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ATTRACTING STEM MAJORS TO A CAREER IN TEACHING

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Abstract

Talented Teachers in Training for Texas (T4) is a recruiting and training program for STEM high school teachers. We describe the program's three distinctive recruiting events – a STEM Master Teacher Job Shadow, a NASA Aerospace Teachers Program, and a STEM Day – along with T4's training focus – a multi-year scholarship and mentoring program designed to invite pre-service teachers into an authentic, sustained academic community of practice supported by high levels of engagement with caring STEM practitioners.

INTRODUCTION

One of the enduring challenges in teacher preparation today is the recruitment and retention of highly-qualified science and mathematics teachers. As the proportion of careers demanding a strong background in science, mathematics, engineering and technology (STEM) continues to rise, so does the concern for addressing the need for mathematics and science teachers who are able to engender interest and passion among their high school students for majoring in STEM fields and pursuing careers in STEM-related occupations beyond college (National Research Council, 2011). Moving beyond workforce development needs, the staffing challenges of mathematics and science teachers has also been linked to other educational problems in the U.S., including the low performance of American students on international comparisons in mathematics and science, lower national economic competitiveness,

declining engineering majors among American college students, and an increasing minority achievement gap (Rising Above the Gathering Storm, 2005).

In a recent national study that examined the supply and demand for mathematics and science teachers, Ingersoll and Perda (2010) found that the problem of STEM teacher supply and demand is two-fold. First, the number of mathematics and science teachers currently being prepared is insufficient to fill the shortages in light of increasing student enrollments and the pace of teacher retirements; also, higher rates of turnover and attrition exist among STEM teachers which leaves a smaller cushion in the workforce to re-supply STEM teachers in schools. Rates of turnover and attrition are highest in hard-to-staff, high-need school districts. Thus, addressing the persistent critical shortage of mathematics and science teachers in schools today requires not only improving approaches to STEM teacher recruitment but also designing recruitment processes that will lead to improved retention and success among novice mathematics and science teachers in hard-to-staff school districts.

Talented Teachers in Training for Texas (T4), a Robert Noyce Scholarship program funded by the National Science Foundation (NSF), was conceptualized to raise awareness of teaching opportunities throughout the local STEM community, to offer attractive entry points to high school teaching experiences, and to target a limited number of aspiring teachers, called T4 Scholars, for authentic inclusion into the STEM teaching community. T4 targets students who are majoring, or considering majoring, in STEM fields at Stephen F. Austin State University and at Angelina College, a T4 partner community college. T4 Scholars are prepared for teaching in high-need high schools through extensive observation and interaction with in-service teachers, group reflection; academic mentoring that begins in their junior and senior years of college, novice teacher support during their first three years in the classroom, professional support through paid conference attendance, and academic scholarship support totaling \$30,000.

T4 EXPOSURE AND RECRUITING STRUCTURE

The T4 recruiting effort is intended to raise awareness among a broad student population about careers and opportunities in STEM teaching. In addition to publicizing the Noyce scholarships, our advertising focused on three distinctive recruiting events: a STEM Master Teacher Job Shadow Program, a NASA Aerospace Teachers Program, and a STEM Day Program. Since “getting the word out” is everything, we set attainable publicizing goals for launching each program and sought to expand recruiting as the programs repeated. In our first year we visited 20 mathematics and science college classrooms and then expanded to 33 visits in year two. We doubled the number of fliers printed, added video testimonials to our website, and tapped the recruiting network of those students who had already benefitted from the T4 programs. We also held evening information sessions for prospective participants. Over 100 students became involved in these programs within the first two years of T4, and many more have heard about the T4 program and careers in STEM teaching.

STEM TEACHER JOB SHADOW

The STEM Master Teacher Job Shadow consists of one full forty-hour week of working with a trained Master Science or Mathematics Teacher after the university’s spring semester and while high schools are still in session. T4 benefits from the fact that our university has an active Robert Noyce Master Teaching Fellows program, an NSF Math Science Partnership cohort of teacher leaders, and a Math, Science & Technology Teacher Preparation Academy for high school teachers. These programs provide a network of excellent teachers for the job shadow.

Master Teachers and T4 Recruits meet together prior to the scheduled event week. Having these meetings allows Master Teachers and the T4 Recruits to become acquainted and discuss school protocols such as dress code, parking, office check in, etc. Master Teachers also clarify their professional expectations for the week. Additionally, Master Teachers receive advice on what has worked well in past shadowing events from previous participants.

During the job shadow experience, T4 Recruits complete reflection journals each day and upon completion of the experience attend a half-day debrief with their Master Teachers. As part of the academic support, the T4 Recruits receive a \$450 stipend for the week and attendance at the Saturday debrief session is required. Reflection journals allow us to capture a wealth of perspectives.

In preparing for the job shadow, Julie (pseudonyms used throughout) wrote “I am ... extremely curious about the overall atmosphere of a high school and seeing it through the student’s eyes because I have never been in a public high school before – I was homeschooled.” At the end of the week, she praised the job shadow but indicated she did not think a career in the public schools was for her. Better to decide based on experience! Others drew different conclusions. After the experience, Erica wrote “I am now, more than ever, inspired to teach and pursue this career. I saw things (abilities and creativity) in myself that I didn’t see before.”

The Master Teachers also raved about the experience. “They got five day’s work... they got to see the reality of it. Not just ‘this hour’ every single day.” Another said, “I think the week at a time is much more valuable than the little snippet... just to push through even when you don’t feel like it. They got to see everything.” Nearly all Master Teachers indicated an eagerness to be included for participation in future events and incorporate other Master Teachers’ ideas in the future.

STEM DAY

Faculty at our university had discussed holding a STEM Day for years, but T4 catalyzed the event to *actually occur*. The vision was to bring in hundreds of local high school students to our university to do exploratory activities and hear speakers from a variety of STEM fields. More STEM majors and more visibility for STEM fields make a richer candidate pool of potential STEM teachers. Although we believed this to be unquestionably a best practice, there was an obstacle. Noyce Scholarship programs last at most five years (including planning). It takes seven years for a high school sophomore to develop interest in STEM, discover teaching as a passion, and get trained (assuming a four year university degree

plan). Using STEM Day events to garner data documenting STEM recruitment was not feasible. Our solution was to utilize college students, potential T4 Recruits, in all of the STEM Day activities as guides and co-presenters. Doing so allowed us to incorporate an event into our program that could substantially affect STEM interest of students at a younger age while simultaneously addressing the goals of T4.

On our first STEM Day, a total of 12 school districts attended with 243 students and 34 teachers. Of the students who attended, approximately 63% reported being in the top 10% of their class in terms of mathematics and science ability. (Response rate was 70%.) In the post-experience survey, 81% of students indicated that their interest in STEM had increased (25% “increased dramatically”). The increase in knowledge about STEM careers was even higher with 36% indicating their knowledge had “increased dramatically” and 60% indicating it “increased somewhat”. Teachers were also encouraged by the effort to reach their students. In a follow-up survey, several commended “the diversity of activities” which had been available at STEM day. They especially appreciated the hands-on activities, the professors sharing their passion about their fields, and students being exposed to the STEM careers panel. University faculty shared the enthusiasm about finally implementing STEM Day.

Unfortunately, our success appeared to be meager among the university students we incorporated as guides and co-presenters. We were able to involve over 80 college students in STEM Day, but as a result many had only cursory roles. In the follow-up survey, 96% indicated that their interest in high school teaching had not changed. (This may have been affected by the fact that around half of the university students involved were either seniors or graduate students.) Around 50% of guides’ written comments asked for “more organized instructions for students volunteering.”

For the second annual STEM Day, the number of university students participating was reduced slightly to 55 students with more specific activities. Guides were assigned to a single cohort of students throughout the morning activities, acting as leaders and mentors. This proved to have a significant impact on our recruiting efforts. Instead of having only 4% of the university students report increased interest in

high school teaching, in the second year, 42% indicated their interest in high school teaching had increased. This increase was achieved at the same time as the overall program grew to 266 high school students and high school student interest levels remained high.

NASA AEROSPACE TEACHERS PROGRAM

One of the greatest assets of the T4 program is a dynamic partnership developed with NASA whereby prospective teachers are embedded with high school groups in NASA's High School Aerospace Scholars (HAS) program as junior teachers. HAS identifies talented high school students from across Texas and Oklahoma, trains them during the school year, then brings them to NASA's Clear Lake facility for a one-week experience where they work on STEM challenges in teams of ten. Each team is assigned a certified classroom teacher, a junior teacher from T4, a NASA professional, and has access to a wide variety of other NASA personnel. The program enjoys a phenomenal reputation and was much enjoyed by the university students who participated as junior teachers.

In our first year, 12 T4 Recruits from our university and partner junior college participated. Afterward Parker said, "Seeing [students'] drive to achieve is one of the more inspiring things," and Aleisha said it opened her eyes to the bonds that teachers and students develop. Two thirds of junior teachers either had their interest in teaching increase or their previous commitment to teach solidified.

After the initial year, we established clearer expectations for T4 Recruits going into the program concerning what they would be doing by adding a pre-experience orientation with past T4 participants in the NASA Teacher Program. Additionally, NASA now provides information to the Master Teachers regarding the participation and expectations for junior teachers.

THE T4 SCHOLAR COHORT STRUCTURE

Although our recruiting programs broke new ground in a number of directions, our largest effort has been focused on our scholarship recipients - our cohort of T4 Scholars. T4 Scholars meet with

university faculty and teaching mentors biweekly to discuss aspects of teaching, examine content and explore challenges for new teachers, meet with practitioners (sometimes novice teachers) from the field, and most of all to become a supportive, sustained academic community. Regular classroom observation and reflection is an integral part of the program, as are local, regional, and national conferences. This community's professional, monetary, and relational support is producing a positive effect on many of the T4 Scholars as the following stories illuminate.

Like many of our T4 Scholars, the money was a big incentive for Parker. As a high school senior, he had been accepted to a top private university. But during his senior year of high school, life as he knew it fell apart. Through changing circumstances in his family, he ended up on the streets. Although a bright student, accepted to a top school, he did not attend a university or college at all that fall. By the spring semester, Parker was able to begin attending a community college. A year later, he transferred to our university.

With limited financial or emotional support, college can be a challenge and Parker found this was true in his situation. He wanted to do something great with his life, which in his mind most likely meant becoming a doctor. He aced general physics in the fall and was earning an A in botany when a speaker came to his class to talk about the T4 programs. In his words, "The T4 program was kind of like a key to the door. I guess it kind of helped push me along." He signed up for the NASA teaching experience. He also decided to take the leap and apply for the T4 scholarship, knowing that it meant committing to teach.

Although the financial support was important to Parker, the relational support was just as valuable. Our program has a veteran teacher with 20 years in the high school classroom who is mentoring Parker's cohort. By the end of the first meeting with her, Parker and another student were calling her 'MOM' – (Mentor Of Math ... & Science). While in the T4 program, Parker will be mentored by MOM not only through college but also during his first three years in the classroom.

Typical teacher preparation programs provide mentoring (by an advisor, a student teaching mentor, etc.) but it is rarely the same person throughout the program. Similarly, school districts routinely assign mentors to new faculty, but these mentorships can fluctuate. Our mentorship is different. It begins at least 4 semesters before a future teacher graduates college, and the same mentor follows the T4 cohort through teaching observation, student teaching, and into the classroom. Even if the teacher changes districts in the second or third year, the mentor will not change, allowing for a more authentic, sustained community of practice where self-reflection, collaboration, and stronger confidence in one's teaching ability can flourish.

A STEM FAMILY

The most unexpected benefit of the T4 cohort model is the “family” as our T4 Scholars like to call themselves. In addition to biweekly meetings, online discussion, and traveling together to conferences and events, T4 Scholars began requesting opportunities to spend time together socially as well – bowling, dinner, a camping trip. Teaching is a challenging endeavor, and effective mentoring works best through developing relationships, preferably outside the teaching day (Odell, 1990). For gifted young academics with lacking support systems who want to make a great contribution with their lives, our program has turned out to be a special haven.

Many T4 Scholars have experiences that parallel Parker's. Erica was a passionate, overcommitted 22-year-old who had just changed her major from accounting to mathematics. Unsure of what she wanted to do with a mathematics degree, her advisor shared information with her about the T4 programs and considering a career in teaching. Erica realized that teaching had always been in the back of her mind, but she had resisted the urge to pursue it. She comes from a supportive family - a father who is a self-described “third generation blue collar grunt” and a stay-at-home mother. Both were proud of their daughter but unable to help her navigate teacher preparation. After much thought, Erica decided to apply for the Job Shadow and the Noyce Scholarship.

A year into the T4 Scholar program, Erica is optimistic. She believes she's getting a "realistic view of what goes on in the classroom" rather than "a textbook perspective." From the full-week job shadow to the biweekly meetings with MOM; from the dinner discussion with a first, a second and a third year teacher about the highs and the lows of teaching, to the networking opportunities provided from attending the national NCTM conference, Erica is experiencing what her parents could not offer her – a gentle immersion into the world of teaching before facing the high school classroom as an-inservice mathematics teacher.

Erica's family was so grateful for the opportunities afforded Erica that her father contacted the project director with this email:

My wife and I wanted to express our sincere appreciation for the interest and support you and the department have provided to our daughter. I am sure that we can never know the full depth of what you have done for her. And you cannot know the depth of what you have done for our family as a whole as well as for Erica.

Parker and Erica came from different backgrounds but ultimately benefitted from the same things: financial and community support founded on the basis of an academic community of supportive university faculty and mentor teachers willing to strengthen the pipeline of STEM teachers in high need schools. Not surprisingly, students in T4 who had the greatest monetary need expressed more passion about pursuing the scholarship. It is interesting that the same has proven true for students in need of mentoring relationships.

CONCLUSION

The U.S. continues to face a critical shortage of STEM professionals, particularly in the teaching field. Being qualified is insufficient. We need to recruit and equip teachers to inspire our youth to see the beauty and applicability of science and mathematics. In the 2010 Report to the President, the President's Council of Advisors on Science and Technology, recommended:

The Federal Government should set a goal of ensuring over the next decade the recruitment, preparation, and induction support of at least 100,000 new STEM middle and high school teachers who have strong majors in STEM fields and strong content-specific pedagogical preparation, by providing vigorous support for programs designed to produce such teachers. (PCAST, p. X)

The need for new teachers, exacerbated by the number of teachers that leave the field annually as a result of lack of professional support (Ingersoll and Perda 2010), makes it imperative that colleges and universities recruit more students into STEM teaching fields and find creative ways to support novice teachers.

Talented Teachers in Training for Texas uses the four programs described above to address these concerns. The Master Teacher Job Shadowing Program, the NASA Aerospace Teaching Program, and STEM Day raise awareness of STEM teaching opportunities and initiate the equipping process for those considering the teaching field. The T4 Scholars Program invites pre-service teachers into an authentic, sustained academic community of practice supported by high levels of engagement with caring STEM practitioners. Initial results demonstrate positive outcomes in both areas. Our program has been quantitatively successful in STEM recruitment and preparation, and the transformative quality of the academic community developed bodes well for future teachers' persistence in the field long after college.

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