquerque, NM on June 4-8, 2018. The workshop was one of several offered in a larger NM CS PD Week conference. Twenty-one cohort 3 participants from Santa Fe and Albuquerque, New Mexico attended the workshop. Collection of baseline survey data and initial interviews of participants took place. A second national PD workshop will be held as part of the Infosys Pathfinders Summer Institute at Indiana University in Bloomington, IN on July 15-20, 2018. Cohort 3 participants from Richmond, VA including 12 middle school science teachers and 2 curriculum and instruction staff will attend this workshop with a travel scholarship provided by Infosys Foundation.

Webinars: In its third year, the project offered webinars targeted at broader audiences as a means to disseminate information about Teachers with GUTS' approach to preparing teachers to integrate CT within science classrooms. A webinar titled "Computational Thinking from a Disciplinary Perspective" was offered through the NSF funded MSPnet.org on January 15, 2018 that was attended by 103 MSPnet member teachers and researchers. Another CT webinar featured learning trajectories used in Project GUTS. It was offered through the STELAR network on January 31, 2018 and was attended by over 80 teachers and researchers.

MOOC: In year 3 the Project GUTS online PD was transferred to the Canvas platform by partners in the Broward County Public Schools (FL) STEM department and a team of facilitators from Broward County, FL. This online course is modeled after the Project GUTS CS in Science PD MOOC. It will be piloted in Fall 2018 and, if successful, it will be shared nationally as the online PD option for Teachers with GUTS.

Conference/Facilitator Summit: Twelve veteran national facilitators participated in the Teachers with GUTS Facilitator Summit held at MIT on May 25-28, 2018. The Summit activities included opportunities for veteran Project GUTS facilitators to discuss the district context in which they worked, share what was working / not working in terms of teacher PD in their district, and refine the six new Teachers with GUTS guides.

Other: The project worked with partnering organizations to offer various Project GUTS PD workshop experiences in Austin, TX (held on June 8-9, 2017 as part of the WeTeachCS conference), Riverside, CA (held on June 21-23, 2017 as a free standing 3 day workshop), Indianapolis, IN (held on June 28-30, 2017 as a NexTech sponsored workshop), Chicago, IL (held on July 31-August 2, 2017 and a second workshop on August 7-9, 2017), and New York City, NY (held on August 28-30, 2017 as part of an CSNYC workshop). Participants in the aforementioned workshops joined the Teachers with GUTS online PD network, used our resources, and learned how to implement Project GUTS lessons. The project made presentations at the NM STEM Symposium, CSTA Annual conference, NSTA STEM Expo, To Code and Beyond, Infosys Crossroads, NSF DRK12 PI meeting, and at two Jameel World Education Lab (J-WEL) conferences.

Specific Objectives: The second phase of the Teachers with GUTS project encompasses years 2, 3, and 4 and began in July 2016. In the second phase, the research focuses on attending to teachers' experiences with the RMTs as well as assessing how well the RMTs prepared teachers to implement the curriculum. The collection and analysis of data associated with teachers' experience of each of the components is ongoing and the analytics was shared with advisors including lead facilitators as part of interpreting use and utility of each component.

Cohort 2 participants provided information on their experiences with the RMTs through an end-of-cohort-year survey. Sixteen of the 19 cohort members completed the survey. Findings from the end of cohort 2 year RMT survey can be broken down into findings on Curriculum resources, Practicum, Strategies, Guides, PD experiences, StarLogo Nova, and StarLogo Nova galleries containing shared projects. (See section on Key Outcomes for more details.)

The collected evidence and analyses from the summer workshop and practicum held in June of 2017, in addition to evidence gathered at quarterly one-day workshops, were used to inform the third iteration of the summer workshop held on June 4-8, 2018. We saw teachers struggling to make sense of CT and we witnessed teachers' lack of experience and comfort with experimentation, specifically designing experiments to answer questions. Two significant refinements were subsequently made to the summer PD workshop. The first was that the introduction to CT was strongly tied to CT within a scientific modeling context (rather than framed in terms of computer science concepts and practices). We hope this grounding of CT as the use of abstraction and automation within scientific modeling and investigations will avert the confusion teachers experienced and mitigate their thinking that CT meant only coding or computer programming. The second was to practice designing and running experiments with models as experimental test beds in every module review.

To assess how well the RMTs prepare teachers to implement the curriculum, we examined teachers' participation in the professional development, their learning, and sense of self-efficacy. Individual teacher's participation in the PD components was tracked. Participation in the professional development offerings was high. Of the original 21 cohort members, 2 dropped out, 1 passed away during the school year, and 1 became a facilitator after leaving the classroom. The remaining 17 cohort members received between 70 and 96 PD hours with an average of 89.2 hours (out of 96 hours offered).

A pre- and a post-assessment of knowledge and skills (KS) were administered to collect data needed to assess teacher learning of key concepts in computer modeling and simulation, computer science, and complex adaptive systems. A pre- and a post-assessment of attitudes, interests, and awareness (AIA) were administered to collect data pertaining to self-efficacy and interest in integrating computer modeling and simulation into the curriculum. We found that teacher participants in cohorts 1 and 2 have shown significant gains in knowledge and skills and attitudes, interests and awareness from baseline to exit (See findings in the next section "Key outcomes.") We were able to assess the reliability of the AIA and KS surveys for use in this research study. Two other instruments, an artifact based interview and scenario based interview have been tested, refined, and mapped to an "ontology of computational thinking within the context of computer modeling and simulation". The ontology describes the behaviors that comprise

computational thinking when designing, decoding, modifying and creating computer models – and using computer models to conduct scientific investigations. Cohort 1 and 2 interview data will be analyzed using the ontology as an analytical framework.

In year 3, select cohort 2 participants were observed implementing the curriculum during the practicum and within their classroom to provide additional evidence. Post-observation interviews of those participants were conducted. Coding and analysis of these data is ongoing. Analysis of data also informs the revision and refinement of subsequent iterations of RMT components.

- 26 days of Project GUTS curriculum implementation across 11 teachers were observed.
- Exit interviews for 12 teachers were transcribed.
- A total of 43 observation reports were completed (including observer reflections about teacher instruction).
  - The reports detail implementations 'during school hours' although some of our teachers worked in alternative school settings, such as a night school for students who have not completed regular high school coursework.
  - 2 observation reports detailed instruction of 3 teachers who co-taught in an afterschool setting.
- Except for one teacher who was observed implementing the chemical reaction module, all other observations focused on module 1.

Case study development is ongoing and preliminary.

Significant Results: Findings from the end of cohort 2 year RMT survey: The most commonly used curricular resources was Module 1 - Introduction to Computer Modeling and Simulation (9), followed by Module 3 - Ecosystems as Complex systems (8), and Module 2 - Water as a shared resource (7). Only four respondents used Module 4 - Chemical reactions. Feedback received was that Module 4 is not well-aligned to middle school standards and covers concepts not expected of learners until high school.   Of the freestanding resources, videos were the most widely used (7), followed by blocks sheet (5), then activity sheets, guides, and common forms (3 each). Fourteen respondents stated that the resources generally met or exceeded their expectations; whereas one stated that finding the online resources were difficult, and another reported that using the resources was difficult for some students. Ten respondents reported way(s) in which the resources failed to meet their expectations. These included a) smaller steps for middle school grade level, more elementary practice to build understanding; b) when a student experienced a difficulty resources not found to help student; c) some of the videos were too long; and d) mismatch between lessons and new StarLogo 2.0 build (the resources were updated within 2 months of switch-over). One participant requested a table be added to the data collection section of the experimental design form. Recommendations for improvement included providing resources on the following: a more in depth description of why certain code works the way it does; providing more what-if tips for teachers on how to fix a problem (in code); a quick search mechanism to find resources quickly; providing a larger variety of lesson plans; more models in the models library; and a more extensive help function on the website.

Respondents reported participating in various opportunities to practice their teaching. Nine stated they participated in the summer practicum experience, 5

participated in "Hour of Code" activities, 4 participated in teaching students during a one-day workshop, and 4 practiced teaching students within an afterschool context. Overall, these practice teaching experiences were viewed as valuable. A sampling of responses includes "It was a great chance to utilize what I learned. I was able to improve my understanding of the program", "[it] is the reason I felt comfortable doing this work in my classroom", and "it met my expectations because students were engaged." Several respondents described ways in which the practice teaching failed to meet their expectations. These included "some lessons did not work well with the other resources", "some teachers I worked with made it harder to reflect and see others in action", and "the practicum and students participating did not resemble my classroom." Recommendations for improvement included "encourage each teacher to experience teaching on their own without the crutch of a peer" and "spend more time working on the computers working through the module lesson by lesson during training instead."

Of the strategies promoted during the PD workshops, 3 strategies were widely used: pair programming (9), project based learning (6), and ask 3 then me (7). Also used but to a lesser extent were the Project GUTS "common forms" for project design and experimental design (2), allowing students to turn their models in to games (3), following the Use-Modify-Create trajectory (2), and promoting student engagement through a culminating activity such as a roundtable, gallery walk, or demo day (4). Teachers stated "Students liked working with a partner so that they were able to help one another", "Students were able to problem solve by themselves without having to ask me for the answer right away", and "These are very student centered approaches and I am always looking for improving my base knowledge in that area." Four teachers recounted ways in which the strategies failed to meet their expectations: "pair programming doesn't work as well as I hoped", "Sometimes I had a hard time finding the reason why a model was not working", and "Students struggled with me not helping them right away". A recommendation for improvement included looking at strengths and weaknesses of each approach to know what other subjects/content for which they would be appropriate.

Respondents reported using the Implementation Planning Guide more than any other guide (9). Other guides reportedly used included the facilitation guide (4) and the club leader guide (2). The implementation planning guide was seen as "easy to use" and "very helpful." A review of the responses supplied evidence of a confusion between the "implementation planning guide" and the module "pacing guides."

The PD workshops were highly regarded. All the respondents had positive responses on how the workshops met their expectations:

"I learned at each one. It was nice because if I had questions throughout the school year we were able to meet up and I could ask colleagues or instructors and not be stumped throughout the whole year. I also like that we are able to work through different modules."

"I wasn't even sure I was going to stay for the entire week of training, but the trainers were very welcoming and understanding of my lack of knowledge in the area and did a great job of helping me approach the materials and content at a speed I was comfortable with."

"The workshop was great it helped provide me all the information and materials that I needed to be successful in the classroom."

"It was great! I loved the help we got and the constant feedback and collaboration with my peers. It was nice to see that others were just like me. Learning along side my peers was a great experience and journey. The leaders were so helpful and understanding of every ones level and comfort. The guidance was on point."

The only suggestion received was to lengthen the duration of the summer PD workshop.

StarLogo Nova was generally well regarded as a modeling and simulation platform. Teachers found the environment "kid friendly", "good for beginning coding", and "easy to use and teach." It failed to meet teachers' expectations when "glitches came up" or because it "didn't work well on iPads." The galleries (collections) of StarLogo Nova models were similarly well-regarded.

Only 4 of the 19 respondents reported actively using the Teachers with GUTS online PD network. Those that reported using it said that it was "very useful", and resources were "easy to find", "well done", and "thorough."

Key outcomes or Other achievements:	<u>Case study development</u>: In year 3, the research team developed then refined a coding scheme, then analyzed cohort 1 participant data. A research framework was adapted from Magdelene Lampert's triangle of classroom dynamics, capturing the complex relationship between teacher, student, and content, which was developed in the context of mathematics education (2003). Initially, two cases were identified that captured how teacher belief in student capability might be a key factor in implementation of the Project GUTS curriculum. In one case, the teacher had mid - high CT knowledge and skills (as evidenced in their KS survey responses) yet their beliefs of student ability (as evidenced in their AIA survey responses and interview) was low. This teacher offered a low-fidelity implementation of Project GUTS in which he provided didactic, "do as I do" instructions to students, and demonstrated how to use a model without giving students agency. The contrasting case describes a relatively new science teacher with low - mid CT who had high expectations of her students and a strong belief in their learning capabilities. This teacher implemented the Project GUTS curriculum with high fidelity, using pedagogy and moves suggested by the program, and saw strong benefits of doing so – she saw increases in student CT, as well as self-efficacy that extended beyond the implementation of this specific curriculum. <u>Preliminary analyses of Cohorts 1 and 2 survey data</u>: We calculated Cronbach's alpha on both the baseline and exit KS and AIA surveys. Preliminary findings are that the AIA and KS instruments were found to have reliability, with Cronbach's alpha of .893 and .896 respectively, across the first two teacher cohorts. We calculated the P-value (proportion of participants answering correctly) of each item on the KS survey. In calculating the P-value of each item on the AIA survey, we normalized item scores to run between 0 and 1 because many items were not dichotomous, and, for the purposes of calculating the P-value, treated "correctness" as a continuous variable. Thus, our P-values can be thought of as the average normalized scores on each item. P-values of each item of the KS survey increase from pre- to post- whereas there were some decreases in items from the AIA survey from pre- to post-. The change in mean total score for the AIA survey was 2.223 and the change in mean total score for the KS survey was 1.48.

We also calculated the Pearson's R of each item, which can be thought of as how well a participant's score on that single item predicts the participant's total score on the survey. We compared participants' scores between the baseline and exit surveys both overall and item-by-item. The significance of differences between baseline and exit scores was assessed using a sign test and a signed rank test. (See attached documents.)

Teachers with GUTS online professional development network: As of June 28th 2018, the site has over 961 members since opening in May 2017. In year 3, 80 resources, 45 discussion topics, 27 news items, 17 event postings, 5 practice challenges, and 415 member profiles were added. New resources were created include lesson plans and activities, advocacy materials, assessments, handouts, presentation slides, reference material, and instructional videos. Additionally, equity resources are being added to assist teachers in promoting equitable access in computing, and using best practices in supporting students from underrepresented groups in computing.

* What opportunities for training and professional development has the project provided?

The project offered year around professional development experiences and training for middle school STEM teachers and Project GUTS facilitators (trainers who provide PD experiences and support for teachers). The professional development experiences included summer workshops and practicums, fall, winter and spring one-day workshops, webinars, an online course, and just-in-time support.

A national Project GUTS Facilitator Summit was held at MIT on May 25-28, 2018. The Summit included skill building activities in StarLogo Nova 2.0; debugging and troubleshooting practice; and sharing of best practices.

The project worked with partnering organizations to offer various Project GUTS PD workshop experiences for middle school teachers in Austin, TX (held on June 8-9, 2017 as part of the WeTeachCS conference), Riverside, CA (held on June 21-23, 2017 as a free standing 3 day workshop), Indianapolis, IN (held on June 28-30, 2017 as a NexTech sponsored workshop), Chicago, IL (held on July 31-August 2, 2017 and a second workshop on August 7-9, 2017), and New York City, NY (held on August 28-30, 2017 as part of an CSNYC workshop).

* How have the results been disseminated to communities of interest?

The project offered webinars targeted at broader audiences as a means to disseminate information about Teachers with GUTS' approach to preparing teachers to integrate CT within science classrooms. A webinar titled "Computational Thinking from a Disciplinary Perspective" was offered through the NSF funded MSPnet.org on January 15, 2018 that was attended by 103 MSPnet member teachers and researchers. Another CT webinar featured learning trajectories used in Project GUTS. It was offered through the STELAR network on January 31, 2018 and was attended by over 80 teachers and researchers.

* What do you plan to do during the next reporting period to accomplish the goals?

PD experiences will be offered to cohort 3 participants in their local regions. These experiences include summer PD workshops; fall, winter, spring one-day follow-up workshops; online monthly PD sessions; and just-in-time support. The online PD sessions will take place monthly and bring together teachers from all three cohort 3 districts (Santa Fe, Albuquerque, and Richmond).

In year 4, research will continue, with attention on teacher practice, particularly around the classroom implementations of Project GUTS curriculum to address the project's main question, "How can we enhance the ability of middle school science teachers to provide high-quality CT experiences for middle school students within regular school day science classes". We will attend to teachers' experiences with the RMTs, their learning (as evidenced in AIA and KS surveys,

artifact-based interviews), their subsequent experience with implementation, and how well the RMTs prepared teachers to implement the curriculum. We will extend the research beyond professional development experiences, exploring other factors that mediate and/or moderate teachers' provision of high-quality CT experiences for middle school students.

Case studies from across Cohort 1 and Cohort 2 participants will be generated. The ontology for computational thinking within the context of computer modeling and simulation will be fleshed out such that each behavior is elaborated with a warrant statement and samples evidence. We will assess cohort 3 participants CT using this ontology.

Cohort 3 student data will also be collected and analyzed. Evidence pertaining to student learning outcomes will be collected and reliability of the assessment instruments will be assessed. In year 4, data collected to date along with evidence of student learning gathered during the cohort 3 year will be reviewed and analyzed by the external evaluator. Descriptive results will be presented to the external review groups for discussion and reflection with the goal of providing an overall assessment of the initiative and its potential to positively affect student CT learning.

We will continue to develop and support a community of practice on the Teachers with GUTS OPDN. We will promote teachers' sharing and posting of new materials on the OPDN.

Supporting Files

Filename	Description	Uploaded By	Uploaded On
AIA-compare-scores.pdf	This diagram provides a visual summary of the results of the comparison of baseline and exit AIA survey responses. The top left panel shows the scores of each participant on each item, running from 0 to 1, with darker colors indicating larger moves. (Red indicates a move from less to more correct, b	Irene Lee	07/02/2018
KS-compare-scores.pdf	This diagram provides a visual summary of the results of the comparison of baseline and exit KS survey responses. The top left panel shows the scores of each participant on each item, running from 0 to 1, with red indicating a move to correct, blue indicating a move away from correct, and white mean	Irene Lee	07/02/2018
KS-change-v-AIA-change.pdf	This diagram shows the change in AIA and change in KS for participants in cohorts 1 and 2. Colored dots show the teacher's content area. Note that the science teachers are showing the most growth in AIA and KS.	Irene Lee	07/02/2018
KS-v-AIA-start-end.pdf	This plot shows pre- to post- AIA and KS scores with small dots indicating pre-scores and large dots indicating post-scores. Again colored dots are used to show the teacher's content area.	Irene Lee	07/02/2018

Products

Books

Book Chapters

Inventions

Journals or Juried Conference Papers

Malyn-Smith, J. and Lee, I (2018). Profile of a CT Integration Specialist. *Computational Thinking in Education 2017 conference proceedings..* . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Malyn-Smith, J., Lee, I., Martin, F. G., Grover, S., Evans, M. A., & Pillai, S. (2018). Developing a Framework for Computational Thinking from a Disciplinary Perspective.. *Computational Thinking in Education 2018 conference proceedings..* . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Mike Tissenbaum, Joshua Sheldon, Mark A. Sherman, Hal Abelson, David Weintrop, Kemi Jona, Mike Horn, Uri Wilensky, Satabdi Basu, Daisy Rutstein, Eric Snow, Linda Shear, Shuchi Grover, Irene Lee, Eric Klopfer, Gayithri Jayathirtha, Mia Shaw, Yasmin Kafai, Eni Mustafaraj, Will Temple, R. Benjamin Shapiro, Debora Lui, Clara Sorensen (2018). The State of the Field in Computational Thinking Assessment. *in Kay, J. and Luckin, R. (Eds.). (2018). Rethinking Learning in the Digital Age: Making the Learning Sciences Count, 13th International Conference of the Learning Sciences (ICLS) 2018.* Vol. 1 1204. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Waterman, K., Goldsmith, L., Pasquale, M., Goldenberg, E.P., Malyn-Smith, J., DeMallie, A., & Lee, I.A (2018). Integrating Computational Thinking into Elementary Mathematics and Science Curriculum Materials and Instruction.. *In Pixel (Ed.), Conference Proceedings: the Future of Education 2018..* . Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Licenses

Other Conference Presentations / Papers

Irene Lee (2017). *Coding to Learn in Project GUTS*. MIT J-WEL Conference. Cambridge, MA. Status = OTHER; Acknowledgement of Federal Support = Yes

Dr. Cynthia Solomon, Prof. Hal Abelson, Irene Lee (2018). *Computational Thinking to Computational Action*. J-WEL Week. Cambridge, MA. Status = OTHER; Acknowledgement of Federal Support = Yes

Irene Lee (2017). *Computational Thinking: An Overview*. New Mexico EPSCoR Innovation Working Group conference. Socorro, NM. Status = OTHER; Acknowledgement of Federal Support = Yes

Jane Drake, Irene Lee, and Paige Prescott (2015). *Exploring the Big Ideas with our community of innovative schools*. International Baccalaureate of the Americas Conference. Chicago, IL. Status = OTHER; Acknowledgement of Federal Support = Yes

Irene Lee, Paige Prescott (2016). *Infusing Computational Thinking into Science Classrooms*. ISTE 2016. Denver, CO. Status = OTHER; Acknowledgement of Federal Support = Yes

Tom O'Connell, Irene Lee, Wendy Maa, Kelly Powers, Emmanuel Schanzer (2017). *Integrating CT Across the Curriculum*. To Code and Beyond. New York, NY. Status = OTHER; Acknowledgement of Federal Support = Yes

Irene Lee, Smita Kohlhatkar, Tom O'Connell, Amy Cliett. (2018). *Introducing Computational Thinking to Tweens*. Infosys Crossroads. Scotts Valley, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Lee, I, & Martin, F (2018). *Investigating Fairness in Machine Learning Applications: Cultivating a future ready mindset*. Computer Science Teachers Association annual conference 2018. Omaha, NE. Status = ACCEPTED; Acknowledgement of Federal Support = Yes

Joyce Malyn-Smith, Thomas Kochan, Irene Lee, Grace Suh. (2018). *Today's Education for Tomorrow's College and Career Readiness*. NSF DRK12 PI meeting. Washington, DC. Status = OTHER; Acknowledgement of Federal

Support = Yes

Presiders: Catherine McCulloch, Amy Busey Presenters: Dan Damelin, Joseph Krajcik, Irene Lee, Susan Yoon (2018). *Using Models to Support STEM Learning in Grades 6–12: Examples and Insights from NSF's DRK–12 Program*. NSTA 2018. Atlanta, GA. Status = OTHER; Acknowledgement of Federal Support = Yes

Irene Lee Pat Phillips (2016). *Working Session on Integrating Computational Thinking Across the K-8 Curriculum*. Computer Science Teachers Association Annual Conference 2016. San Diego, CA. Status = OTHER; Acknowledgement of Federal Support = Yes

Other Products
Audio or Video Products.

MSPnet Webinar "Computational Thinking from a Disciplinary Perspective". Shared with MSPnet community via link: https://csrterc.adobeconnect.com/pal5jm7klfcj/?session=na5breezz4a3txp7i3wp89xi

Audio or Video Products.

STEM+C Webinar: Introduction to Computational Thinking.

Shared via EDC STEM+C project participants.

Educational aids or Curricula.

Project GUTS CS in Science Instructor Handbook (updated for StarLogo Nova 2.0)

available for download (free) at teacherswithguts.org

available to purchase in print at https://marketplace.mimeo.com/projectguts

Educational aids or Curricula.

Teachers with GUTS Facilitator's Guide: Learners to Leaders.

Available to download (free) at TeacherswithGUTS.org

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Websites
Teachers with GUTS online professional development network
http://www.teacherswithguts.org

TeacherswithGUTS.org is the online pd network for the Project GUTS community of teachers, facilitators, and supporters.

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Klopfer, Eric	PD/PI	1
Lee, Irene	Co PD/PI	9
Anderson, Emma	Other Professional	3
Dynes, Scott	Other Professional	0
Gibbs, Susan	Other Professional	6
Greenhill, Colin	Other Professional	0
Hagaman, Melody	Other Professional	2
Haines, Jordan	Other Professional	0
Hsaio, Ling	Other Professional	5
Huang, Wendy	Other Professional	2
Kao, Shannon	Other Professional	0
Levy, Maria	Other Professional	3
Stump, Lisa	Other Professional	2
Trujillo, Karen	Other Professional	1
Tung, Yan-Chi	Other Professional	3
Tyson, Kersti	Other Professional	1
Wendel, Daniel	Other Professional	3
Zeiber, Jacqueline	Other Professional	0
Riolo, Maria	Statistician	1
Alvarado-Alcantar, Rebecca	Graduate Student (research assistant)	2
Kaminsky, Alexis	Consultant	2
Reider, David	Consultant	1

Name	Most Senior Project Role	Nearest Person Month Worked
Prescott, Paige	Other	1

Full details of individuals who have worked on the project:

Eric Klopfer
Email: klopfer@mit.edu
Most Senior Project Role: PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Dr. Eric Klopfer, professor and director of the MIT Scheller Teacher Education Program, served as PI with responsibility for project oversight and oversight of the development of the StarLogo software. Klopfer also develops partnerships within and outside of MIT to extend the reach of the project.

Funding Support: N/A

International Collaboration: No
International Travel: No

Irene A Lee
Email: ialee@mit.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 9

Contribution to the Project: Lee is the co-PI of the project and serves as the project director. She directs and oversees the design and development of RMTs, the project's research component and community development. (Lee participates in data collection and analysis.)

Funding Support: N/A

International Collaboration: No
International Travel: No

Emma Anderson
Email: ejanderso@mit.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Emma Anderson serves as a researcher on Teachers with GUTS. She conducted teacher observations, coordinated research team meetings, developed / refined observation protocol, coded and analyzed interview and observation text.

Funding Support: N/A

International Collaboration: No
International Travel: No

Scott B. C. Dynes
Email: scott@dynes.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Scott Dynes served as the project manager of the online professional development network (OPDN) development effort. Dynes implemented the OPDN prototype in order to conduct a series of iterative design cycles. The prototypes were developed using an online wire-framing tool (Axure). The interactive prototypes were tested by 16 teachers representative of the Project GUTS community. User testing entailed having the teachers attempt a series of common tasks (based on an earlier needs assessment) using the prototype; Dynes and OPDN designers observing teachers using the interface, and debriefing at the end of the testing sessions. Three rounds of testing, redesign, re-building took place between August and December 2015. Dynes developed the full technical specifications for the OPDN and identified 10 Drupal development groups to bid on the project. Lee and Dynes interviewed the five best candidates and selected one to develop the OPDN based on experience with Drupal development, understanding of our design, capacity, strengths and abilities, and interest in the project.

Funding Support: N/A

International Collaboration: No
International Travel: No

Susan Gibbs
Email: su.susangibbs@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 6

Contribution to the Project: Gibbs serves as a lead facilitator, curriculum writer/reviewer, and OPDN content manager for the project.

Funding Support: N/A

International Collaboration: No
International Travel: No

Colin L Greenhill
Email: clgreenhill@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Colin Greenhill, software consultant, contributed to the development of StarLogo Nova, the platform used in the Project GUTS curriculum and professional development program. In particular, Greenhill implemented new user interface elements for adding instrumentation to StarLogo Nova models.

Funding Support: N/A

International Collaboration: No
International Travel: No

Melody Hagaman
Email: mehagaman@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Melody Hagaman served as the New Mexico program coordinator for Teachers with GUTS in year 2. She liaised with the Las Cruces Public Schools and New Mexico State University for the planning and organization of the summer workshop and practicums. Hagaman was responsible for communication with Las Cruces teachers, parents of students participating in summer workshops.

Funding Support: N/A

International Collaboration: No
International Travel: No

Jordan Haines
Email: jhaines@mit.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Jordan Haines, software consultant, contributed to the development of StarLogo Nova, the platform used in the Project GUTS curriculum and professional development program. In particular, Haines implemented an offline mode and a server side bundling utility to export all project contents and assets to .zip file for use by the offline app. This is important so StarLogo Nova project data is preserved locally in the event of a internet outage.

Funding Support: N/A

International Collaboration: No
International Travel: No

Ling Hsaio
Email: lingh@mit.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 5

Contribution to the Project: Ling Hsaio serves as the lead researcher on Teachers with GUTS. She is responsible for training and supervision of field research teams, data collection and cleaning, qualitative analyses, and refinement of research protocols.

Funding Support: N/A

International Collaboration: No
International Travel: No

Wendy Huang
Email: wendymail@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Wendy Huang served as a guide developer for Teachers with GUTS.

Funding Support: N/A

International Collaboration: Yes, Singapore
International Travel: No

Shannon Kao
Email: skao127@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Shannon Kao, software consultant, contributed to the development of StarLogo Nova, the platform used in the Project GUTS curriculum and professional development program. In particular, Kao led the porting of StarLogo Nova's rendering engine to Javascript and HTML5 (the new industry standard). This move was necessary in order to maintain StarLogo Nova's viability and to enable teachers who only have access to iPads to use the tool and thus, our curriculum.

Funding Support: N/A

International Collaboration: No
International Travel: No

Maria Levy
Email: maria@hwangworks.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Maria Levy, graphic and curriculum designer, was responsible for the design and layout of the curriculum framework. She researched curriculum layouts and developed an initial set of goals including readability, visual hierarchy, and improvement of images (to higher resolution). She developed and presented a prototype to 24 middle school teachers who were participants in a Project GUTS summer workshop. Their feedback and suggestions on ways to improve the usability of the document were included in the subsequent layout and design. Levy created templates for student activity sheets, guides, and common forms, and redesigned and developed the Facilitator Guide "Learners to Leaders" using the template. Levy also produced new logos and user interface graphical elements for the OPDN (6mo at .5 FTE)

Funding Support: N/A

International Collaboration: No
International Travel: No

Lisa Stump
Email: lstump@mit.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Lisa Stump served as a software developer on the Teachers with GUTS project. She implemented StarLogo Nova features requested by participating teachers.

Funding Support: N/A

International Collaboration: No
International Travel: No

Karen Trujillo
Email: ktrujill@nmsu.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Karen Trujillo oversees data collection for Teachers with GUTS in Southern NM. She liaises with the Las Cruces Public Schools on behalf of the project. (Trujillo is involved with data collection.)

Funding Support: N/A

International Collaboration: No
International Travel: No

Yan-Chi Tung
Email: yanchi@mit.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Yanchi Tung served as the software development project manager for this project. She coordinated and oversaw development sprints during OPDN development and refinements.

Funding Support: N/A

International Collaboration: No
International Travel: No

Kersti Tyson
Email: kerstityson@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Tyson serves as a researcher and consultant to the project. She participates in data collection and analysis.

Funding Support: N/A

International Collaboration: No
International Travel: No

Daniel J Wendel
Email: starlogodaniel@gmail.com
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Daniel Wendel, software consultant, led the development of StarLogo Nova, the platform used in the Project GUTS curriculum and professional development program. MIT's Scheller Teacher Education program supported the development of StarLogo Nova but is no longer funded to develop of new features. Teachers with GUTS supported the implementation of software features and user interface elements specifically requested by teachers and facilitators, and other features important for student learning that were be requested by the PI, such as the ability to view agent's variables for location, age, health, energy, etc. and the output of data from StarLogo Nova to a .csv file for further analysis using analysis and visualization tools. An unexpected change in industry support of Macromedia's Flash as a graphical software package led to the reimplementation of StarLogo Nova in Javascript and HTML5 (the new industry standard). This move was necessary in order to maintain StarLogo Nova's viability and to enable teachers who only have access to iPads to use the tool and thus, our curriculum. Wendel managed the team of StarLogo Nova developers including: Shannon Kao, Jordan Haines, and Colin Greenhill.

Funding Support: BioCAS ModelBEST

International Collaboration: No
International Travel: No

Jacqueline Zeiber
Email: jzeiber@nmsu.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 0

Contribution to the Project: Zeiber is responsible for data collection in Southern New Mexico.

Funding Support: N/A

International Collaboration: No
International Travel: No

Maria Riolo
Email: annichia.r@gmail.com
Most Senior Project Role: Statistician
Nearest Person Month Worked: 1

Contribution to the Project: Maria Riolo served as the statistical analyst for the project.

Funding Support: N/A

International Collaboration: No
International Travel: No

Rebecca Alvarado-Alcantar
Email: rebbeaa@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Alcantar served as the lead field investigator in Las Cruces, NM while a graduate student at NMSU.

Funding Support: N/A

International Collaboration: No
International Travel: No

Alexis Kaminsky
Email: alexis.kaminsky@gmail.com
Most Senior Project Role: Consultant
Nearest Person Month Worked: 2

Contribution to the Project: Alexis Kaminsky, criticial friend and evaluator, supported PI Lee by providing various alternative perspectives on the project. For example, she questioned whether or not the project was able to adequately plan for the summer professional development workshop and practicum due the disruption caused by the grant transfer process. Lee and Kaminsky thought through a series of scenarios and developed alternatives to mitigate the problems posed in each scenario. (Kaminsky is involved in data collection and analysis.)

Funding Support: N/A

International Collaboration: No
International Travel: No

David Reider
Email: david@educationdesign.biz
Most Senior Project Role: Consultant
Nearest Person Month Worked: 1

Contribution to the Project: David Reider serves as the external evaluator of the project.

Funding Support: N/A

International Collaboration: No
International Travel: No

Paige A Prescott
Email: paigeaprescott@gmail.com
Most Senior Project Role: Other
Nearest Person Month Worked: 1

Contribution to the Project: Paige Prescott served as program coordinator for Teachers with GUTS. She liaised with the Santa Fe Public Schools for the planning and organization of the summer workshop and practicums. Prescott also contributed to the revision of the Project GUTS online course and mentored 40 participants as they prepared to become Project GUTS regional facilitators for their school districts. She also coordinated efforts with other Project GUTS efforts such as NM EPSCoR's GUTC program and SFPS 21st CCLC afterschool program that implements Project GUTS curriculum. Prescott was responsible for communication with school districts and teachers, parents of students participating in summer workshops, preparation and distribution of advertisement and recruitment materials, planning and organizing the Project GUTS strand of the Facilitation Summit, and other functions.

Funding Support: Code.org NM EPSCoR (GUTC subaward to Santa Fe Institute) Google CS4HS

International Collaboration: No
International Travel: No

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Albuquerque Public Schools	School or School Systems	Albuquerque, NM
CodeVA	Other Nonprofits	Richmond, VA
Community Learning Network	Other Nonprofits	Santa Fe, NM
Infosys Foundation USA	Other Nonprofits	Palo Alto, CA
New Mexico State University	Academic Institution	Las Cruces, NM
Richmond Public Schools	School or School Systems	Richmond, VA
Santa Fe Public Schools	School or School Systems	Santa Fe, NM (USA)

Full details of organizations that have been involved as partners:

Albuquerque Public Schools

Organization Type: School or School Systems
Organization Location: Albuquerque, NM

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: Albuquerque Public Schools is supporting the project by donating school site for workshops, recruiting teachers to participate in Cohort 3, and coordination of research efforts within the district. The project has received research review board approval to conduct research in district.

CodeVA

Organization Type: Other Nonprofits
Organization Location: Richmond, VA

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: CodeVA is supporting the project by donating workshop space for

workshops, recruiting teachers to participate in Cohort 3, and coordination of research efforts in Richmond VA.

Community Learning Network

Organization Type: Other Nonprofits
Organization Location: Santa Fe, NM

Partner's Contribution to the Project:
In-Kind Support
Facilities

More Detail on Partner and Contribution: Community Learning Network organized and coordinated the NM CS PD Week conference in Albuquerque, NM. Project GUTS PD was one of the strands offered, and cohort 3 participants were served through this PD. CLN arranged for facilities and equipment on the campus of University of NM for this workshop.

Infosys Foundation USA

Organization Type: Other Nonprofits
Organization Location: Palo Alto, CA

Partner's Contribution to the Project:
In-Kind Support
Facilities

More Detail on Partner and Contribution: Infosys Foundation organized a national PD week for programs including Project GUTS. They are providing travel scholarships for cohort 3 participants to attend the workshop in Bloomington, IN, providing equipment, facilities, and support.

New Mexico State University

Organization Type: Academic Institution
Organization Location: Las Cruces, NM

Partner's Contribution to the Project:
In-Kind Support
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: NMSU hosted our Teachers with GUTS professional development workshop and practicum, donated staff time for logistical support, and provided in-kind support for printing, computers, and other equipment.

Richmond Public Schools

Organization Type: School or School Systems
Organization Location: Richmond, VA

Partner's Contribution to the Project:

In-Kind Support
Facilities
Collaborative Research
Other: Curriculum & Instruction support

More Detail on Partner and Contribution: Richmond Public Schools is supporting the project by donating school site for workshops, recruiting teachers to participate in Cohort 3, and coordination of research efforts within the district. The project has received research review board approval to conduct research in district.

Santa Fe Public Schools

Organization Type: School or School Systems
Organization Location: Santa Fe, NM (USA)

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution: Santa Fe Public Schools is supporting the project by donating space at a school site for the Teachers with GUTS summer workshops and practicums. They also help us to recruit teachers through email lists and administrative contacts. The project has an active MOU with the district to enable research data to be collected within district schools. (The district does not have an RRB.)

What other collaborators or contacts have been involved?

Agaric LLC served as the developer of the Teachers with GUTS online PD network.

Riverside School District offered Project GUTS PD in Riverside, CA.

WeTeachCS at University of Texas, Austin offered Project GUTS PD in Austin, TX.

Chicago Public Schools offered Project GUTS PD in Chicago, IL.

CSNYC offered Project GUTS PD in NYC, NY.

NexTech offered Project GUTS PD in Indianapolis, IN.

Impacts

What is the impact on the development of the principal discipline(s) of the project?

Co-PI Lee contributed to the development of a framework for "Computational Thinking (CT) from a Disciplinary Perspective" aimed at describing how CT can be encouraged, taught and practiced within disciplines throughout primary and secondary education. It identifies an initial set of "elements" describing CT practices that bridge learning and working in highly sophisticated STEM environments and shares examples of these practices used by STEM professionals at work and developed by students in schools. Many of the elements come into play within the Project GUTS curriculum and can be practiced within Teachers with GUTS PD workshops. It is hoped that this framework will provoke dialogue among educators advocating for CT as a core skill for all and will contribute to breakthroughs in thinking about how CT should be learned and assessed in and out of school.

What is the impact on other disciplines?
Nothing to report.

What is the impact on the development of human resources?

The project has developed and disseminated new educational materials such as curricular modules, lessons, and activities, and provided exposure to and training in the modern scientific practice of computer modeling and simulation to secondary school teachers and, indirectly, to their students.

The project also provided support and training for the national facilitator corps.

What is the impact on physical resources that form infrastructure?
Nothing to report.

What is the impact on institutional resources that form infrastructure?
Nothing to report.

What is the impact on information resources that form infrastructure?

The project made an impact on information resources that form infrastructure by developing the Teachers with GUTS online PD network that serves as the community of practice for educators who use (or are interested in learning about) the Project GUTS curriculum and tools. The project also updated and offers an online course that introduces modeling and simulation to middle and high school teachers free of charge.

What is the impact on technology transfer?
Nothing to report.

What is the impact on society beyond science and technology?

By preparing teachers to offer rich computational thinking experiences within science classes and reaching all students, this project contributes to the development of a technologically-adept workforce and educated citizenry. In particular, it is important at the edge of the Human-Machine Frontier that students understand what computer models are, how they work, and how they include assumptions made by the designer.

Changes/Problems

Changes in approach and reason for change

In year 3, several project wide changes were made to strengthen the evaluation and research components of the project in anticipation of the demands of the larger scale of research in the coming year. The Teachers with GUTS research in year 3 looks across three districts (Santa Fe, NM; Albuquerque, NM; and Richmond, VA) to provide an overall assessment of the promise of this initiative in promoting student CT learning across various educational contexts. A change was made from a "critical friend" to a traditional evaluation model to provide the program with more extensive information collection and feedback. David Reider, an external evaluator with a strong track record in computer modeling and simulation and STEM program evaluation, will conduct the external evaluation. Additionally, the research team expanded to enable the program to conduct research, including teacher and student data collection and analyses, across the three districts. IRB changes including changes to program personnel, refinements to instruments, and inclusion of the three districts as research sites, have been approved.

Recruitment for the third cohort was focused on middle school science teachers from the Richmond (VA), Santa Fe (NM), and Albuquerque (NM) areas because the research team sought to move beyond the population of teachers in New Mexico to assess potential for scaling and to build the project's capacity to serve teachers from other regions who served varied demographics. Partnerships were established to facilitate the recruitment of teachers and conduct

of research in the cohort 3 year. IRB approval was received for changes including the collection of student data. District IRBs were attained from Richmond (VA) Public Schools, Albuquerque Public Schools, and an MOU for research was established with Santa Fe Public Schools.

Actual or Anticipated problems or delays and actions or plans to resolve them
Nothing to report.

Changes that have a significant impact on expenditures
Nothing to report.

Significant changes in use or care of human subjects
Nothing to report.

Significant changes in use or care of vertebrate animals
Nothing to report.

Significant changes in use or care of biohazards
Nothing to report.

Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.
Nothing to report.