Question Responses:
Proposed ETEAMS Prototype Targeted Partnership (MSP-1321319)

Submitted July 3, 2013 by Jim Silliman, PI, Texas A&M University – Corpus Christi

In response to questions received in a June 25th, 2013 email from David L. Haury, Program Director, National Science Foundation, more than a dozen ETEAMS personnel have worked over an eight day period to address concerns identified in the questions, collect additional information, and develop detailed descriptions of program components. The project leadership is excited for the opportunity to share more details on the proposed prototype and is eager to provide any additional information needed to support the proposal selection and award process.

Question #1. Courses for pre-service teachers

While reviewers were strongly supportive of your intention to engage Fellows in authentic research experiences, it was not clear to reviewers what changes, if any, are planned for the courses that participants take in the teacher preparation program. Please clarify what changes you are planning for the courses that participants in the ETEAMS project would take. For instance, on page 14 of your proposal, you indicated that the project team will "shepherd" a number of changes, including, "increased participation of elementary education majors in content courses for specialized middle levels STEM education." On that same page you indicated that ETEAMS will "expand implementation of vertically aligned mathematics and science curriculum." Please clearly identify and describe all planned changes to coursework that project participants will encounter in the ETEAMS project. I am specifically interested in how you intend to meet your stated objective of "deepening preservice elementary teachers' content knowledge in middle levels math and science."

Response #1:

The focus of the ETEAMS program design is to test a new model for offering an intensive middle levels math and science fellowship during the final year of general elementary teachers' preservice preparation. The intervention occurs at a time when most preservice elementary teachers have already completed content-based coursework and are typically engaged exclusively in field-based instructional preparation programs. This timing brings both affordances and challenges, and one of the challenges is to implement a coordinated effort to help fellows develop self-efficacy in their abilities to teach and learn mathematics and science, build the content knowledge for teaching middle levels mathematics and science, and come to a more sophisticated view of the nature of STEM disciplines. ETEAMS leverages all major components of the design to address this challenge, especially the implementation of mathematics and science certification preparation workshops, authentic science research experiences, assistance with peer-mediated mathematics and science instruction, and curriculum development activities.

Middle Levels Certification Preparation Workshops

Our approach to meeting the critical goal of "deepening preservice elementary teachers' content knowledge in middle levels math and science," is most directly addressed through fellows'

participation in one of two intensive middle levels math and science certification workshops spanning the year-long fellowship. The content of these workshops was initially developed as part of capstone courses for middle levels mathematics and science teaching specialists, subsequently adapted as workshops for non-mathematics and science inservice teachers, and will be implemented in the fellowships as intensive content-based courses of study in which fellows review, apply, and build on their prior knowledge of middle levels mathematics or science content (see Response #2 for details). In fact, the ways in which these workshops incorporate curriculum historically reserved for specialized STEM teaching courses is primarily what is referred to on p. 14 of the proposal as shepherding "increased participation of elementary education majors in content courses for specialized middle levels STEM education programs in the college of Science and Engineering."

Changes to Teacher Preparation Courses

Even before joining the ETEAMS project, fellows will have already completed at least 7 required content-based mathematics and science courses from the College of Science and Engineering for elementary and middle levels education majors. These courses include at least one mathematics and one science course offered through TAMUCC's core curriculum requirements (typically College Algebra and Biology I), together with a sequence of three content-based courses in elementary mathematics (SMTE 1350 focuses on Numbers & Operations, SMTE 1351 focuses on Data Analysis & Probability, SMTE 3352 focuses on Geometry and Measurement), and two content-based courses in elementary science (SMTE 3315 focuses on Physical Sciences and SMTE 3316 focuses on Life Sciences). Co-PIs McCollough and Champion have each regularly taught these courses, and SMTE 1351, SMTE 3315, and SMTE 3316 each focus on applications of data analysis in problem solving settings, with connections to middle levels mathematics and science content standards.

Through the development of the ETEAMS authentic research experiences and curriculum materials, ETEAMS will support curricular changes to these SMTE courses, including (1) increased use of authentic and accessible science research data, (2) improved use of integrated mathematics and science curriculum in SMTE course curriculum, and (3) more emphasis on learning trajectories which characterize vertical alignment of state standards for teaching middle levels mathematics and science. At least one non-ETEAMS instructor of the SMTE courses, Dr. Sarah Ives, has already committed to engaging preservice elementary teachers in a data analysis project based on the ETEAMS science projects.

In addition, we anticipate SMTE students to be involved at the core partner schools by taking responsibility for one Science Thursday presentation at each of the schools per semester. SMTE students' participation in these early teaching experiences with middle levels students will complement existing Family Math and Science Night projects, which are already well-established components of these courses. The changes to these three SMTE content courses will provide more institutionalized opportunities for engagement of freshman, sophomore, and junior elementary education majors in middle levels mathematics and science classrooms, which in turn supports non-ETEAMS fellows' abilities to teach upper elementary mathematics and science, and will serve as a tool for recruiting future ETEAMS fellows.

Finally, ETEAMS fellows will experience substantially different field-based teacher preparation coursework than current preservice generalist elementary education teachers in their final year of field-based courses. See Response #2 for details on the ways in which middle levels mathematics and science content will be infused into these traditionally pedagogically-focused courses on teaching, planning, and assessment.

Description of the new Science Thursdays Program at Core Partner Schools

ETEAM fellows, participating teachers, and Grades 4-8 students will be involved in a rotating schedule of 3-hour long mathematics and science activities on Thursday afternoons at the core partner schools. These activities include:

- **Common Planning**: Fellows will join participating inservice teachers in 3 hour common planning blocks to develop integrated math and science lessons. This will be accompanied by mathematics or science activities for classroom students facilitated by TAMUCC STEM faculty.
- **Certification Training**: Fellows will each participate in either a workshop to prepare for completing the TExES Grades 4-8 Mathematics or Grades 4-8 Science certification exam.
- **Peer Mediated Instruction**: Fellows will work with education faculty to learn about, plan, and facilitate peer tutoring activities in which older elementary and middle levels students will teach mathematics and science to younger peers.
- **Curriculum Development**: Fellows will meet with education faculty to reflect on their STEM research projects and to develop activities, projects, and other curriculum to share with cooperating teachers at core partner schools.

As indicated in the tentative Fall 2013 Schedule of Science Thursdays Events below, activities will be supported by two instructional coaches, multiple STEM faculty, a dedicated graduate student assistant, and College of Education field-based instructors:

Fall 2013 Schedule of Science Thursdays Events at Core Partner Schools

Date	Kostoryz Elementary	Schanen Estates Elementary	Browne Middle
8/29	Launch Meeting		
9/5	Intro to Common Planning, Math Activities for Students (Bruun or Ives)	Intro to Peer Mediated Instruction (Hill)	PST Curriculum Development (Jeffrey)
9/12	PST Curriculum Development (Hughes)	Intro to Common Planning, Science Activities for Students (Hill)	Intro to Peer Mediated Instruction (Jeffrey)
9/19	Intro to Peer Mediated Instruction (Hughes)	PST Curriculum Development (Hill)	Intro to Common Planning, Science Activities for Students (Jeffrey)
9/26	Certificate Training Workshops in Grades 4-8 Mathematics & Science		
10/3	Common Planning, Science Activities for Students (Silliman)	Peer Mediated Instruction (Hill)	PST Curriculum Development (Jeffrey)
10/10	PST Curriculum Development (Hughes)	Common Planning, Science Activities for Students (Smee)	Peer Mediated Instruction (Jeffrey)
10/17	Peer Mediated Instruction (Hughes)	PST Curriculum Development (Hill)	Common Planning, Math Activities for Students (Tintera)

Date	Kostoryz Elementary	Schanen Estates Elementary	Browne Middle
10/24	Certificate Training Workshops in Grades 4-8 Mathematics & Science		
10/31	Common Planning, Math Activities for Students (Preservice elementary teachers)	Peer Mediated Instruction (Hill)	PST Curriculum Development (Jeffrey)
11/7	PST Curriculum Development (Hughes)	Common Planning, Science Activities for Students (Hill)	Peer Mediated Instruction (Jeffrey)
11/14	Peer Mediated Instruction (Hughes)	PST Curriculum Development (Hill)	Common Planning, Science Activities for Students (Preservice elementary teachers)
11/21	Certificate Training Workshops in Grades 4-8 Mathematics & Science		
12/5	Common Planning, Science Activities for Students (Silliman)	Peer Mediated Instruction (Hill)	PST Curriculum Development (Jeffrey)
12/12	PST Curriculum Development (Hughes)	Common Planning, Science Activities for Students (Smee)	Peer Mediated Instruction (Jeffrey)
12/19	Peer Mediated Instruction (Hughes)	PST Curriculum Development (Hill)	Common Planning, Math Activities for Students (Tintera)
1/9	Certificate Training Workshops in Grades 4-8 Mathematics & Science		

Note: Professors Hughes and Jeffrey are teacher educators in the College of Education. Their participation in Science Thursdays will be part of their responsibilities as field-based instructions at core partner schools.

Question #2. Field-based experiences

Reviewers were unclear about how the changes described for the field-based component of the ETEAMS project would differ from what is currently in place in your preservice program. In what specific ways will the field experiences of the 40 Fellows differ from the experiences of current participants in the generalized elementary teacher preparation program?

Response #2:

Infusion of Mathematics and Science Content into Field-based Education Courses

A major change to coursework for ETEAMS fellows will be modification of the student teaching curriculum to include participation in the Science Thursdays activities at core partner schools. Currently, all elementary and middle levels teachers complete two field-based semesters at professional development school sites. In the Fall, generalist elementary education majors are placed at an elementary school for EDUC 4608, which is a penultimate 3-credit course on instruction and assessment featuring classroom observation and teaching experiences in the mornings on Tuesdays and Thursdays, and instruction by a field-based university instructor at the schools in the afternoons. ETEAMS fellows will be placed in Grades 4-8 classrooms for their classroom observations in this course, and will engage in the new Science Thursdays

curriculum in lieu of the typical general teaching curriculum during one of their afternoons at the core partner school. The new Science Thursdays curriculum, described in more detail below, centers on mathematics and science content, with a rotating schedule of activities focused on content, curriculum planning, research, and instruction. Importantly, the mathematics and science certification workshops are integrated into the Science Thursdays time.

The 9 semester credit hour Spring student teaching course, EDUC 4994, will also be augmented for the ETEAMS fellows. Fellows will all be placed in a Grades 4-8 classroom, they will continue to participate in the Science Thursdays curriculum, and they will be involved throughout their student teaching in implementing the ETEAMS peer mediated instruction and integrated mathematics and science curriculum into their lesson plans.

Changes to Field Placements

The existing field placement process for generalist elementary education majors includes placement in different schools for the Fall and Spring student teaching coursework. Preservice teachers typically observe and assist a cooperating teacher in the fall, perhaps teaching a few "mini-lessons," and then may never see that person again. Relatively few interactions between preservice teachers and cooperating teachers at their first placement site often lead to comparatively more shallow mentoring relationships than are typical of field placements in students' Spring student teaching semester. In addition, student teachers' field placements can vary widely in terms of cooperating teachers' knowledge and instruction in mathematics and science. Student teachers often struggle to work within existing classroom norms while striving to practice standards-based teaching practices they've learned in their teacher preparation courses.

Supported by school administration and ETEAMS teacher leaders at each core partner school, ETEAMS fellows will be placed in the same school for both their Fall and Spring student teaching courses. They will work with teachers supported by ETEAMS instructional coaches and will become integral components of the core partner school communities' efforts to implement peer-mediated mathematics and science instruction and vertically aligned integrated mathematics and science curriculum.

One unusual feature of the Science Thursdays design is that fellows will have monthly blocks of common planning time to participate in team planning with all middle level teachers at core partner schools. In the existing student teaching placement system, preservice teachers have to work any planning with their cooperating teacher into very limited times before or after school, or during the teachers' planning period (which is also the inservice teacher's only time to grade, communicate with parents, gather materials). Typically, student teachers do lesson planning separately from their cooperating teacher, and there can be large gaps between the types of lesson plans that student teachers are required to do (inquiry based, cooperative learning strategies, hands-on activities) and the regular planning of cooperating teachers. The common planning times will address this challenge and help to build a collegial professional learning community among preservice and inservice teachers at core partner schools.

Other key differences in the experiences of ETEAMS fellows during the final year of their teacher preparation program include:

1. Fellows will be involved in authentic field-based science research experiences. The engagement in authentic research processes will help reshape fellows' views on the

nature of mathematics and science and will include direct interactions with STEM faculty and graduate student researchers.

2. Fellows will also be encouraged to support the 4-8 students in extracurricular opportunities (such as Science Fair, Science Olympiad, MATHCOUNTS). This will give ETEAMS fellows a broader range of mathematics and science instruction than existing preservice teachers.
3. Fellows will participate in one of two year-long certification workshops in Grades 4-8 mathematics and science content.
4. Fellows and the inservice teachers will have opportunities to develop deeper professional relationships through a year-long cohort model that includes shared experiences in science research, curriculum development, and studying for certification together. These relationships are likely to provide social and professional supports for fellows as they enter the teaching profession.
5. Fellows will experience enhanced mentoring into middle levels teaching through extended time at a single school, direct engagement with experienced ETEAMS instructional coaches and teacher leaders, and school-wide mathematics and science teaching collaborations.

Question #3. Application of research experiences to the classroom

While reviewers were convinced that participating Fellows will individually benefit from the planned research experiences, concern was expressed about direct applications of the research experiences to middle school classrooms. Please describe how the project will ensure that beyond the personal benefits to participating Fellows, there will be direct applications of the research experiences to classroom instruction. In short, what measures will ensure that the students of Fellows will gain some benefit from the research experiences?

Response #3:

One primary concern of instructors and administration at the ETEAMS school partners has been consistent funding conditions which have led to difficulties in incorporating hands-on mathematics and science instruction in Grades 4-8 classrooms. Though state standards recommend at least 50% of science instruction in these grades incorporate field or lab-based activities, teachers at the partnering schools report difficulties obtaining quality curriculum, supplies and equipment for projects, experiments and laboratory activities. The ETEAMS involvement in core partner schools will directly address these challenges by providing professional development for participating inservice teachers, enhanced instructional coaching, increased opportunities for common planning in mathematics and science, and concerted support from fellow participants, STEM faculty, and teacher education faculty.

However, the partnership has been careful to avoid creating a "top-down" structure for changing schools. Each of the core partner schools have existing curriculum, teachers, and initiatives to support student learning in mathematics, and the ETEAMS program is designed to complement and support those efforts. In particular, the design of Science Thursdays will support Grades 4-8 students' understanding, interest, and performance in mathematics and science.

Curriculum Development Based on Authentic Science Research

As described in Response #1, one of the four types of rotating Science Thursdays events is Curriculum Development, which will engage fellows in activities with their field-based university instructor, STEM faculty, and the ETEAMS graduate student assistant to reflect on the fellows' authentic science research experiences and to develop curriculum for cooperating teachers' classrooms. This work may range from creating mini-lessons on mathematics and science content in their research, to developing project ideas based on their research data, to developing "my science project in a box" kits for elementary and middle students to explore their research topics using hands-on materials. This work will support the common curriculum planning times with teachers at their schools, and teach fellows about the important professional development cycle of learning content and applying what has been learned to teaching.

One concern regarding integration of university research to school curriculum involves alignment to state standards for mathematics and science instruction. A preliminary analysis suggests strong alignment between several aspects of Grades 4-8 Texas Essential Knowledge and Skills (TEKS) and the ETEAMS research projects, including content standards (taxonomy**,** biotic and abiotic processes**,** biodiversity, habitats**,** erosion, weathering**,** response to stimuli**,** how catastrophic events affect ecosystems**,** adaptation**,** human dependence on ocean systems**,** how humans affect ecosystems (ex. pollution, overpopulation), and modes of scientific inquiry). In addition, the research projects aligns to TEKS addressing how students should learn diverse ways that scientists study the world, how science can be understood using mathematical, physical and conceptual models, and the importance of using statistical information (mean, median, mode, frequency, range), ratio, graphing skills to represent findings, measurement, and operations with fractions and decimals.

Research and Learning on the ETEAMS Website

Fellows will work with the ETEAMS graduate student assistant, teacher leaders, and instructional coaches to develop content for the ETEAMS website. Designed and developed by co-PI Champion, the website will feature user-generated content, including documentation of research field work such as data files, pictures and videos of the research process, blog-like posts on procedures and research questions, and reports of research findings. Fellows, teachers, and students will be encouraged to interact on the website, commenting on research artifacts, and posing questions for researchers. Teachers at the schools will be encouraged to ask students to make predictions and draw conclusions based on the researchers' data. By interacting with the dynamic research logs on the ETEAMS websites, students at partner schools (and other schools) will have opportunities to gain a more nuanced view of the processes of scientific research, see people in their community engaged in authentic science research, and even contribute to future research. This represents a marked difference from existing grades 4-8 curriculum at the participating schools, at which science labs and experiments typically occur in a single class period under comparatively artificial contexts and much of the science curriculum comes from textbooks and worksheets. Led by senior personnel Tintera, participating STEM faculty and mathematics and science educators will contribute to this effort by periodically reviewing website content for scientific accuracy and suggesting additions, revisions, and resources needed to accurately reflect the scientific research process and related STEM content.

Ongoing STEM Experiences for Grades 4-8 Students

Many of the students attending the two core partner elementary schools (Schannen Estates Elementary and Kostoryz Elementary) will continue to participate in the ETEAMS program as they "graduate" elementary school and attend core partner Browne Middle School. Consequently, the ETEAMS project, especially Science Thursdays events and vertically aligned curriculum, will serve as a thread of consistency for participating students during their middle levels school experiences. In addition to the support for instruction and curricular changes and exposure to ETEAMS research projects through the website, Grades 4-8 students will have a number of opportunities to engage with STEM researchers and in mathematics and science enrichment activities:

- Students at each school will participate in monthly mathematics and science activities facilitated by STEM faculty, which will include presentations of STEM careers, research results, classroom demonstrations, and hands-on activities based on faculty's research areas.
- ETEAMS will support creation of "my science project in a box" kits by fellows and the graduate student assistant to engage middle levels students in hands-on activities based on the authentic science research led by PI Silliman and senior personnel Smee.
- During the 2nd and 3rd years of implementation, teachers at the core partner schools will plan field trips (at least one per school) for Grades 4-8 students to learn about mathematics and science research at TAMUCC.
- During the summer preceding the 2nd and 3rd years of implementation, select groups of interested and high performing middle school students will participate in summer research experiences with the fellows and inservice teachers.
- The graduate student and instructional coaches will support teachers and students to participate in MATHCOUNTS, science fair, and Science Olympiad competitions. Fellows will support science fair projects related to the fellows' research projects.

Question #4. Workshops for certification exams

It is indicated on page 9 of your proposal that certification workshops were developed as part of a teacher recruitment initiative. Are the workshops intended to reach a particular audience or address a specific identified need? Please elaborate on the rationale for developing these workshops, and please indicate if the workshops are intended to be of particular benefit to certain participant groups.

Response #4:

Description of Teacher Certification Workshops

The rationale for developing and delivering the certification preparation workshops in 2011-2012 was part of a two-year $95,000 grant project funded by the private Sid Richardson Foundation in which the TAMUCC College of Education pursued ways to increase the supply of secondary mathematics and science teachers in South Texas. The first facet of the teacher recruitment initiative was focused on marketing activities (e.g., billboards, flyers, job fairs) for TAMUCC's alternative teacher preparation options in mathematics and science during 2010-2011. During

the second year, the grant team worked with mathematics and science educators to explore the idea of offering workshops to a broad audience of local teachers with the goal of preparing non-math or science certified teachers to add Grades 4-8 mathematics or science certification by examination. In addition to self-directed studying of exam content, workshop participants would attend 8 three-hour sessions led by TAMUCC faculty on Saturday mornings during Spring 2012.

Mathematics and science education faculty at TAMUCC developed and delivered teacher certification workshops as part of a teacher recruitment initiative. Starting in Fall 2011, the workshops were developed by co-PI Champion, mathematics educator Sarah Ives, and science educator Katie Crysup-Sikes. The content for the workshops was based on learning outcomes in capstone courses for middle levels mathematics and science specialists. Since Grades 4-8 mathematics and science specialists must pass the associated content-based TExES certification exams in their specialties, the capstone courses include review for certification exams. Students in these courses have had nearly 100% passing rates on the certification exams, but they typically have already taken multiple advanced university courses in their specialty and the courses have low enrollments (about 12-15 total students take the capstone class each year in math or science).

The instructors transformed the certification review materials in the capstone courses into workshop materials for a potential pool of teacher participants who may have little or no recent postsecondary mathematics or science coursework. As indicated in the Supplementary Documentation of the proposal, hundreds of local educators applied for the workshops. Though grant administrators accepted applicants with comparatively better preparation in mathematics and science, most workshop participants held generalist elementary education certifications and had very limited undergraduate mathematics or science backgrounds. More than half of participants scored below 40% on pretest instruments, and many of the participants expressed frustration or surprise in the difficulty of the mathematics and science content on the exams. Nonetheless, the workshops were very successful; certification outcomes among workshop participants actually exceeded average passing rates for the TExES exams, and the workshops approximately doubled the number of TAMUCC-prepared teachers who obtained certification in Grades 4-8 mathematics or science in 2012.

Lessons Learned from the Teacher Certification Workshops

There were a number of challenges identified by faculty following the 2012 workshops. As a first offering of middle levels mathematics and science teaching certification workshops for non-mathematics and science degree holders, the instructors had to develop a great deal of instructional and practice materials over and above their regular teaching, research, and service responsibilities. Though compensated by the grant, the workshop instruction was a challenging service effort for faculty to fit into their professional agendas. In addition, many grant participants reported they had limited time to complete assignments for the workshops while working as local teachers, and attendance at Saturday workshops was inconsistent.

The difficulty of exam content was another challenge. The Math 4-8 exam content includes calculus and linear algebra content, and the Science 4-8 exam content includes theories related to force and Newton's laws of motion, physical and chemical properties of matter, energy transformations, work, power, theory of evolution, structure and function of living things, stimulus and response of organisms to their environment, Earth history, cycles in Earth's systems, weather and climate, solar system and the universe, field and laboratory techniques and safety. Without recent undergraduate coursework on these topics, the content was very

challenging to learn in a compressed time frame for many of the participants. Many expressed needs for additional instructional time.

The ETEAMS project has included several changes based on the experience of the prior workshop implementation and the needs of fellows. First, we have recruited Kim Moore and Sandy Smee, both experienced and knowledgeable mathematics and science teachers (respectively) with expert level understanding of content in their certification domains, to lead the certification workshops. Moreover, we will leverage the cohort model of the fellowship program to promote the community of learners (which will include fellows and some inservice teachers at core partner schools who participate free of charge) as they work together to complete practice exercises and study exam content. We're also spacing the workshop delivery over the course of a year, and workshop instructors will provide one-on-one tutoring support for workshop participants as needed. We are also addressing the fact that many of the previous workshop teachers left with a certification but with little or no authentic experiences in mathematics or science education outside the workshop.

Our target for 90% pass rates on certification exams is based in part on the design of the ETEAMS program to select fellows from among the highest performing and most interested mathematics and science students among generalist education majors. That is, we expect workshop participants to be substantially better prepared in mathematics and science, and we will provide coordinated support to prepare for the certification exam.

Question #5. Research Plan

You indicated in your proposal that two of the four research questions will be addressed using a quasi-experimental "longitudinal matched group design", and that two research questions will be addressed using focus group interviews, immersive ethnographic field study, and semi-structured interviews. These are very general descriptions. Please provide more detail of the research procedures you plan to employ, including a description of all participants, variables, data types and sources, protocols to be used or developed, comparisons to be made, and analytic procedures anticipated. A chart mapping variables, data sources, and analytic methods to research questions would be helpful.

Response #5:

To situate the research plan, recall the four guiding research questions:

Q1. To what extent does participation in the ETEAMS middle levels STEM teaching fellowship program influence the:

a. ***views on the nature of science*** among preservice elementary teachers, university faculty, and grades 4-8 students and teachers?

b. ***self-efficacy in grades 4-8 STEM content*** among preservice elementary teachers, classroom teachers, and grades 4-8 students?

c. ***STEM interest*** among preservice elementary teachers, and grades 4-8 students and teachers?

d. ***mathematics and science performance*** among preservice elementary teachers and grades 4-8 students?

Q2. To what extent does participation in the ETEAMS middle levels STEM teaching fellowship program influence the:

   a. quantity, quality, and diversity of new ***grades 4-8 mathematics and science certifications*** earned by teacher education graduates?

   b. quantity, quality, and diversity of ***new grades 4-8 STEM teacher applications and hirings*** for nearby school districts?

   c. **professional trajectory, persistence, and mobility** of generalist elementary education graduates?

Q3. What mechanisms, resources, and policies **support and constrain effective implementation** of a middle levels STEM teacher fellowship program for preservice elementary teachers?

Q4. In what ways do preservice elementary teachers in a middle levels STEM teacher fellowship program use and interpret **sources of self-efficacy** and reflect on their **beliefs about inclusiveness, teaching, learning, science, and mathematics** throughout their participation in the fellowship?

Participants & Sampling

The proposed study will include 3 years of longitudinal data collection across three participant groups: preservice teachers at TAMUCC, inservice teachers at six purposefully selected schools in CCISD, and grades 3-8 students at those same schools.

Data collection is structured around matched group comparisons, in which robust data from 3 core partner schools (Schanen Estates Elementary, Kostoryz Elementary, and Browne Middle School) is compared to data from 3 other participating schools in CCISD (preliminarily planned as Yeager Elementary, Sanders Elementary, and Hamlin Middle School).

Over the three years of data collection, the approximate total number of participants in the study is $N = 3610$, which includes approximately 300 grades 3-5 students at each of the four elementary schools, 1100 students at each of the middle schools, 120 preservice elementary teachers, and 15 inservice teachers at each of the six schools.

All full time teachers at the six participating schools listed as instructor of record for one or more grades 3-8 mathematics and science classes will be invited to participate in the study, and all preservice teachers participating in the ETEAMS fellowship will be invited to participate in the study as well. We anticipate that inservice and preservice teachers who wish to participate in the study will only be excluded from the study due to incomplete data (e.g., leaving their teaching position part-way into the school year).

Since mathematics and science courses are required of all elementary and middle levels students at CCISD, all grades 3-8 students at the six participating schools will be invited to participate in the study. We anticipate that students who wish to participate in the study will only be excluded from the study due to a lack of informed consent documentation (e.g., missing parent consent forms) or incomplete data (e.g., transferring schools part-way into the school year). Though there are no minimum age requirements for student participants, we anticipate the minimum age of study participants to be approximately 8 years old. Preservice teacher participants will typically be in the final year of undergraduate study, so are presumed to be over 18 years of age. Inservice teachers will also be 18 years of age or older (likely at least 21 years old).

Preservice teachers will be invited to participate in the study at the time they are accepted into the ETEAMS fellowship program. Inservice teachers at the 3 core partner schools will be invited to participate in the study during annual launch activities for the ETEAMS project. Inservice teachers at the 3 matched group schools will be invited to participate in the study through email and site visits by program staff. Students will be invited to participate in the study by an ETEAMS staff member during a site visit to one of their mathematics or science classes.

Data Collection Procedures

As indicated in the proposal, co-PI Cherie McCollough will lead the quantitative strand of the research (Q1 & Q2) and co-PI Joe Champion and key-personnel Matt Bowers will lead the qualitative inquiry into Q3 and Q4. References for pre-existing instruments (indicated by italics in the table below) are provided in the research proposal.

Variables	**Question**	**Source**	**When**	**By**	**Type**
Interest and Self-efficacy in Math & Science (*MISO S-STEM*)	Q1	Students at all schools	Fall (pre), Spring (annually)	Moore	Quantitative Survey
Numbers of students competing in math and science competitions	Q1	Program records, teachers and curriculum coordinators at all schools	Annually	Moore	Quantitative
Counts of teachers and students in STEM experiences led by mathematicians and scientists	Q1	Program logs from Science Thursdays	Monthly	S. Smee	Quantitative
TExES Test of Grades 4-8 Math & Science Pedagogical Content Knowledge	Q1, Q2	Preservice teachers	Fall Math & Science (pre), Spring Math or Science (post)	Moore & S. Smee	Quantitative Exam
Ratings & critiques of Fellows' research projects	Q1, Q3	STEM faculty	Annually	Tintera	Quantitative & Qualitative
Science Teaching Efficacy Belief Scale (STEBI)	Q1, Q4	Preservice and inservice teachers at all schools	Fall (pre), Spring (annually)	Moore	Quantitative Survey
Mathematics Teaching Efficacy Belief Instrument (MTEBI)	Q1, Q4	Preservice and inservice teachers at all schools	Fall (pre), Spring (annually)	Moore	Quantitative Survey
Views on the Nature of Science (*VNOS-A*, *VNOS-C*)	Q1, Q4	Preservice teachers, inservice teachers, students at all	Fall (pre), Spring (annually)	Moore	Qualitative Survey

Variables	Question	Source	When	By	Type
		schools			
Views on Culturally Relevant Math & Science Teaching (*SEBEST*)	Q1, Q4	Preservice teachers	Fall (pre), Spring (annually)	Moore	Qualitative & Quantitative Survey
Quantity, quality, and diversity of grades 4-8 STEM teaching workforce	Q2	Internal application and hiring records, school or district offices, Corpus Christi and surrounding areas	Annually	S. Smee	Quantitative
State Math and Science Assessment Results (*STAAR*)	Q1, Q2, Q3	State and district assessment office (all schools)	Annually	Wright	Quantitative
Certifications Results in Grades 4-8 Math & Science	Q2	Certification test results (preservice teachers)	Annually	Hill	Quantitative
Participation in Certification Workshops	Q2, Q3	Workshop instructors	Annually	S. Smee & Moore	Qualitative
Follow-up data on former ETEAMS participants	Q2, Q4	fellows, participating inservice teachers	Annually (after year 1)	S. Smee & Scherer	Quantitative
Lesson Plans for STEM lab activities and inquiry-based investigations	Q3	Teachers and curriculum coordinators at all schools	Monthly	Moore & S. Smee	Qualitative Artifact
Survey of Instructional Practices	Q3	Teachers at all schools (self-reported)	Fall (pre), Spring (annually)	Moore	Quantitative Survey
Classroom Observations of Instructional Practices (*RTOP*)	Q3	Coaches (classroom observation)	Twice per year (unannounced)	McCollough & Moore	Qualitative Observation
Student Survey of Instructional Practices (modified)	Q3	Students at all schools (sampled)	Fall (pre), Spring (annually)	Moore	Quantitative Survey
Lists of academic journal submissions	Q3	Project Leadership Team	Annually	McCollough	Qualitative
Lists of presentation submissions	Q3	Project	Annually	McCollough	Qualitative

Variables	Question	Source	When	By	Type
		Leadership Team			
Teaching artifacts (student work, class notes, project materials)	Q3	Coaches, participating teachers, fellows, website	Twice Monthly	Fellows	Qualitative Artifacts
Focus group interviews on program implementation	Q3	preservice teachers (sampled), external evaluators	3 times per year	Bowers	Qualitative Interview
Lists of issues affecting ETEAMS implementation and scaling	Q3	All project personnel	Twice Monthly	Silliman	Qualitative Survey, Artifacts
Program Artifacts (website, photos, recruitment and informational materials)	Q3	Website, implementation team	Quarterly	Scherer	Qualitative Artifacts
One-on-one interviews on views of teaching and learning math & science	Q4	Preservice teachers (sampled)	8 per year (annually)	Bowers	Qualitative Interview

Time for Participation in the Study

Note: In the following, "STEM surveys" refers to survey instruments addressing views on the nature of science, self-efficacy in grades 4-8 STEM content, and STEM interest.

The estimated time for study participants to complete data collection procedures differs according to type and duration of participation.

Participating preservice teachers, in addition to being engaged in the 1-year grant-sponsored ETEAMS fellowship program, will complete baseline STEM surveys (~1-2 hours), complete mathematics or science pre- and post-tests (~2 hours), participate in 1-2 focus group interviews (~1 hour each), and complete the Survey of Instructional Practices survey once (~1 hour).

Participating inservice teachers at the core partner schools, in addition to being engaged in up to 3 years of grant-sponsored ETEAMS instructional programs, will complete baseline demographic and STEM surveys (~1-2 hours) , participate in 1-2 focus group interviews (~ 1 hour each) per year, participate in up to 3 one-on-one semi-structured interviews (~1 hour each) per year, complete annual follow-up STEM surveys (~1 hour), SASS teacher follow-up surveys (~1/2 hour), and the Survey of Instructional Practice (~1/2 hour).

Participating inservice teachers at the matched participating schools will complete baseline STEM surveys (~1-2 hours) and annual follow-up STEM surveys (~1 hour), SASS teacher follow-up surveys (~1/2 hour), and the Survey of Instructional Practice (~1/2 hour).

Participating students at the core partner schools, in addition to participating in up to 3 years of grant-sponsored ETEAMS instructional programs, will complete baseline STEM surveys (~1 hour) and annual follow-up STEM surveys.

Data Analysis

Regarding analysis of quantitative data for Q1 & Q2, the comparison group design for data collection allows for parametric and non-parametric tests of means (e.g., Chi-square, student's t, z, Wilcoxon signed-rank test) for tests of differences on measures of views on the nature of science, self-efficacy, STEM interest, and mathematics and science performance between participant groups at the core partner and matched schools. In addition, longitudinal data will allow for repeated measures analysis of variation in certification results, teaching application and hiring counts, teacher attrition rates, and related measures in Q1 and Q2. In addition, structural equation modeling, generalized linear modeling, and analysis of variance procedures (ANOVA, MANCOVA) will be used to develop and validate models of relationships among variables in Q1 and Q2 while adjusting for demographic differences, prior performance, and even multi-level effects such as school campus locations.

Data addressing the two qualitative research questions will be initially analyzed using a centralized thematic coding schemes based on the 8 variables listed in Q3 and Q4, a conceptual framework based on the review of literature on professional development of early career teachers and social cognitive learning theory. Interview records will be coded using the software tool NVivo, and select segments transcribed for analysis. Qualitative artifacts and ethnographic field notes from observations and interviews will be digitized (scanned, photographed), logged and thematically coded as in interview responses. Following thematic coding of qualitative data, the researchers will use theoretical and inline memoing techniques, together with axial and selective coding strategies to triangulate emergent themes, seek confirming and disconfirming evidence, and purposely sample additional data as needed to obtain indications of maximum variation in the research data and theoretical saturation.

Question #6. Dissemination plan

Given the expected outcomes of the proposed teacher preparation model, and the spectrum of anticipated findings, a dissemination plan for communicating your outcomes to various constituency groups is expected. Please identify the various constituency groups that you believe would benefit from learning about your project and its outcomes, and describe concrete actions that you will take to communicate your findings to each of these constituency groups.

Response #6:

As a prototype targeted partnership, ETEAMS leadership is keenly aware of the need for disseminating project outcomes, developing clear articulation of program components, and engaging in dialogues with constituencies at many levels. There are many constituencies which stand to benefit from learning of the ETEAMS project outcomes, including:

1. College of education faculty at mid-sized, urban, and minority-serving public universities looking to better prepare generalist elementary teachers and to provide additional certification options to their students
2. Mathematics and science faculty, especially those involved in school outreach and/or the content preparation of elementary and middle levels teachers

3. Teacher preparation program leaders, especially at minority serving institutions and smaller universities for which there are relatively small numbers of preservice teachers specializing in math and science teaching degrees
4. Mathematics education, science education, and educational psychology researchers
5. Local, state, and national policy makers, especially those working to increase the number of secondary math and science teachers and ensure elementary and middle level students' global competitiveness in STEM performance
6. Local and other school administrators looking to fill middle levels mathematics and science teaching positions
7. Local students and parents of students and community activists involved in math and science teaching and learning initiatives
8. Preservice elementary teachers and early career teachers concerned about hiring prospects and preparation to teach mathematics and science
9. Elementary and middle levels teachers and teacher educators in need of culturally relevant and engaging mathematics and science curriculum
10. Other state and national Math & Science Partnerships and related grant-funded teacher preparation initiatives

The following table summarizes concrete steps ETEAMS leadership have committed to make in order to help in the dissemination of project outcomes among representatives of the identified constituencies. In addition, ETEAMS personnel commit to regular meetings to discuss dissemination possibilities, including preparation of research presentations, scholarly articles, practice-oriented articles, white papers and technical reports, informal website posts, presentations at professional meetings, and information materials such as website summaries, program manuals, and brochures. Journals and conferences listed in the table represent a mixture of selectivity, breadth, and scope of impact, and may be supplemented or replaced by similar venues as the project progresses.

Constituency	**Form, *Venue***	**Lead**
1. College of education faculty	Research Article, *Journal of Teacher Education* Presentation, *National Association of Science Teachers*	Hill
	Presentation, *American Educational Research Association*	Bowers
2. University math & science faculty	Practice Article, *Eos, Transactions & American Geophysics Union* Research Article, *International Journal of Chemistry* Presentation, *American Geophysical Union*	Silliman
	Presentation, *Nat. Assoc. for Research Science Teaching*	McCollough
	Presentation, *Coastal & Estuarine Research Federation* Presentation, *Ecological Society of America*	Smee
	Presentation, *Mathematical Association of America - TX*	Tintera
3. Teacher preparation	Research Article, *School-University Partnerships* Presentation, *American Educational Research Association*	Hill

Constituency	Form, *Venue*	Lead
program leaders	Presentation, *Assoc.of Mathematics Teacher Educators* Practice Article, *Mathematics Teacher Educator*	Champion
4. Mathematics, science, psychological education researchers	Research Article, *School Science & Mathematics* Research Article, *Science Education and Technology* Presentation, *American Educational Research Association*	McCollough
	Research Article, *Journal of Mathematical Behavior* Research Article, *J.for Research in Mathematics Education*	Champion
5. Policy makers	Practice Article, *Academic Leadership*	McCollough
	Policy Brief, *MSP Website*	Champion
	Presentation, *National Council of Teachers of Mathematics Research Presession*	Champion
6. School administrators	Presentation, *Annual Meeting of CCISD Administrators (TBD)*	Wright
	Presentation, *Annual Meeting of Coastal Bend Administrators (TBD)*	Silliman
7. Students, parents, community	School Letters, *Participating Schools*	Wright
	Local News Coverage, *Corpus Christi, TX*	Silliman
8. Early career teachers	Presentation, *TAMUCC Teacher Preparation Seminars*	Hill
	Presentation, *ME by the SEa*	Moore
9. Grades 3-8 teachers and teacher educators	Practice Article, *Science Scope* Presentation, *Science Teachers Association of Texas*	Hill
	Presentation, *Conf.for the Advancement of Math Teaching*	Champion
10. Grant-funded teacher preparation initiatives	Presentation, *National MSP Conference (TBD)*	Silliman
	Presentation, *State MSP Conference (TBD)*	Champion

Question #7. STEM faculty involvement

The proposal clearly indicates that doctoral students and researchers will be involved with Fellows during the research experiences, but it is not clear how STEM faculty in general are involved in the ETEAMS project. Please clarify the extent to which faculty members in STEM disciplines are involved in the ETEAMS project, or will contribute to ETEAMS activities.

Response #7:

In addition to the major roles of PI Silliman and senior personnel Smee and Tintera, the ETEAMS project includes substantial support for involvement of TAMUCC STEM disciplinary faculty in the preparation of middle levels mathematics and science teachers. For many STEM faculty, working with middle levels education can be both rewarding challenging. Cognizant of the support necessary for such involvement, our target is to recruit mathematics and science faculty with experience working with teachers and schools as STEM faculty participants during the first year. In subsequent years, as Science Thursdays curriculum becomes more established and the cyclical science research and website projects produce more substantial results, we will recruit a broader range of faculty and graduate students from STEM disciplines, including participation at least 2-4 mathematics or science faculty per year with limited experience working with teachers and schools. Participating STEM faculty will receive modest stipends (e.g., $1000 per 10-20 hours of work) to choose from a menu of options for contributing to the ETEAMS project, including:

1. Meet with several small groups of ETEAMS fellows in a semi-structured Question & Answer session about their research interests, professional history, and views on the nature of mathematics and science (~10 hours)
2. Serve as a research mentor and consultant for 1-2 small teams of fellows as they ask questions about their research data, run analysis, represent the data with charts and graphs, and make reasonable interpretations (~10-20 hours)
3. Participate in Science Thursday activities facilitated by Dr. Silliman, Dr. Smee, or the science graduate student. Includes participation in planning and delivery of the activities at one or more schools (~10 hours).
4. Meet with ETEAMS personnel and with math and science education faculty to rate and critique vertically aligned curriculum developed by fellows and teachers at participating schools. activities (~5-10 hours)
5. Meet with ETEAMS personnel to rate and critique of ETEAMS research project findings and website postings, noting strengths and suggesting areas for improvement (~5-10 hours)
6. Work with the ETEAMS research team to analyze qualitative data on fellows', teachers' and students' statements regarding their views on the nature of science. Provide expert-validation of statements regarding views on the nature of science research. (~5-10 hours)
7. Visit participating schools, work with fellows and teachers during collaborative planning times, observe one or more mathematics or science lessons. Write daily summaries of the experience, focusing on self-efficacy, content knowledge, and views on the nature of mathematics science (~10-20 hours)

An initial list of faculty in the Department of Mathematics & Statistics targeted for participation in the fellowship include Sherry Bair, Sarah Ives, Blair Sterba-Boatwright, Mufid Abudiab, and Alex Sadovsky . Drs. Bair and Ives have expertise in teacher preparation, and Drs. Boatwright, Abudiab, and Sadovsky all have experience in outreach activities with school children. Similarly, prospective faculty in the Department of Life Sciences and the Department of Physical & Environmental Sciences include Manuela Gardner, Gregory Buck, Tania Anders, Jennifer Smith-Engle and Feri Billiot, all of whom have successful outreach experience with public school students in the Corpus Christi region.

Updated Roles & Responsibilities of Project Personnel

In the time between proposal submission and these question responses, the project leadership has continued discussion with stakeholders and personnel. See below for a revised list of planned roles and responsibilities.

Jim Silliman: Principal Investigator

- Communicate vision of the program
- Represent the program, including at MSP conference
- Coordinate evaluation and reporting procedures
- Hire and supervise graduate student and program assistant
- Lead recruitment of STEM faculty and graduate students
- Lead four Science Thursdays sessions per year
- Organize and supervise 3 authentic research projects for fellows (fall of 2013)
- Coordinate launch of summer research experiences for fellows and teachers
- Organize project leadership meetings
- Lead internal communication, resolve disputes, make final decisions
- Be responsible for all major deadlines
- Contribute to dissemination and research working groups

Denise Hill: Co-Principal Investigator

- Recruit and select fellows
- Coordinate placement of fellows in field basing and student teaching experiences
- Facilitate development of vertically aligned integrated science and math curriculum
- Support fellows in creating elementary and middle school laboratory activities based on their research experiences
- Serve as professional advisor and mentor to fellows
- Help to design and support implementation of peer-assisted instruction
- Meet weekly with the instructional coaches and student teaching supervisors to ensure consistent implementation of project across partner schools
- Collect lesson plans and organize products created through team lesson planning
- Be the primary liaison between CCISD leadership and TAMUCC leadership
- Participate in program leadership meetings
- Initiate communication with matched schools
- Coordinate logistics at the schools for Science Thursdays activities with 4-8 students
- Contribute to dissemination and research working groups

Joe Champion: Co-Principal Investigator

- Lead quantitative and qualitative data analysis
- Lead the articulation team and dissemination of the ETEAMS teacher preparation model
- Lead the design and development of project website

- Create brochures and other marketing materials
- Consult with workshop instructors, instructional coaches, and program support staff
- Support the evaluation team with data analysis and reporting
- Contribute to the dissemination and research groups
- Communicate regularly with principal investigator and lead researcher

Cherie McCollough: Co-Principal Investigator

- Lead the research and dissemination working groups
- Lead publishing teams, authorship on publications
- Choose research and evaluation instruments and make needed modifications
- Oversee data collection, data entry, and survey design
- Track conferences and presentations for project members
- Participate in program leadership meetings
- Lead implementation of informed consent and data collection protocols
- Contribute to recruitment and selection of fellows
- Assist with recruitment of STEM faculty and graduate students

Pamela Wright: Co-Principal Investigator

- Lead recruitment of participating inservice teachers
- Support inservice teachers in participating in certification workshops
- Create schedule and arrange personnel (substitute teachers) to allow for team planning between inservice and preservice teachers
- Create schedule, assist with logistics to support Science Thursdays
- Lead reporting of CCISD-based data on teachers and students (demographic data as well as test score results)
- Participate in project leadership meetings
- Support vertically-aligned integrated math/science instruction in participating schools
- Support peer-assisted instruction program
- Serve as primary connection to CCISD leadership

Kim Moore: Instructional Coach and Project Manager

- Collect research data and conduct informed consent procedures
- Serve as a reflective coach for inservice teachers and Fellows, helping to implement evidence based practices in the 4-8 classrooms
- Teach monthly math certification workshop for approximately 20 fellows and teachers. Assess and support participants, provide individual instruction as needed.
- Help to design and support implementation of peer-assisted instruction
- Participate in program leadership meetings
- Communicate weekly with graduate student to support field based research program and coordinate calendar for Science Thursdays
- Meet weekly with the student teaching supervisors to ensure consistent implementation across the three schools
- Update website with artifacts from activities occurring in the schools
- Facilitate development of vertically-aligned integrated math/science curriculum

Lee Smee: Key Personnel

- Lead four Science Thursdays per year
- Organize and supervise 3 research projects for fellows
- Coordinate summer research activities for fellows
- Recruit graduate student volunteers to facilitate STEM enrichment opportunities (i.e. Science Olympiad, MATHCOUNTS, Science Fair)
- Assist recruitment of STEM faculty and graduate students for ETEAMS participation
- Support science graduate students involved in outreach and research
- Participate in project leadership meetings
- Contribute to the publishing, dissemination, and research working groups

George Tintera: Key Personnel

- Lead four mathematics-focused Science Thursdays events for students per year
- Lead rating and critique of curriculum, research projects, & web content by STEM faculty
- Assist with recruitment of STEM faculty and graduate students
- Help to establish evaluation systems
- Contribute to the program articulation team
- Contribute to program dissemination
- Participate in project leadership meetings

Sandy Smee: Science Instructional Coach & Program Assistant

- Teach monthly science certification workshop for approximately 20 fellows and teachers. Assess and support participants, provide individual instruction as needed.
- Assist with data collection
- Lead entry of survey data and cataloguing of qualitative data

- Work with university accounting systems to manage budget and expenses.
- Follow-up with former fellows through the duration of the project

Avery Scherer: Graduate Assistant

- Coordinate fellows' science research projects, documenting attendance and outcomes
- Contribute to website by helping to document research projects and helping fellows use the website for Grades 4-8 students interaction
- Manage schedule for STEM faculty participation in Science Thursdays
- Lead three Science Thursdays each year, recruiting fellow graduate students as needed
- Assist recruitment of graduate student volunteers to facilitate STEM enrichment opportunities (i.e. Science Olympiad, MATHCOUNTS, Science Fair) at partner schools
- Support data entry and cataloguing procedures

Matt Bowers

- Lead at least 3 focus group interviews yearly on program implementation
- Conduct at least 8 one-on-one interviews yearly on views of teaching and learning of math and science
- Lead qualitative data collection, analysis and publication

Jackie Stillisano: Lead External Evaluator, Education Research Center

- Lead evaluation activities
- Lead evaluation of qualitative research efforts
- Provide accountability that research goals were met
- Evaluate the effectiveness of the program
- Assess the impact of the program, both anticipated and unanticipated outcomes
- Identify program strengths and weaknesses, make yearly program recommendations
- Document the development and implementation of the program
- Identify what elements of the program are scalable, replicable and transferable

Danielle Brown: External Evaluator

- Lead evaluation of quantitative research activities
- Support documenting the development and implementation of the program
- Contribute to program accountability, assessments of effectiveness, & recommendations

Hersh Waxman: External Evaluator

- Support documentation of project development and implementation
- Contribute to program accountability, assessments of effectiveness, & recommendations