ITEST Program Evaluation

Innovative Technology Experiences for Students and Teachers (ITEST) Program Evaluation

Program Evaluation Plan and Data Collection Instruments

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I. Introduction

NSF's Innovative Technology Experiences for Students and Teachers (ITEST) program aims to strengthen the formal and informal learning experiences of K-12 students to cultivate their interests in and capacities for science, technology, engineering and mathematics (STEM) careers, with a special emphasis on technology. It also seeks to improve the leadership and knowledge of the community that conducts outreach for STEM learning. Since 2003, ITEST has funded nearly 150 projects to implement, study, and scale up effective strategies to motivate and equip young students to pursue STEM careers. Yet, evidence about the program's overall impact is thin, and data are lacking on more and less effective project features—what works and what does not.

To address the lack of evaluative program data, SRI International and Inverness Research Associates have undertaken an evaluation of the ITEST program. This document presents the evaluation's design. We first present the logic model underlying the ITEST program and the research questions driving the evaluation. Then, we present the data collection and analysis plans. Finally, we present a timeline for the program evaluation.

II. Logic Model, Research Questions, and Evaluation Overview

The ITEST program invests in projects that vary widely by type (i.e., research, convenings, scale-up, and strategies), context (e.g., urban, rural), content focus (e.g., bioscience, engineering, computer science), setting (e.g., informal, formal), and target population (e.g., teachers, students), among others. Despite these variations, all ITEST projects share a common goal: to expand the STEM workforce by increasing students' capacity for and interest in STEM studies. We begin this section with an overview of the theory of change that specifies how ITEST seeks to attain this goal. We then use the logic model to specify a set of overarching research questions. Note that the logic model represents the program and not the evaluation. Later in the document we specify the aspects of the logic model that the evaluation will be measuring.

Logic Model

Given the complex and multifaceted nature of ITEST, we have developed a logic model to aid in decisions about key aspects of the program that merit research and evaluation. The model is a systematic and visual way to present the relationships among the resources available to create and deliver the program, the activities the program offers, and the anticipated changes or results. It identifies the ultimate outcomes the program seeks to achieve and the assumptions regarding how the program is hypothesized to contribute to those outcomes. The logic model also identifies intermediate outcomes.

Exhibit 1 portrays the logic underlying the ITEST program, beginning with the program's goal of increasing participation in the STEM workforce at the far right bottom of the graphic. Increasing workforce participation generally requires that students successfully attain STEM degrees. We use this term to refer to graduate and undergraduate degrees in a STEM discipline (whether through traditional or nontraditional pathways) (Malcolm et al., 2005) as well as to technical degrees requiring fewer than 4 years of postsecondary schooling. Successful attainment

of such degrees generally requires students to leave secondary school with the dispositions and capacities for future STEM study.

Our review of the research points to six central dispositional constructs. Students must have an interest in STEM learning and STEM careers (Girod, 2005; Appleton et al., 2008). Students must possess a self-identity as science learners (Girod, 2005; Kozoll & Osborne, 2004) as well as a sense of self-efficacy (Pintrich & DeGroot, 1990; Thomas, Anderson, & Nashon, 2008; Kind, Jones, & Barmby, 2007). They must have a favorable disposition toward their future participation in science (Kind, Jones, & Barmby, 2007). They must be aware of the value of science in society (Kind, Jones, & Barmby, 2007; Davis-Kean, 2007; Messersmith et al., 2008). Finally, they must believe that they have knowledge of STEM careers (Hurtado et al., 2009).

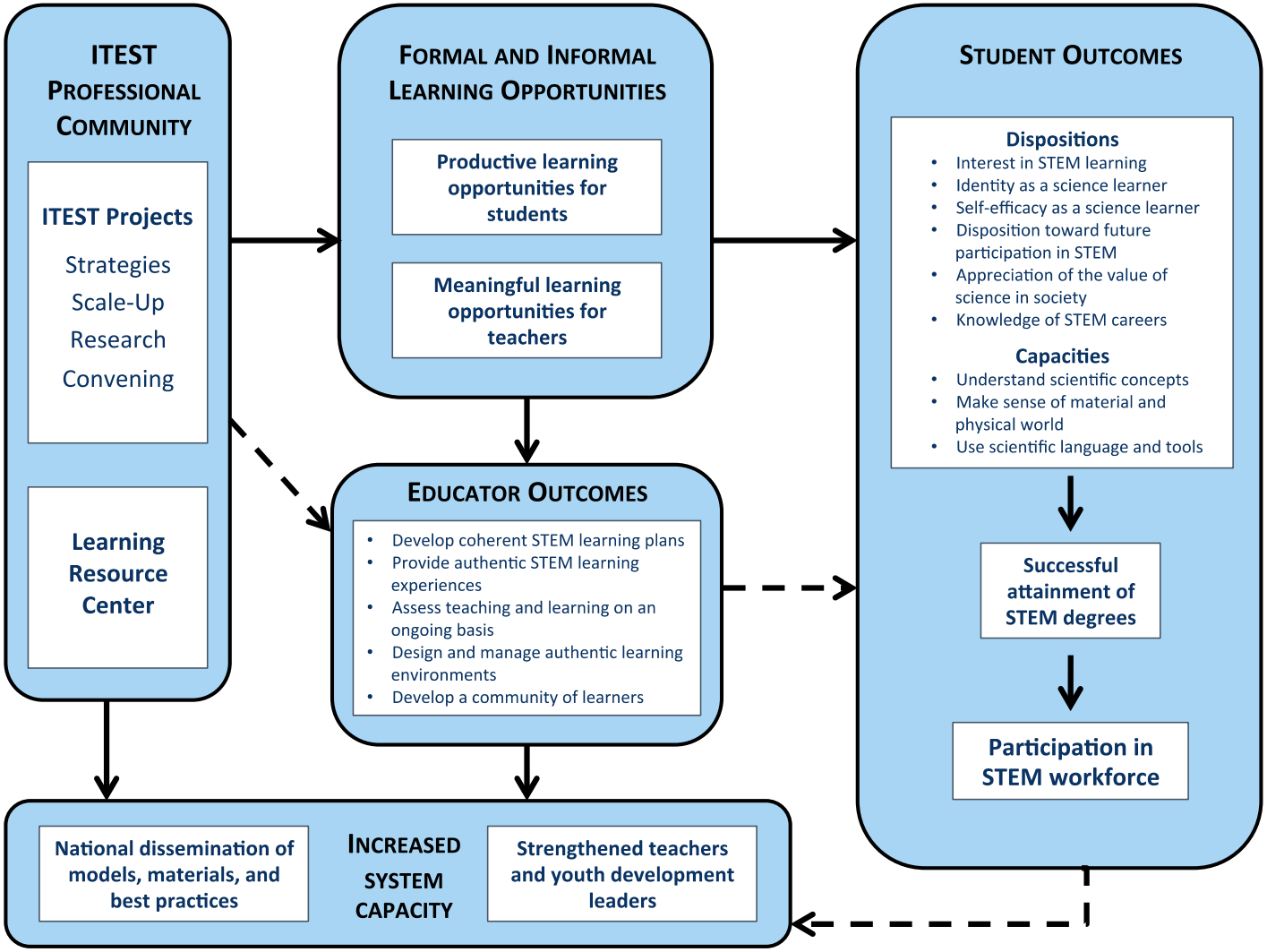
In terms of student capacities for STEM learning, we rely on the National Research Council consensus documents on learning in formal and informal settings (NRC, 2007; 2009). Learners practice and develop scientific capacities as they (1) "come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science;" (2) "manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world"; and (3) "participate in scientific activities and learning practices with others, using scientific language and tools" (NRC, 2009, p. 4).

For students to develop these dispositions and capacities, they must have access to productive learning opportunities. Students must have opportunities to engage with and develop their fluencies with scientific concepts, explanations, arguments, and models (Chinn & Malhotra, 2001) as well as with scientific practices of reasoning, metacognition, data analysis, and mastery of the use of scientific language (Brown, Reveles, & Kelly, 2004). In our own work, we have defined productive experiences as those comprising "rigorous investigation informed by the scientific process that results in new content knowledge and knowledge of how to learn, relevant to students' lives, and providing the opportunity for inspiration that translates into motivation" (American Museum of Natural History, 2010, p. 11).

For teachers to create active, STEM-rich environments, they need opportunities to learn deeper science content and to participate in scientific inquiry themselves (Basista & Mathews, 2002). Many ITEST projects focus on creating just such productive learning opportunities for teachers. The overarching goals are to support teachers to have the capacity to develop coherent learning plans, to guide student learning through authentic experiences, to assess their teaching and student learning on an ongoing basis, to design and manage authentic learning environments, and to develop a community of learners in their classrooms (see NRC, 1996).

Most ITEST projects provide direct service—meaningful learning opportunities—for youth and their teachers. Scale-up projects implement models in a large-scale setting such as across a state, region, or the nation. Other projects involve improving the knowledge base on effective STEM experiences by conducting research or convening researchers and practitioners. Through its convenings, communication strategies, and the work of the Learning Resource Center (LRC), ITEST also seeks to build a professional community that shares lessons learned and works in concert to build the nation's STEM workforce. As the professional community develops and more teachers are trained, the capacity of the system as a whole will expand to foster better learning opportunities even in the absence of ITEST.

Exhibit 1. Logic Model for the ITEST Program Evaluation



Research Questions

The model suggests three main research questions:

1. What are the projects' impacts? What are the achieved outcomes in key areas for students and teachers in ITEST projects? Do youth who participate in ITEST projects demonstrate greater interest in STEM activities and careers than nonparticipants? To what extent are project evaluations rigorous?
2. What project models are most effective in delivering desired student and teacher outcomes? What project characteristics contribute to these models' success?
3. How can we best characterize and describe ITEST projects? What do the projects do? Who do the projects serve? Where and when are ITEST project activities taking place?

Overview of the Evaluation

We have designed a comprehensive, multimethod evaluation to address these research questions. The design incorporates a portfolio review and case studies of ITEST projects and outcomes. Exhibit 2 indicates the data sources that we will use to address each research question.

Exhibit 2. Research Questions and Data Sources

	Data Source						
	Portfolio Analysis			Case Studies			
Research Question	**Program description**	**Project descriptions**	**Project evaluations**	**Project background**	**Project strategies**	**Project administration**	**Project outcomes**
1. What are the projects' impacts?							
What are the achieved outcomes in key areas for students and teachers in ITEST projects?			X				X
Do youth who participate in ITEST projects demonstrate greater interest in STEM activities and careers than nonparticipants?			X				X
To what extent are project evaluations rigorous?	X		X				X
2. What project models are most effective in delivering desired student and teacher outcomes?							
What project characteristics contribute to these models' success?		X	X	X	X	X	X
3. How can we best characterize and describe ITEST projects?							
What do the projects do?	X	X		X	X		
Who do the projects serve?	X	X			X		X
Where and when are ITEST project activities taking place?	X	X		X	X		

III. PORTFOLIO REVIEW

To create a comprehensive description of the ITEST portfolio, we will use the logic model presented in Exhibit 1 as the framework for describing the ITEST projects and their evaluations. We will use this framework to describe what the ITEST projects do and in what content areas, who the projects serve, where and when the ITEST projects take place, and how they have changed over time. We also will characterize the intended and achieved outcomes in key areas for students and teachers and assess the level of rigor of the project evaluations. The review will include three components: (1) a description of the ITEST program that details program intent, changes over time, and offers a contextual lens through which to understand individual projects; (2) descriptions of ITEST projects that characterize important descriptive features of the projects and identify project "models;" and (3) a review of project evaluations that characterizes and assesses the quality of project evaluations. Our approach for each of the three components is described in detail below.

Program Description

The first component of the portfolio review is a description of the ITEST program as a whole, including its evolution over time. This description will be derived from a review of ITEST program solicitations, interviews with NSF ITEST program officers, and analyses of the LRC.

Examine ITEST solicitations

From 2003 through 2011, NSF has funded eight consecutive cohorts of ITEST projects. While the overall structure and purpose of the ITEST program has remained intact, the program solicitations have contained changes that impacted the types of projects funded, the populations served by ITEST projects, and the project evaluation requirements. Because the solicitations have changed over time, it is necessary to understand and describe these changes in order to provide a comprehensive picture of the ITEST program. To do so, we reviewed all ITEST program solicitations released between 2003 and 2009, and for each solicitation, we identified:

- NSF's stated goals for awarded projects;
- Desired or required characteristics of ITEST projects (i.e., populations and activities that the solicitation recommends or requires);
- Requirements or recommendations for project evaluation methods.

We then compared and contrasted the program solicitations in order to describe changes in the ITEST program over time. Our findings from this analysis are presented in the September 30th annual report. As our program evaluation continues, we will review the more recent solicitations. Findings from all solicitations will be incorporated into future reports on the portfolio analysis.

Interview program officers

In order to get a broad perspective on the ITEST program, we interviewed five ITEST program officers who have been involved with the program since its inception. In our interviews, we asked program officers to provide information about the background of the ITEST program, the changes they have perceived since the program began, and how they would characterize the ITEST projects. We also solicited their input with regard to perceived gaps in the ITEST portfolio, important outcomes from ITEST projects, and examples of good formative and summative evaluations. The program officers provided us with a wealth of descriptive information, and we will use this information in our general description of the ITEST program, as well as our review of how the program and projects have changed over time.

Characterize the role of the Learning Resource Center (LRC)

Funded by NSF in conjunction with the first cohort of ITEST projects, the LRC is charged with providing technical assistance and support to ITEST projects. As shown in the logic model, the LRC plays an important role in the ITEST community. In this role, the LRC disseminates information about ITEST projects, convenes annual meetings of ITEST principal investigators (PIs), and strives to build community among ITEST grantees. In order to describe the role of the LRC within the ITEST community, we will review the LRC website, examine external evaluations of the LRC, and interview LRC staff.

Analysis

Data will be analyzed in order to draw a general picture of the ITEST program, including NSF's intent and the program's evolution over time. As such, we will take a qualitative analytic approach that draws on the principles of content analysis (e.g. Holsti, 1969) to identify broad themes across the data and track changes over time. In particular, we will detail the evolution of program goals, desired or required project characteristics, and evaluation expectations. This approach will offer an important contextual background to guide direct data collection and to ascertain whether program intent was realized.

Project Descriptions

The second component of the portfolio review is a description of the entirety of projects funded through the ITEST program. This review will include all project types: strategies, scale-ups, research projects, and convenings. To describe the portfolio of projects, we will gather and review data from the Management Information System (MIS) maintained by the LRC and the NSF eJackets in order to describe project goals, activities, partnerships, populations served, and dissemination strategies. We will then use these data from the MIS and eJackets to identify project models. Throughout the portfolio analysis task, we will consider where we may add the most value to existing information collected and presented by the LRC given our access to the eJacket system.

Gather and review data from the MIS

Over the past 8 years, the LRC has collected a great deal of descriptive information on ITEST projects through its project profiles and annual questionnaire of project PIs (starting in 2009). The project profiles contain short descriptions of ITEST projects in all eight cohorts, which describe project goals and activities. They also contain basic descriptive data, which can be used to categorize ITEST projects across an array of dimensions such as project type (e.g., convening, research, strategies), populations served (e.g., students, teachers), geographic location (e.g., urban, rural, suburban) and area of focus (e.g., engineering, computer science, geography). The annual survey of project PIs delves deeper into who participates in ITEST projects, how often they participate, and in what kind of activities they participate. The LRC maintains these data in its MIS. So as not to duplicate data collection efforts, we requested and received access to these data from NSF and have begun preliminary analyses to characterize and categorize ITEST projects.

Gather and review data from eJackets

NSF's eJackets are electronic file folders that contain project documents such as project proposals, annual and final reports (including evaluation reports), and proposal funding justifications. We have begun to review each project's eJacket in order to supplement the descriptive data from the MIS, identify project partners and participating organizations, and identify dissemination strategies.

Coding Scheme

Our coding scheme is consistent with the taxonomy presented in LRC's MIS. Since the LRC has had considerable interaction with the projects, we will use this knowledge base as a starting point for basic descriptive data for the ITEST program. The field variables we will track, and their corresponding codes, are summarized in Exhibit 3 below.

Exhibit 3. Variables and Codes

Variable	Codes
Grade Served	K-2; 3-5; 6-8; 9-12
Topic Area	Bioscience; computer science; engineering; environmental science; mathematics
Project Components	Tech-based; class-work; career skills; field work; participation of scientists; mentoring; career planning; engaging STEM researchers
Technologies Employed	Geospatial technologies, programming tools, multi-media tools, data analysis/computation tools, visualization/computer modeling, hand-held devices, social networking tools, game development, electronics/robotics tools, engineering/design tools, virtual reality, communication tools, imaging tools, other tech tools
Use of Technologies	Learning tool, data collection (e.g. probes), data sharing (e.g. databases, social media), dissemination of findings (e.g. web page, social media)
Intervention Target and Numbers Involved	Student Focused [no count; fewer than 25; 25-50; 51-100; more than 100] Teacher Focused [no count; 1-10; 11-25; 26-50; more than 50] Hybrid [no count; 1-10; 11-25; 26-50; more than 50]
Project Format	Students [summer (<2 weeks); summers (>2 weeks); in school; after-school; weekends; youth employment; distance learning; online networking] Teachers [after-school; weekends; PD days; during school; summer institute with youth; summer program; distance learning; online networking]
Award Size	Dollar amount
Grantee Organization	College/university; government; industry; K-12; museum; non-profit; youth organization
Project Evaluators	Firm; individual; university institute; not specified
Evaluation Budget	As % of total budget
Dissemination	Presentation [conference; workshop; media; training; meeting] Publication [conference paper; journal article; book; book chapter; other] Product [website; curricula; software/hardware]
Partnerships	K-12; industry; college/university; non-profit; government; youth organization; community/tribal organization; museum; professional association
Region	New England; Middle Atlantic; East North Central; West North Central; South Atlantic; East South Central; West South Central; Mountain; Pacific
Urbanicity	Urban; rural; suburban; multiple

Analysis of MIS and eJacket Data

We will analyze the MIS and eJacket data in three sequential steps. The first step will be to calculate descriptive statistics such as frequencies and variances for each of the variables identified in Exhibit 3 above. These calculations will provide a description of the entire population of projects in the ITEST program. The second step of the analysis will involve the creation of a set of cross tabulations through which we can explore the relationship between different project characteristics. For example, if NSF is interested in whether there has been a discernible shift in the type of partnerships across cohorts, we would create a table as illustrated in Exhibit 4. Similarly, if NSF is interested in how technologies are used in conjunction with

specific project components (e.g. data collection probes in conjunction with participation of scientists) we could explore that cross tabulation. Such analyses would also allow for descriptions of change over time and between projects in different location types (urban vs. rural), for example.

Exhibit 4. Illustrative Table Shell: ITEST Project Partnerships by Cohort

	Cohort 1	Cohort 2	Cohort 3	Cohort 4	Cohort 5	Cohort 6	Cohort 7	Cohort 8
K-12								
College/University								
Non-profit								
Government								
Youth organization								
Community organization								
Museum								
Professional association								

The final step of the analysis will be model development, for which we will identify a set of common project models. This process involves identifying a set of project characteristics that "cluster" together. An example of a model might be urban-based projects involving partnerships between a school system and museums or other science-rich institutions to provide after-school experiences to K-12 students. The project models will be identified inductively from the data in the MIS and eJackets. Thus, the degree to which we will be able to create a set of unique models across settings and cohorts will depend on the empirical data.

Project Evaluations

The third component of the portfolio review is an analysis of the project evaluations. The goal of the evaluation review is to broadly characterize the types of evaluations conducted by ITEST project evaluators, assess the quality and rigor of these evaluations, and document the achieved outcomes in key areas for students and teachers. Data on project evaluations will be extracted from the eJacket system. For completed projects, we will review the project evaluations included in the final reports. For on-going projects, we will review the evaluation plans described in the proposals and the evaluation reports included in the annual reports.

While the ITEST solicitations require that ITEST project PIs conduct an evaluation of their ITEST project, there are few requirements that guide the type of evaluation to be conducted. As such, project evaluations employ disparate evaluation methodologies and serve a wide array of purposes. Given this diversity, we will begin our evaluation of each project evaluation by identifying the purpose of the evaluation (formative or summative) and characterizing the evaluation methodologies (e.g., experimental, quasi-experimental, one group pre/post, qualitative) employed in the project evaluations. Next, using the evaluation plans and evaluation reports, we will identify the outcomes of interest for students and/or teachers in each project evaluation. We will then categorize the outcomes and present a summary of the types of

outcomes targeted by the evaluations, as well as the relative success of projects in achieving the outcomes across all ITEST projects. Finally, we will assess the quality and rigor of the ITEST project evaluations. We will draw on the criteria used by the NSF-funded Online Evaluation Resource Library (OERL), which defines quality criteria for sound project evaluation plans, instruments, reports based on best practices information from the Joint Committee on Standards for Educational Evaluation, and the American Evaluation Association's Guiding Principles for Evaluators. The following questions, based on the OERL, will guide our review of each ITEST project evaluation:[1]

1. Does the evaluation reflect an understanding of the project logic model, including elements such as the goals/objectives, short-term and long-term outcomes, activities, stakeholders, and context?
2. Does the evaluation make clear what questions are to be answered?
3. What is the evaluation design? Is the evaluation design in line with the goals of the evaluation?
4. What is the sampling frame for the evaluation? What types of data are collected? How are the data collected? When is the data collected?
5. What instruments are used to collect data? What is the quality of the data collection instruments?
6. How are the data analyzed? Are the analysis methods appropriate, given the research questions and purpose of the evaluation? Are the interpretations of the results supported by the data?
7. What conclusions and recommendations were reported? Were the recommendations and conclusions backed by the data?

We will summarize answers to these questions to provide a description of the level of quality and rigor of project evaluations across all ITEST projects.

Data Collection and Coding Scheme

To assess the evaluations, we will code each project's evaluations along a number of dimensions that will enable us to answer the above questions based on the OERL. Exhibit 5 shows the specific variables we are interested in and the coding categories we will utilize, based on the pilot work done so far.

[1] Note that these criteria apply to projects that have served youth or educators, not convenings, workshops, or research projects, nor the LRC.

Exhibit 5. Variables and Codes for Evaluation Review

Variable	Codes
Evaluation type	Formative; summative
Evaluation goal	Implementation; impact
Student data sources	Attitude survey; evaluation survey; background survey; knowledge survey; observation; interview; focus group; standardized tests; ITEST attendance; grades; course enrollment; student work; logs; school attendance
Teacher data sources	Attitude survey; evaluation survey; background survey; knowledge survey; interview; observations; logs
Parent and staff data sources	Survey; interview
Evaluation designs	Experiment; quasi-experiment; pre-post with control; pre-post no control; post only with control; post only no control; qualitative
Instrumentation	Project-constructed; externally-constructed; reliability reported; validation of measures; psychometric properties
Analyses	Descriptive statistics; T-test; ANOVA; chi-square; regression; ANCOVA; qualitative only
Quality of evaluation	Integrity of comparison groups; sampling frame; coherence with project logic model; appropriateness of analytic methods; transparency (e.g. limitations of reported findings are adequately presented)

Analysis

Similar to the analysis of the project descriptions, the first step of the evaluation analysis will focus on descriptive statistics. This step will provide a descriptive summary of the range of evaluation purposes, methodologies, and outcomes assessed. The second step of the analysis will apply the evaluative criteria discussed above to assess the rigor of each evaluation and the value of the information it offers for the individual project and for the program overall. This evaluative lens also will enable us to identify exemplary evaluation practices and key challenges that projects encounter in conducting rigorous evaluations.[2]

In order to ensure the reliability of findings, we piloted our coding scheme and assessment criteria across a sample of evaluation reports using stratified random sampling. Using a statistical analysis program, we randomly selected three projects from each of cohorts 1 through 7 for review, for a total of 21 evaluation reports. As a part of the piloting process, two researchers independently read and reviewed the 21 reports, entering their evaluation codes into separate Excel databases. Upon completion of the reviews, the two Excel databases were combined and researchers' reviews were assessed for comparability. Inter-rater reliability was assessed for two questions: 1) are the interpretations supported by the data; and 2) what were the evaluation challenges.[3] This pilot enabled us to revise the instrument so that it adequately captures salient

[2] As discussed in the "Integrated Analysis" section below, these findings will be considered together with case study data to offer insight into NSF's ongoing efforts to make the programs it funds more evaluable.

[3] Researchers achieved very high inter-rater reliability on these items, achieving 100% agreement on whether the interpretations in the report were supported by the data and 97% agreement on evaluation challenges.

information from the full spectrum of evaluation reports. It also will enable us to train researchers in the use of the instrument so that data capture is consistent across coders. Moving forward, we will apply our coding scheme and assessment criteria to the full set of evaluation reports. We also will assess inter-rater reliability, as described above.

IV. CASE STUDIES

Over the course of the study, we will conduct 24 case studies to understand how ITEST projects function, what characteristics contribute to a model's success, and the impact of the projects on participants. We discuss the general approach to the 24 case studies in this section.

Case Study Sampling

Case study projects will be selected from "strategies" and "scale-up" projects. We are excluding convening and research projects from the case studies because they are not a central data source to answer the research questions of the evaluation (listed in Exhibit 2). Further, we will only include a scale-up project if we are able to collect the full complement of data at a single location.

We will employ a two-step strategy for selecting projects for case studies.

1. We will select 12 promising projects to enable us to answer the research questions: *What project models are most effective in delivering desired student and teacher outcomes? What project characteristics contribute to a model's success*? Promising projects will be identified through our review of project evaluations, discussed in the previous section, and recommendations from project officers. The goal will be to identify projects that have demonstrated the greatest impact on participants through a credible evaluation. Note that the sample may include a small number of projects that no longer receive ITEST funding, but which have been identified as highly successful and which have adequate data from which to draw.
2. After identifying 12 promising projects, we will attempt to select the remaining 12 cases so that the entire sample of 24 case study projects reasonably approximates the full range of ITEST projects along the following dimensions: topic area, project components, and project format.[4] While the small number of cases precludes a sample that is statistically representative along these dimensions, every effort will be made to achieve reasonable face validity for a sample of 24 cases that reflects the breadth of the ITEST portfolio. All active projects will be eligible for selection as part of this strategy with the exception of notably underperforming projects, since data from these projects will not help answer the research questions.

[4] Please see Exhibit 3 for codes detailing the range of categories for each dimension.

Case Study Data Collection and Instrument Development

Two-person evaluation teams will visit each project for 3 days—sufficient time to become immersed in a project. Projects that are larger in scope may require up to 2 additional days on site; projects that are no longer active may require less time on site. On-site activities will include interviews with the principal investigator, project staff, local evaluators, and partners as well as focus groups of participants. When practicable, we will schedule site visits at times that enable us to observe project activities such as a teacher professional development session or an afterschool class.

We considered three primary factors in developing interview protocols: (1) what do we want to measure, (2) of whom will we ask questions, and (3) what types of questions do we want to ask.

First, the logic model sets forth the constructs to be measured—what we want to know about. The case studies will focus on key elements of the theory of change outlined in the logic model, including the supports provided by the ITEST projects, improvements in the learning opportunities for students and teachers, and outcomes for participants.

Second, for each of the constructs, we determined the type of respondent with the knowledge to answer the question reliably. For example, the principal investigator and other project staff have information about the project context, funding streams, and project curriculum. The local evaluator will be able to describe the evaluation design, findings, and challenges encountered. Participants have information about their frequency of participation in the project and their intentions for seeking other similar opportunities. Where appropriate, we will ask multiple respondents questions to measure a single construct. This strategy enables us to triangulate findings across respondents and increase the reliability of the data collection. Examples of interview and focus group topics by respondent can be found in Exhibit 6. Draft interview protocols are included in the Appendix.

Exhibit 6. Illustrative Interview and Focus Group Topics by Respondent

Topic	Respondent					
	PI/Co-PI	Project Partner	Local Evaluator	Teacher (focus group)	Student (focus group)	Parent (focus group)
Project history, goals, context	X	X				
Project structure, partners, funding streams	X	X				
Model Components	X	X	X			
Implementation successes and challenges	X	X	X			
Perceived short-term and long-term impacts	X	X	X	X	X	X
Aspects of the project perceived to be most/least beneficial	X	X	X	X	X	X
Lessons learned for STEM learning models	X	X	X			
Evaluation design, goals, methods, challenges	X		X			
Partner goals		X				
Reasons for involvement		X		X	X	X
Frequency of involvement		X		X	X	X
Intentions of seeking similar opportunities		X		X	X	X
Prevalence of and efficacy in using technology			X	X	X	X
Project sustainability	X	X	X			

Third, the types of questions to pose depend on the information being collected. Most interview questions are open-ended to encourage respondents to talk about the issues that are important to them and their projects. Some questions, however, were designed to be closed-ended to enable the research team to count instances of a construct. We designed the protocols according to widely accepted principles that increase the reliability and validity of the instruments (see, for example, Patton, 2002).

To maximize the reliability of case study data, site visitors will be trained before going into the field and will receive a manual containing all materials relevant to case study data collection (e.g., selection criteria for respondents, protocols, consent forms, debriefing forms). The training will help team members develop a common understanding of the data collection and analysis goals. SRI has used a similar training model in other evaluations and has found that it increases the reliability of data collected by multiple researchers because shared understanding maintains consistency in data collection across projects and facilitates cross-project comparisons.

Case Study Data Analysis

The goal of the case study data analysis will be to first analyze the interview and focus group data within each project in an effort to understand the goals, structures, implementation, and outcomes as they are occurring in the context of each project. The evaluation team will then look across projects to identify cross-cutting themes and patterns related to the implementation and effectiveness of the program more broadly.

We will follow an iterative approach to analyzing the qualitative data, one that begins before each site visit, continues while on-site, and proceeds through the drafting of internal case study debriefing guides to cross-project analysis (See Appendix for the draft debriefing guide). Before we conduct the case studies, we will collect and review relevant documents (e.g., project proposals, annual reports, websites). The formal analytic process will begin as we sketch the outlines of each project on the basis of the documents we collect. Analysis will continue during the case studies themselves. Two researchers will conduct each case study, and throughout the visit, the team will discuss with each other their initial impressions about key features of the ITEST project and the degree to which the emerging story matches study hypotheses (drawn from the logic model). More formally, the researchers will meet each day of the visit to go through the case study debriefing form and formulate preliminary responses. Researchers will discuss with each other what they learned in their interviews and, if necessary, fill in any gaps and examine initial hypotheses in subsequent interviews. Researchers also will discuss themes that emerge that they may not have anticipated. Engaging in this analytic process while on-site serves to tailor and refine data collection to capture the most important features of local implementation. It also allows researchers to generate and test hypotheses while still in the field.

Once each visit is completed, researchers will draft case study reports. Drafting such reports requires the researchers to reduce their field notes to descriptive prose within the structure of a formal debriefing form. This translation of field notes to a case study report involves sorting all the data collected in each site (interviews, observations, and document reviews) by the topic areas that define the sections of the debriefing form (e.g., project context, project components, implementation successes and challenges, and project effectiveness). Within each section or major topic area, the researchers will code for information on specific subtopics. The researchers then will use the sorted data to draft each section of the case study report. Because the researchers will draw on information from a variety of respondents, they will use the case study report to synthesize their findings and note apparent contradictions. As they translate their field notes into the case study report, they will use specific examples and quotes as evidence for their assertions. Distilling field notes into a case study report in this way serves three purposes. First, it reduces the amount of data we must manage for further analysis. Second, it establishes a consistent within-case analytic process across projects. Third, it anticipates the cross-project analysis by seeing that each pair of researchers address the topics we expect to focus on as we look across projects. The debriefing form that will guide the case study reports reflects the evaluation questions and topic areas discussed in this document.

The case study reports are meant to facilitate cross-project analysis. Once the individual reports are completed, formal cross-project analysis will begin. The goal of the analysis is to compare, contrast, and synthesize findings and propositions from the single projects to make statements about the sample or segments of the sample (e.g., informal or formal projects). We

will begin the cross-project analysis process with a debriefing meeting. A debriefing of this type is an efficient means of developing themes for cross-project analyses. Individual researchers, assigned to specific topics, then will conduct more fine-grained analyses and report back to the larger group before we begin the process of integrating findings from across the data sources.

Integrated Analysis

The previous sections describe our analytic approaches for each of the data sources. We also will conduct an integrated analysis that looks across the multiple data sources. The integrated analysis will focus on three lines of inquiry critical to ITEST and to NSF's ongoing support of similar programs: 1) through what mechanisms, and under what circumstances, are the ITEST projects resulting in changes in formal and informal learning opportunities, teacher outcomes, and student dispositions and capabilities; 2) which project models are most effective in achieving desired goals; and 3) how can the ITEST program, and similar NSF-funded programs, be made more evaluable?

To understand through what mechanisms, and under what circumstances, ITEST projects result in positive outcomes, we will expand on findings from the portfolio review by drawing on the rich and highly contextualized case study data. Findings from the portfolio review will provide program-level data on project components and outcomes. Case study data will provide details about the particular contexts in which the projects are operating and the learning experiences provided, and specifics on how project implementation evolves over time. By analyzing these data together, we will be able to identify the characteristics of successful projects across the ITEST portfolio.

To understand what project models are most effective in achieving project goals, we will use case study data to test and elaborate the project learning models that emerge from the portfolio review. Whereas the portfolio review will offer broad outlines of the STEM learning models employed across the ITEST program, case study data will enable us to refine these models in light of a nuanced understanding of on-the-ground practices. In order refine the learning models, we will use an inductive analytic strategy (Erickson, 1986). We will begin the task by analyzing data from the portfolio analysis to develop working theories of potential models. We will then test and refine these models with iterative passes through the more descriptive and explanatory case study data. Once we are satisfied that additional passes through the data will yield no new insights, we will apply a comparative lens across models to better understand which are most effective and which are most problematic in achieving desired goals.

To understand how the ITEST program, and similar NSF-funded programs, can be made more evaluable, we will scrutinize data about ITEST evaluation practices across the portfolio, using case study data to better understand the successes and challenges projects encounter in conducting rigorous evaluations. In this effort, we will seek to understand what kinds of information are most useful to individual projects and to NSF, as well as how that information may be best collected, analyzed, and communicated. Moreover, we will explore ways in which the needs of individual projects for timely and tailored information may be balanced with NSF's need for program-level information that is commensurable across projects.

Taken together, the components of the integrated analysis will help NSF tailor solicitations in ways that lead to projects with a higher likelihood of success, fund projects employing more promising models, and rigorously evaluate the effectiveness of funded projects. As such, this evaluation will help NSF to continue making investments likely to lead to desired outcomes.

VI. INSTITUTIONAL REVIEW BOARD

It is SRI's policy that investigators respect and protect the rights and welfare of individuals recruited for or participating in research conducted by or under the auspices of SRI. SRI strictly adheres to the Federal Policy for the Protection of Human Subjects, or the "Common Rule," as codified in separate regulations by a number of Federal departments and agencies. SRI's involvement of human subjects in research comes under the terms of a formal assurance with the Office for Human Research Protections of the Department of Health and Human Services. All SRI staff or contractors who conduct, support, or review research involving human subjects must comply with the regulations identified in that assurance, as well as applicable state and institutional policies and standards of professional conduct and practice. SRI's Institutional Review Board (IRB) has the primary responsibility for the oversight of the protection of human subjects involved in any SRI research project in accordance with such regulations.

VII. TIMELINE

Exhibit 7 details the timeline for project activities and associated deliverables.

Exhibit 7. Evaluation Timeline

Task	Year 1				Year 2				Year 3			
	2010	2011			2011	2012			2012	2013		
	F	W	Sp	S	F	W	Sp	S	F	W	Sp	S
Revise Design	●	●	●		●							
Convene expert panel			●				●				●	
Submit OMB package				●		●						
Analyze portfolio				●	●	●	●				●	●
Conduct case studies							●	●	●	●	●	
Create reports		●		●		●		●		●		●

*__F__ = October, November, December; __W__ = January, February, March; __Sp__ = April, May, June; __S__ = July, August, September

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APPENDIX:

DRAFT DATA COLLECTION INSTRUMENTS

Principal Investigator Interview Protocol

Personal Background

1) Please tell me about yourself.
    a. What is your current role? How long have you had this position?
    b. How long have you been involved with this ITEST project?

Project Background

2) Tell me a little bit about how the ITEST project came to be?
    a. What was the motivation to apply for the award?
    b. Was the project based on a previously funded ITEST project?

3) Tell me a little bit about the planning process?
    a. Who was involved in the planning process? Probe for:
        a. Key staff from your institution
        b. Key external partners
        c. Key stakeholders
    b. If your project works with schools, was there a process for selecting schools to participate?

4) Is there additional funding for the project beyond the NSF ITEST funding?
    a. What are those specific funding sources?
    b. How have they been used?

5) What were the project's key goals as conceived at the beginning of the project?
    c. Have those goals changed since the beginning of the project?

6) Were there any other external/contextual factors that had a large influence on the design of the project? Probe for:
    a. Resources (or lack thereof) in the local community or schools
    b. Local school district initiatives
    c. Priorities of your institution
    d. Priorities of other local institutions

Project Participants

7) Who participates in the program? Probe for:
    a. Special characteristics of participants
    b. Numbers of participants

8) How are participants recruited to the program?
    a. Which methods are most successful (and how do you know)?
    b. What do you think motivates participants to become involved?

9) Do most participants persist through the entire program?

Project Activities

10) Briefly describe what your project does.
    a. Include activities and number of contact hours.
    b. Is there any variation in the experience of the participants?
    c. What technologies are used (or learned) by participants or by the project at large?
    d. How are technologies used (e.g., as a learning tool, for data collection, for data sharing, to disseminate findings)

11) Which strategies have been implemented well and what has facilitated implementation?

12) Which strategies have been the most difficult to implement?
    a. What is being/has been done to address these challenges?

13) How has the project evolved over time?
    a. What changes were made? Why?
    b. Have these changes been effective?
    c. What changes do you see (if any) going forward?

Evaluation and Outcomes

14) Do you have any data on the effectiveness of your project?

15) Describe your external evaluation.

16) How are the evaluation results used?

17) What have been the key short-term and long-term outcomes for the teachers involved in your project?
    a. How do you know?
    b. Do outcomes vary based on group (e.g., cohort, grade level, school)

18) What have been the key outcomes for the students involved in your project?
    a. How do you know?
    b. Do outcomes vary based on group (e.g., cohort, grade level, school)?

19) What have been the key contributions and benefits to project staff (e.g., knowledge, relationships, connections and networks, etc.)

20) What have been the key contributions and benefits to the host institution (e.g., increased capacity, shifts in mission, etc.)?
    a. What about for external partners involved in the project?

Sustainability and Scale-up

21) What are the current plans for the project when the grant period ends?
    a. What resources are needed to continue the project?
    b. If you plan to continue in some way, what is the plan for providing the resources to support the project?

22) Has the project model been implemented at other institutions or in other communities?
    a. If yes: What part(s) of the model was implemented? Were there any challenges in scaling-up the model?
    b. If no: What would it take to scale up and reach multiple institutions or communities? What do you see as the barriers to scaling up this type of work?

The ITEST Community

23) To what extent does your project interact with the LRC?
    a. What do you see the most important role or roles of the LRC?
    b. How would you describe your interactions with the LRC?
    c. What have you gained, if anything, from the LRC?

24) To what extent do you work with, share advice, or otherwise interact with other ITEST projects?
    a. What do you interact about? How often? Where?
    b. What have you gained, if anything, from these interactions?
    c. Do you know of any examples where insights you've shared about your project have helped to improve other projects?

25) To what extent are project staff contributing to the larger ITEST or STEM education community. Probe on:
    a. Attending ITEST PI meetings
    b. Participating in LRC working groups
    c. Uploading instruments to the LRC
    d. Publishing journal articles or presenting papers at conferences.
    e. Creating products that can be of use to STEM educators

Closing Questions

26) What have been the major successes of your project? What about major challenges?

27) What are the key features and lessons learned from this project that might be of interest to others engaged in similar work with teachers or youth?

28) What is the likelihood that participating in this project will influence the STEM academic and career outcomes for youth participants, or students of teacher participants?

Project Partner Interview Protocol

Personal Background

1) Please tell me about yourself and your organization.
    a. What is your current role? How long have you had this position?
    b. Have you done work related to STEM education in the past?
    c. Do you have experience working with the targeted participant group (e.g., teachers, middle school girls, etc)?

2) When did you start working with this ITEST project (e.g., in the design phase, after it was operational)?
    a. Did you have an existing relationship with the PI or project staff? If not, how did you become involved in the project.

Project Background

3) Were you involved in the planning process? If you were, tell me a little bit about the planning process?

4) How would you characterize your organization's level of involvement in this project?
    a. Number of staff members involved
    b. Types of project roles filled by your organization's staff.
    c. Other resources contributed to the project

5) What are the key goals of this project?
    a. Have these goals changed since the beginning of the project?
    b. How do they relate to your organization's goals?

6) Were there any external/contextual factors that had a large influence on the design of the project? Probe for:
    a. Resources (or lack thereof) in the local community or schools
    b. Local school district initiatives
    c. Priorities of your organization
    d. Priorities of other local institutions

Project Participants

7) What is your role, if any, in recruiting participants?
    a. Which methods are most successful (and how do you know)?
    b. What do you think motivates participants to become involved?

Project Activities

8) Briefly describe the project's interventions that you are involved with.
    a. Include activities and number of contact hours.
    b. Is there any variation in the experience of the participants?
    c. What technologies do you use and for what purposes?

9) Which strategies have been implemented well and what has facilitated implementation?

10) Which strategies have been the most difficult to implement?
    a. What is being/has been done to address these challenges?

11) How has the project evolved over time?
    a. What changes were made? Why?
    b. Have these changes been effective?
    c. What changes do you see (if any) going forward?

Evaluation and Outcomes

12) Do you have any data on the effectiveness of the project?

13) How are the evaluation results used?

14) What have been the key short-term and long-term outcomes for the teachers involved in your project?
    a. How do you know?
    b. Do outcomes vary based on group (e.g., cohort, grade level, school)

15) What have been the key outcomes for the students involved in your project?
    c. How do you know?
    d. Do outcomes vary based on group (e.g., cohort, grade level, school)?

16) What have been the key benefits of this work for your organization (e.g., increased capacity, shifts in mission, etc.)?

Sustainability and Scale-up

17) What are the current plans for your organization's involvement in the project when the grant period ends?
    a. What resources are needed to continue the project?
    b. If you plan to continue in some way, what is the plan for providing the resources to support the project?

18) Has the project model been implemented at other institutions or in other communities?
    a. If yes: What part(s) of the model was implemented? Were there any challenges in scaling-up the model?
    b. If no: What would it take to scale up and reach multiple institutions or communities? What do you see as the barriers to scaling up this type of work?

The ITEST Community

19) To what extent do you think this project contributes to the STEM education community. Probe on:
    a. Publishing journal articles or presenting papers at conferences.
    b. Creating products that can be of use to STEM educators

20) To what extent do you work with, share advice, or otherwise interact with other ITEST projects?
    a. What do you interact about? How often? Where?

Closing Questions

21) What have been the major successes of the project? What about major challenges?

22) What are the key features and lessons learned from this project that might be of interest to others engaged in similar work with teachers or youth?

23) What is the likelihood that participating in this project will influence the STEM academic and career outcomes for youth participants, or students of teacher participants?

Evaluator Interview Protocol

1) Please tell me about yourself
    a. What is your current role? How long have you had this position?

2) When did you start working with the ITEST project (e.g., in the design phase, after it was operational)?
    a. Relationship with the project staff?

3) Tell me a little bit about the planning process for the evaluation?
    a. (If involved in design phase) Was evaluation a significant concern during the planning of the project?
    b. How did you determine the focus of the evaluation?
    c. What were your considerations when designing the methodology?

4) What are the purposes of the evaluation (e.g. formative, summative)?

5) Can you describe the design of your evaluation? (e.g., quasi-experimental, qualitative with control group, etc)
    a. What are your evaluation questions?
    b. What types of data do you collect? Probe for:
        i. Surveys
        ii. Focus groups/interviews
        iii. Knowledge assessments
        iv. Attitude assessments
        v. Standardized test scores
        vi. Observation data
        vii. Student records (including future enrollment)
    c. Have you developed your own instruments?
        i. If so, have you shared those with the ITEST communities?
        ii. If no, where did you get your instruments?
    d. How often are data collected?

6) Have there been any challenges in collecting data? (e.g., if project involves external partners, have they been cooperative with the evaluation; if evaluation involves a control group, has it been easy or difficult to identify and collect data for them)

7) Do you plan on making (or have you already made) changes to your evaluation design? Why? Please describe the changes.

8) At this point in the project, do you have data on the outcomes of interest? What have you found?

9) How do you share results with project staff?
    a. Do you share your results more widely (e.g., web site, conferences, publications)

10) Do you see any evidence that the project is using the evaluation results?
    a. Give an example.

11) To what extent do you work with, share advice, or otherwise interact with other ITEST project evaluators?
    a. What have you gained, if anything, from these interactions?

12) To what extent do you as an evaluator interact with the LRC?
    a. What is the nature of most of your interaction with the LRC?
    b. What have you gained, if anything, from the LRC?

Teacher Focus Group Protocol

1) Let's begin by going around and saying names and your position(s) at the school.

2) How did you hear about the ITEST project?
    a. What motivated you to participate?
    b. Do you participate with other teachers from your department? school? district?
    c. Have you ever done anything else similar to this type of a project?

3) What activities are you engaged in as part of the project?
    a. How often do you attend?

4) As a result of your work with this project, have you gained specific knowledge or skills? Probe for each of the following:
    a. Use of technology
    b. Curriculum or instructional plans
    c. Hands-on activities for the classroom
    d. Creating a community of learners
    e. Content knowledge
    f. Other?

5) How, if at all, have you implemented what you learned in your classrooms? Ask for SPECIFIC EXAMPLES.

6) As a result of your work with this project, do you think differently about your future as a STEM educator?

7) What activities have been most valuable to you in your development as a STEM teacher? Why?

8) What activities have been least valuable to you in your development as a STEM teacher? Why?

9) What, if any, new roles have you taken on at your school as a result of your participation in this project?

10) Have you been able to share what you learned with colleagues who did not participate?

11) Would you participate in another similar project if you had the chance? Why?

Student Focus Group Protocol

1) Let's begin by going around and saying your name and your grade level.

2) How did you hear about this project?
    a. Why did you decide to participate?
    b. Have you done anything like this before?
    c. Did you know many of the other people in the program before it started?

3) What kinds of things do you do in this program?
    a. What technologies or devices did you use?
    b. How often do you attend?

4) What do you like most about the program?

5) What do you dislike about the program?

6) What kinds of things have you learned from this program? Get specific examples.

7) How many [science/math/technology] classes do you plan to take in high school? Do you plan on taking any AP [science/math/technology] classes?

8) What do you want to do after high school? If they want go to college, ask:
    a. What do you want to study in college
    b. What do you want to do when you graduate college?

9) Has this program changed what you want to do in or after high school? What about after college? If yes:
    a. How has it changed?
    b. Why did it change?

10) Have you learned about a career that you didn't know existed, or didn't know much about, before you participated in this program?

11) Do you know how to do things on a computer or with other technology, that you didn't know about before you participated in this program?

12) Does participating in this program make a difference in how much you like your [science/math/technology] class during the school day?
    a. Does participating make a difference in how much (or what kind of) science/math/technology you plan to take in high school?

13) Would you want to do something like this again?

14) Have you done anything since participating in this project that you think is related to the kinds of things you did with the project? Probe for:
    a. Invented, designed or built something on your own.
    b. Participated in a science or engineering fair or event.

ITEST Program Evaluation
Case Study Debrief Guide

Project title:
Grantee institution:
Principal investigator:
Year awarded:
Award type:
Dates of site visit:
Site visitors:

1. Summary
Provide a 1-page story of what we learned, focusing on a brief overview of the project, the environment in which it operates, key strengths, and struggles.

2. Project Background
What factors impact the design, implementation, and impact of the ITEST project?

2a. Describe how the ITEST project came about. What was the motivation or the impetus for the project? Who were the early stakeholders/partners? Is this a new project or were grant monies used to expand/modify an existing project? If based on an existing project was the existing project ITEST funded?

2b. What STEM areas are addressed in the project? What are the goals of the project (e.g., building content knowledge, providing research experiences, serving underserved communities)?

2c. Describe the local context and the implications for the project (e.g., Have resources or lack of resources available in the local community affected the design or implementation of the project? Have priorities of the school districts or local institutions affected the project?)

2d. How does the ITEST project cohere or conflict with other salient initiatives of the participating institutions?

3. Project Strategies
Provide a comprehensive description of the project and its participants.

3a. Who does the project serve? Provide numbers of teacher and student participants and their characteristics.

3b. What recruitment strategies are used? Which are most successful (and how do they know)? From participants' perspectives, what motivates them to become involved?

3c. Describe the core strategies the project is using. What are the major programmatic elements for teachers and/or students? How often do participants meet? What is the duration of each strategy? Is there any variation in experiences of participants?

3d. What technologies are used in the project? For what purposes?

3e. What is the environment in which the project occurs and what resources are available (e.g., technology)?

3f. Which strategies have been implemented well and what has facilitated implementation?

3g. Which strategies have been the most difficult to implement? Why? What is being/has been done to address these challenges?

3h. Have there been any changes to the project over time? What changes were made and why?

4. Project Administration

Provide a comprehensive description of the project staff and funding mechanisms.

4a. Describe the structure of the project staffing. What organizations are project staff from and what are their various roles? Describe the relationship among staff from different organizations. What enables them to work well together, if they do? Are there any challenges to the working together?

4b. Has the project leveraged funding from other sources to support the project? Describe specific funding sources and how these additional resources have been used.

5. Project Outcomes

Provide an overview of the outcomes measured by the project for both formative and summative purposes.

5a. Describe the data they collect, how they collect it, and what they do with it. Include formative evaluations and summative evaluations of outcomes. How useful have the evaluations been to the PI and other project staff?

5b. What short- and long-term outcomes have been identified by project staff? Are there differences in outcomes across participants (e.g., by grade level, or length of participation)? To what do they attribute those differences?

5c. What did the participants report getting out of the project and to what did they attribute those outcomes? Are there differences across participants?

5d. What have the PI and other project staff report getting out of the project (e.g., increased knowledge and experience, a wider professional network)?

5e. Have there been any institutional changes due to the project (e.g., increased capacity, refocusing of resources)? What prompted these changes?

6. Sustainability and scale-up

What are the prospects for project sustainability and scale-up?

6a. What do project staff anticipate will come of the project when the grant runs out? (e.g., Will it be sustained as is, end, be modified, or shifted into another grant?) What would be needed to ensure sustainability? What are the barriers to sustaining the project?

6b. Has the project model been implemented at other institutions or in other communities? What would be necessary to make scale-up possible? What are the barriers to scale-up?

7. The ITEST community

What has been the contribution of the ITEST community, including the LRC, on the project?How has the project contributed to the larger ITEST community?

7a. Do what extent does this project connect with the LRC? With other ITEST projects?

7b. Have these connections had an effect on the design or implementation of this project?

7c. Have these connections contributed to building the capacity of the project to achieve its overarching goals?

7d. To what extent are project staff contributing to the larger ITEST community (e.g., attending PI meetings, participating in LRC working groups, uploading instruments to the LRC)?

8. Other Interesting Points

Are there any other issues that are important for our understanding of the implementation or outcomes of this project?