THE IMPORTANCE OF PARTNERSHIPS AND DATA COLLECTION IN LONG TERM PROGRAMS FOR PRE-SERVICE AND IN-SERVICE SCIENCE AND MATHEMATICS TEACHERS. M. L. Urquhart[1,2], [1]Department of Science/Mathematics Education at the University of Texas at Dallas, 800 West Campbell Road FN 33, Richardson, TX, 75080, urquhart@utdallas.edu, [2]William B. Hanson Center for Space Sciences, The University of Texas at Dallas

Introduction: As noted in reports such as *Rising Above the Gathering Storm* [1,2] the United States is facing a crisis with regard to the preparation of science, technology, engineering, and mathematics (STEM) workforce. In response, the Committee on STEM Education (Co-STEM) of the National Science and Technology Committee released the *Federal STEM Education 5-Year Stategic Plan* [3]. Co-STEM's recommendations include the recruitment and preparation of 100,000 K–12 STEM teachers and strengthening of current STEM teachers. Accountability and demonstrating results for funders, be they state, federal, or private, is not new. However, Co-STEM places increased pressure on federally funded education efforts, such as those for NASA, to demonstrate measureable outcomes of success.

In the Department of Science/Mathematics Education (SME) in the School of Natural Sciences and Mathematics (NS&M) at the University of Texas at Dallas (UTD), we have several programs to prepare pre-service teachers and serve and strengthen the capabilities of in-service teachers. Here I describe the nature of these programs, the data collection challenges and requirements, and efforts to meet those challenges through partnerships with teachers, individual schools, school districts, and state and national parent organizations.

Programs in Science/Mathematics Education: Programs in SME fall into two broad categories, with significant overlap: 1) Academic programs that represent the primary mission of a university, and 2) Outreach programs that require neither enrollment at the university nor formal courses for participation.

Preparation of Secondary Science and Math Teachers: The UTeach Dallas program [4] is a replication of the original nationally acclaimed UTeach model [5] at the University of Texas at Austin. UTeach Dallas began in 2007 with a $2.4 million high-fidelity replication grant from the National Math and Science Initiative [6] and Texas Education Agency (TEA) [7]. The program currently has over 350 students and 90 graduates with a 100% placement rate for graduates seeking local teaching positions and a >90% teaching retention rate. Students experience teaching first hand starting as early as their first semester at the university. Recruitment of STEM majors involves offering a trial of the two one-credit hour introductory courses for teacher certification with reimbursable tuition. UTeach coursework is pedagogy focused rather than STEM content focused. A Phase II NSF Robert F. Noyce Teacher Scholarship program [8] assists in supporting and retaining upper-level STEM majors in completing degrees and certification. Partnerships for UTeach Dallas include the STEM discipline departments in NS&M and five Title I [9] school districts as well as other school districts, individual schools, and teachers.

Long-Term Professional Development (PD) of Science and Mathematics Teachers. The longest running SME academic programs are the Master of Arts in Teaching (MAT) programs in Science Education and Mathematics Education. Teachers enrolling in Science Education have a wide variety of backgrounds, from little initial science content, to STEM degrees in fields other than subject taught (such as an individual with a biology degree teaching physics), to those with undergraduate and/or graduate degrees in subject taught [10]. The majority of math MAT students have historically held a content degree in mathematics, which is changing as the grade level focus broadens. The focus of both MAT programs is on strengthening content knowledge concurrently with pedagogical content knowledge along with educational technology, research, and leadership skills.

A complementary outreach program to the MAT in Science Education is the UT Dallas Collaborative for Excellence in Science Teaching (the UTD TRC). The UTD TRC is competitively funded on an annual basis by the Texas Regional Collaboratives for Excellence in Science and Mathematics Teaching (TRC) [11]. The TRC is a network of 58 programs throughout the state, which have common requirements of:

- At least 100 contact hours of content-focused PD for primary participants known as Teacher Mentors (TMs)
- Annual STEM content focus areas selected in coordination with TEA
- Formal university and K-12 partnerships
- Mentoring of additional teachers by TMs
- Data collection

Funds are provided per teacher, with each program determining the nature of expenditures within specific guidelines. In the case of the UTD TRC, funds provide tuition assistance for select MAT courses, training ma-

terials, K–12 classroom materials, teacher stipends, opportunities for teacher conference attendance, and some salary support and training for the instructional team. Most UTD TRC professional development is provided in the summer and weekends by SME faculty outside of courses. The TRC requires grantees to maintain formal partnerships with university STEM faculty and at least three high-needs (Title I) school districts.

UTeach Dallas Induction provides up to three years of support for graduates from UTeach Dallas and other UTeach programs teaching in the Dallas/Fort Worth area. Induction consists of one-on-one in-school visits by an Induction Coordinator, access to lesson plans and instructional resources in SME, and organized workshops held approximately one Saturday morning per month. The UTD TRC and UTeach Dallas Induction partner to provide joint workshop opportunities for teachers in the two programs.

Education and Public Outreach. The UTD TRC and UTeach Dallas Induction are parts of the outreach mission of SME that provides long-term PD to STEM teachers. In addition, SME is partnered with the William B. Hanson Center for Space Sciences on the Education and Public Outreach (EPO) for the small NASA Coupled Ion Neutral Dynamics Investigation (CINDI) Mission of Opportunity [12]. CINDI EPO has partnered with the MAT [13] and UTD TRC as well as with SME outreach programs for K-12 students such as the Women in Physics Camps [14].

Data Collection and Partnerships: For academic programs data collection is for instructional purposes, programmic evaluation, and state or accreditation monitoring requirements. The focus is, by necessity, on instruction and student learning as well as performance outcomes in university or K-12 field experience settings. Faculty monitor student learning through a variety of methods including both in-house created assessments and research-based tools developed by the STEM Discipline-Based Education Research communities and teaching performance for pre-service teachers on standardized observation tools.

For programs such as UTeach Dallas and the UTD TRC, data collection is primarily driven by grant requirements and parent organizations, which serve as partners and performance monitors. The UTeach Institute oversees UTeach replication, and collects survey data as well as programmatic data on demographics, student performance, and retention in program and post graduation. This data has proved essential in demonstrating effectiveness for the UTeach Institute's and UTeach Dallas' continued fundraising efforts with both public and private funders. Maintaining contact with graduates through induction and beyond has proved invaluable in data collection efforts.

A deeper level of individualized data collection is required by the NSF Noyce Program. UTeach Dallas must collect additional data on individual internship and scholarship recipients, and track the latter for several years post graduation. Separate survey data is also collected for Noyce participants by an external evaluator, raising concerns of multiple frequent surveys to the same population impacting quality and quantity of responses.

The TRC requires extensive data collection from UTD TRC participants and continuous monitoring of program performance and progress towards required objectives. Every teacher participant is input into the project database, with personal demographic data. Pre/post test data, TRC surveys, a yes or no on consent to participate in research, and classroom demographic data are required of all TMs. All TMs in state assessment tested grade levels must provide aggregated student performance data with at least five schools reporting for entire tested grade levels. Aggregated data is then compiled statewide for reporting to funding agencies. Non-fiscal project monitoring data includes agendas and sign-in sheets, links to participants and hours earned, and content providers for each PD session.

Implications: Data collection to measure program impacts for both pre-service and in-service teachers is critical to demonstration of success and requires a coordinated effort. An important consideration for in-service teacher programs is that measuring impacts on teacher effectiveness depends heavily on partnerships with local schools and districts. When working with K–12 teachers, student outcomes are an important data source for universities and outside agencies – yet also challenging and potentially expensive to acquire. With the UTD TRC, we rely primarily on teacher or grade-level aggregated student state testing data, when available. Access to such data requires agreements with teachers, schools, and school districts. Periodic classroom observations, benchmark data for student performance, and comparison groups would provide a clearer picture of the impacts of PD. However, these data sources have implications for privacy concerns for both teachers and students thus requiring a deeper level of partnership between providers and K–12 schools.

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