ITEST DATA BRIEF

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The Innovative Technology Experiences for Students and Teachers (ITEST) program was established by the National Science Foundation in direct response to current concerns and projections about the growing demand for and current shortages of STEM (Science, Technology, Engineering and Mathematics) professionals in the U.S. and seeks solutions to help ensure the breadth and depth of the STEM workforce. The ITEST National Learning Resource Center at Education Development Center, Inc., supports projects and synthesizes and disseminates the program's learnings to a wide audience.

This Data Brief explores project level findings reported in the 2011–2012 MIS. It does so by examining the responses to several main questions regarding projects' research and/or evaluation questions, outcomes measured for students and teachers, and findings to date. Overall, these results shed light on the collective findings from the ITEST program, and provide examples of successful participant outcomes and project implementation strategies of interest to the ITEST Community and NSF. Additional and more in-depth analyses of MIS questionnaire data will likely uncover further evidence of replicable models from ITEST that contribute to the knowledge base on science, technology, engineering and mathematics (STEM) education and workforce development.

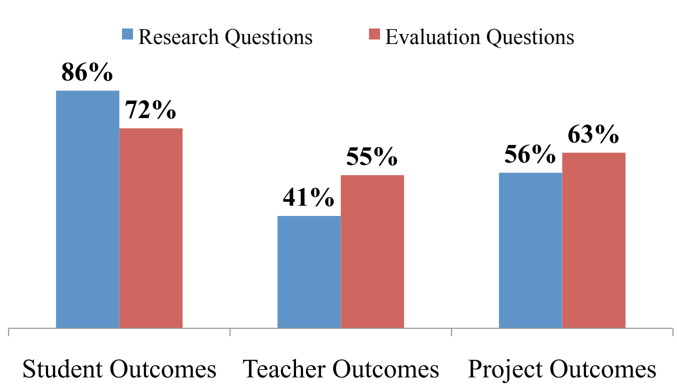
Summary of Project Findings from the 2011–2012 ITEST Management Information System (MIS)

Since 2003, the ITEST Learning Resource Center (LRC) at EDC has been funded by the National Science Foundation (NSF) to provide technical assistance and support to ITEST projects. The LRC's approach to technical assistance focuses on developing a community of practice among ITEST project teams, who share expertise and lessons learned with their peers to continuously improve practice across the program. Starting in 2009, the LRC, in coordination with NSF program officers, began to collect data from ITEST projects using a Management Information System (MIS) questionnaire. The results of MIS *inform NSF, the LRC, the ITEST projects, the field, and other stakeholders as to the state of ITEST: who participates, how often, when, and in what kind of activities.* Three versions of the MIS are administered each year: (1) the baseline version asks projects about their targets—populations, technologies, etc.; (2) the annual version includes the same questions but asks for the *actual* results for the previous year; and (3) the final version asks for a summative report over the entire project life cycle.

What Projects Are Investigating

All 83 projects that completed the MIS questionnaire were asked to include their research or evaluation questions. A thematic analysis of responses shows that most projects are examining student, teacher, and/or project outcomes (*Figure 1*). Many of the questions relating to student and teacher outcomes are focused on STEM career knowledge, skills, and dispositions. Project outcomes are mostly focused

Figure 1. Percentage of projects reporting research and evaluation questions by outcome area



on questions regarding effectiveness, including how the project accomplishes its goals, and scalability.

Project Findings Are Aligned with Intended Outcomes

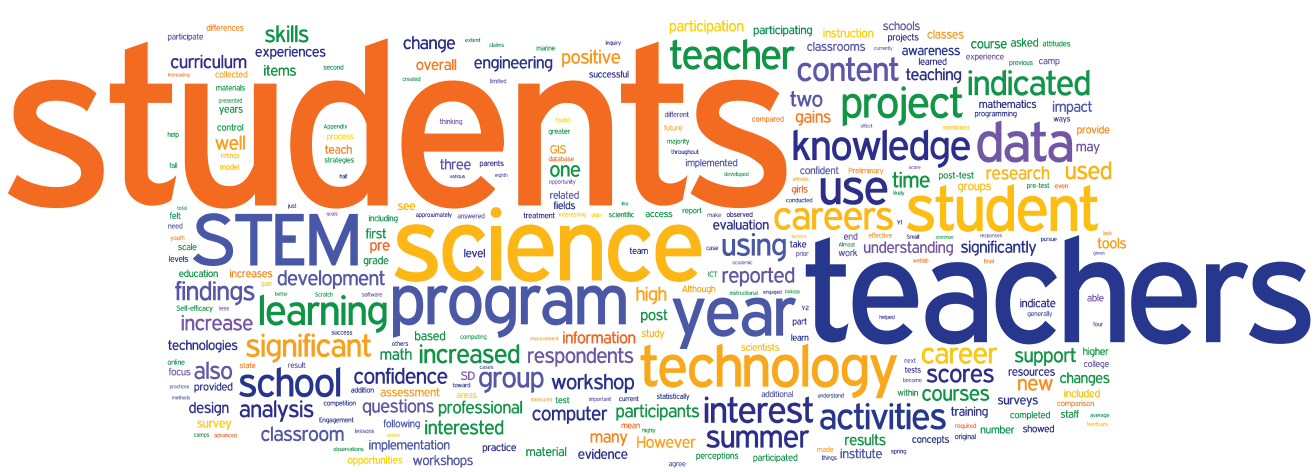
In the MIS questionnaire, the LRC provided a list of different youth and teacher outcomes and asked Principal Investigators (PIs), program managers, and evaluators to identify which ones they measure. These outcomes are drawn from project descriptions as well as from responses to open-ended questions on previous versions of the questionnaire. The most common youth outcome measured is youth interest in STEM, followed closely by youth interest in STEM careers (*Table 1*). More than 85 percent of projects working with youth measure one or both of these outcomes. The most prominent teacher outcomes include changes in teacher practice/pedagogy, changes in teacher knowledge of how to use the cyberinfrastructure/technology tools in their teaching, and changes in implementation of ITEST materials (*Table 2*).

Seventy-one of the projects completing the annual and final versions of the MIS questionnaire were also asked to provide a brief summary of their project findings, which the LRC analyzed using thematic codes. Of these projects, six reported limited findings and seven were not able to report findings at all because they were either in the process of collecting data or the relevant data had not yet been analyzed. Those seven projects are not included in this analysis.

Not surprisingly, projects' reported findings are closely aligned with their intended outcomes. The MIS questionnaire included two questions that lists outcomes for teachers and students and asks PIs, program managers, and evaluators whether their project measures them. When these outcomes are compared with the open-ended responses regarding findings, there is strong consistency in the categories identified (see *Tables 1 and 2*). The percentage differences reflect the fact that when checking off outcomes, projects identified a mean of 8.7 outcomes for youth and 4.4 for teachers. In contrast, when writing about project findings, the mean number of findings identified was 1.4 for youth and 0.8 for teachers.

When looking at the teacher outcomes and findings, the most common response was changes in teacher practice/pedagogy. This emphasis on teacher practice contrasts with the other top outcomes, all of which focused on STEM or on technology. However, in their written

Figure 2. Text cloud identifying the most commonly cited words and terms included in project findings



descriptions of project findings, PIs often merged pedagogical goals with STEM goals, as the changes in pedagogy they identified are intimately linked with the integration of STEM in the classroom.

Table 1. Top reported outcome areas and project findings related to youth/students

	Outcomes (n=72)		Findings (n=64)	
	% of projects	*rank*	*% of projects*	*rank*
Changes in youth interest in STEM	90%	1	20%	2
Changes in youth interest in STEM careers	88%	2	19%	3
Changes in youth engagement in STEM	78%	3	13%	6
Changes in youth STEM content knowledge	75%	4	30%	1
Changes in youth knowledge of STEM careers, preparation and/or workplace demands	72%	5	16%	4
Course(s) taken in STEM fields*	--	--	13%	5

*This item was not listed as an option for outcome area measured, but was present in the open-ended question regarding project findings.

Table 2. Top reported outcome areas and project findings related to teachers

	Outcomes (n=70)		Findings (n=71)	
	% of projects	*rank*	*% of projects*	*rank*
Changes in teacher practice/pedagogy	67%	1	27%	1
Changes in teacher knowledge of how to use cyberinfrastructure/technology tools in the context of STEM teaching	61%	2	9%	5
Changes in teacher implementation of ITEST materials	60%	3	17%	2
Changes in teacher use of cyberinfrastructure/technology tools	57%	4	8%	6
Changes in self-efficacy in teaching STEM content	53%	5	11%	4
Changes in teacher STEM content knowledge	51%	6	14%	3

Youth/Student-Related Findings

As indicated in Table 1 above, the major findings related to youth are:

- Increased STEM content knowledge and skills
- Increased interest and engagement in STEM
- Increased interest in preparation for STEM careers

In many cases, projects reported gains in one or more of these areas. In some cases, there was specific mention of the STEM disciplines such as engineering or mathematics but very few mentions of more specific fields such as astronomy or biology. In addition, many referenced the use of pre- and post-surveys or assessments in their description of gains in these areas.

There were several PIs, evaluators, and staff who reported mixed results with students. In some cases, there were gains in one area but not others (such as an increase in content knowledge, but little or no change in interest in STEM or STEM careers). In other cases, there was a lack of consistent change in skills or interest over multiple years or implementation periods. In just a couple of instances, there were reported declines in

"Students indicated clearly that they see science and technology as crucial to their academic success and essential for college preparation. In addition, they universally indicated that technology in particular opened a wide variety of options for future careers, well beyond the stereotypical engineering jobs. A few students even discussed their passion for art and how technology can elevate the arts and other non-scientific professions."

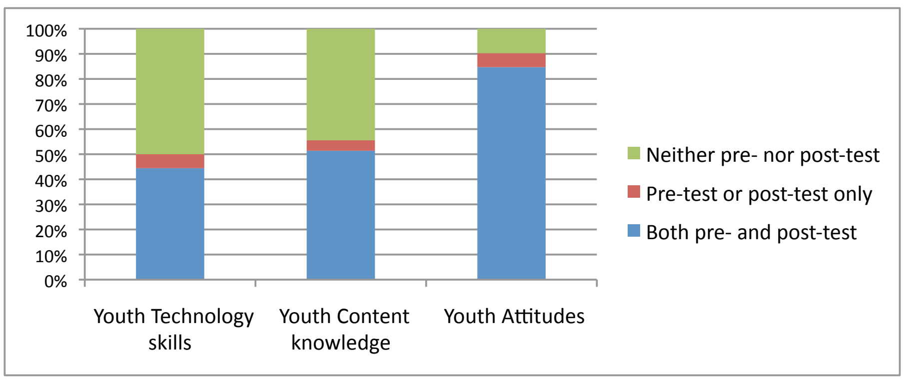
—ITEST Program Manager

Measuring change: Instruments used in ITEST projects

The most common instruments identified in the MIS questionnaire for measuring youth outcomes were written pre- and post-assessments of youth attitudes toward STEM. Two qualitative measures were also used by more than half of the projects: observations (67 percent) and interviews (51 percent) of youth. Half of the projects used performance-based assessments, and 39 percent used embedded assessments.

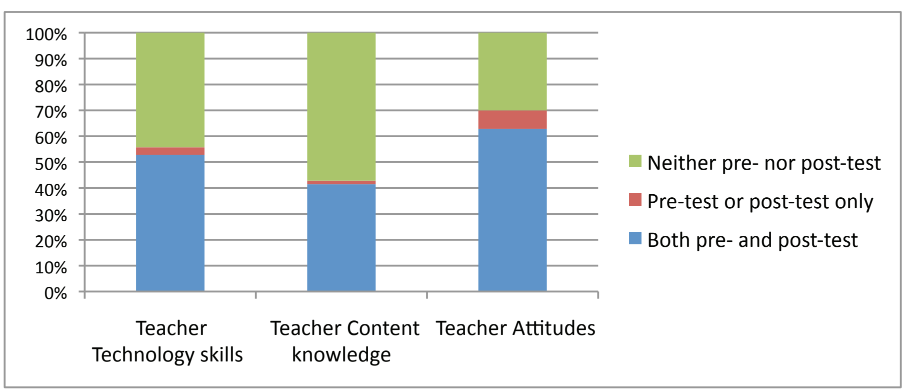
Because pre- and post-assessments have consistently emerged as the most common instrument used in ITEST projects, this year's MIS questionnaire asked projects to clarify whether or not the assessments were written, and divided the instruments into youth content knowledge, technology skills, and attitudes. Fully 85 percent of projects use written pre- and post-assessments of youth attitudes (*Figure 3*), while a smaller percentage of projects measure pre- and post-assessments of technology skills and content knowledge.

Figure 3. Percentage of projects using pre- and/or post-assessments of youth technology skills, content knowledge, and attitudes (n=72).



Written pre- and post-assessments were also the most common instruments for measuring teacher change, with pre- and post-assessments of teacher attitudes toward STEM more common than those measuring technology skills or content knowledge (*Figure 4*).

Figure 4. Percentage of projects using pre- and/or post-assessments of teacher technology skills, content knowledge, and attitudes (n=70).



students' interest in STEM or STEM careers. One PI, concerned with these findings, suggested potential issues with response bias on the pre-test (when students may have provided higher than normal scores due to social desirability) or poor responses on the post-test (which was scheduled at the very end of the school year).

Teacher-Related Findings

The major findings related to teachers are:

- Improved pedagogical skills, including enhanced integration of technology and teaching STEM content
- Improved STEM content knowledge and skills

Just as they reported with youth, PIs and staff also mentioned pre- to post-program gains for teachers. They shared evidence that indicates teachers are improving their STEM content knowledge and skills and are able to teach these concepts to their students. When they discussed the changes in pedagogical skills, they often wrote about increased use of technology and integration of ITEST project materials and curricula. There were also frequent mentions of changes in the ways that teachers interacted with youth, often by implementing new or innovative methods of engaging students.

Project-Level Findings

In addition to reporting on findings regarding students and teachers, PIs and staff mentioned findings related to the implementation of their projects. Twelve projects identified effective professional development or instructional strategies in their summary of project findings. They often referred to the way that activities were structured or delivered as well as the use of specific technology tools. For example, some projects found it very effective to use hybrid models of professional development with teachers; they were able to determine the appropriate balance of in-person interactions, along with structured virtual follow-up. Projects that work with students highlighted the importance of making activities interesting, authentic, and relevant in helping students' understanding of the content and potential applications.

"Teachers have included more real-world examples in their instruction and tied those examples to careers. One teacher talked about his efforts to integrate and connect the sciences through project-based learning. They have integrated more technology of all types, and appear to be less intimidated by technology, an attribute which we will investigate in future rounds of funding. Students have been given opportunities to teach classes in soil and water testing, use GPS units, give presentations to various groups and become leaders in other learning environments."

—ITEST Principal Investigator

Limitations in Reporting Findings

There were a few limitations in analyzing project findings, and synthesizing these results proved to be very challenging. One of the greatest constraints was the rather open-ended nature in which PIs and staff were asked to report on their projects' findings. While this open-ended question yielded rich descriptions, the responses varied greatly in substance, length, and focus. Moreover, a number of PIs and staff, due to where they are in their implementation cycle, could not provide a complete summary because they did not have the relevant data or results on which to report. Finally, the diversity of the ITEST program added another layer of complexity. While the assortment of content areas, implementation models, types of participants, and project goals distinguishes ITEST from many other STEM education programs, they also complicated the analysis. Despite these difficulties, common themes emerged from the data that enabled the LRC to provide a broad overview of findings from the program. These responses also will inform future revisions to the MIS questionnaire.

Summary

These findings reveal that ITEST projects develop and enhance youth and teacher participants' knowledge, skills, and dispositions. The three main areas of impact include: (1) STEM content knowledge and problem-solving skills; (2) STEM interests and dispositions; and (3) STEM career knowledge, interests, and awareness. In addition to building teachers' STEM content knowledge and skills, many projects provide experiences that facilitate changes in teachers' practice. While these experiences bring new technologies to the classroom, they also offer educators opportunities to learn how to integrate pedagogical practices such as student-based inquiry or project-based learning.

ITEST PIs and staff also reported that they developed effective professional development and instructional models and strategies. In some cases, the use of the technology provided a "hook" for the basis of instruction. In others, projects developed and refined certain processes, such as providing professional development both in-person and online, that contributed to successful implementation.

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