

THE IMPACT OF THE ROBERT NOYCE MENTORING PROGRAM ON INCREASED TEACHING EFFECTIVENESS AMONG TEACHER CANDIDATES

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Abstract

The State of Texas is in dire need of effective classroom teachers, particularly teachers in the STEM fields. In an effort to meet the needs of Texas schools, and to ensure that effective teacher candidates are entering Texas classrooms, a grant from the National Science Foundation to implement the Robert Noyce Scholarship program was obtained. In an effort to examine the effectiveness of the program, a qualitative study was employed. The findings highlight potentials for utilizing content area specialists to serve as mentors who facilitate specified field experiences.

Keywords: preservice teacher preparation, mentoring, STEM

Introduction

In 2016, only 2,880 math and science certifications were issued across the State of Texas, despite a much larger need (Bailey, 2017 p. 10). Additionally, Texas continuously sees many educators leaving the profession. In fact, in the 2016-2017 school year 35,959 educators left the teaching profession (TEA, 2019). In addition to the clear need for more educator, it is important that educator preparation programs continue to focus on increasing the teaching effectiveness of their candidates.

Effectiveness in STEM fields

Educational research findings indicate teacher effectiveness is not only difficult, but extremely complex, and often lacks validity and reliability (Goe, Bell, Little, 2008; Seidel & Shavelson, 2007). Research findings also indicate that educator preparation programs that have quality early field experiences, a consistent mentoring network, and high-quality specific content-based curriculum courses produce graduates that are more likely to succeed and stay in the classroom (Darling-Hammond, 2006).

The Robert Noyce Scholarship Program

In an effort to meet the needs of Texas schools, and to ensure that effective teacher candidates are entering Texas classrooms, the College of Sciences and Mathematics, in collaboration with the College of Education, at a rural Texas

university, applied for and received a grant from the National Science Foundation to implement the Robert Noyce Scholarship program. The program is entitled Talented Teachers in Training for Texas (T4).

While T4 scholars have repeatedly pointed to the sizable scholarship attached with a T4 award as their greatest draw toward applying for the program, many say in hindsight the mentorship was the most valuable component. Not only did scholars meet biweekly with STEM and education faculty, hand-picked veteran science and math teachers were chosen to oversee their mentoring throughout scholars' undergraduate experience and into the classroom. These former classroom teachers ran biweekly training sessions for scholars leading up to their clinical teaching semester. These same mentors, having established rapport with the scholars, were scheduled as their supervising teacher during clinical teaching. In contrast, outside of the T4 program supervising teachers rarely knew their supervisees personally and typically had no STEM teaching experience as the university assigns supervising teachers based purely on school location. Perhaps best of all, however, these teaching mentors continued to support T4 scholars through the job application process and through their early years in the classroom. Additionally, the grant funded travel to regional math and science teaching conferences so scholars were able to reconnect with their mentors and peers during an intensive three- to four-day period, all while keeping abreast of the latest best practices in the field. T4 was created with the goals of:

1. Creating experiences through which university STEM majors examined careers in high school teaching through early intensive field experience (Hubbard, Embry-Jenlink, & Beverly, 2015).
2. Recruiting aspiring STEM teachers for engagement in structured mentoring networks (inclusive of experienced classroom teachers, aspiring STEM teachers, and STEM and education university faculty) for two years before graduation and three years after entry into the teaching profession (Hubbard, Embry-Jenlink, & Beverly, 2013);
3. Examining and identifying the most effective practices for STEM teacher training and retention.

Teacher Effectiveness

Teacher effectiveness within educational research is subject to diverse methodologies, definitions, and measurements (Goe, Bell, Little, 2008; Seidel & Shavelson, 2007). This research focused on four characteristics of effective teaching: student centered pedagogy, culturally responsive pedagogy, positive classroom management, and evidence of teacher content knowledge.

Table 1*Four Characteristics of Effective Teaching*

Quality	Definition	Supporting Research Findings
Student-Centered Pedagogy	The teacher initiates a student-centered classroom through creation of an environment that gives students opportunities to contribute, engage in hands on activities, interact in an authentic manner with the content and with their peers.	Fenstermacher & Richardson, 2005; Goe, Bell, Little, 2008, Seidel & Shavelson, 2007
Culturally Responsive Pedagogy	Culturally responsive pedagogy is woven into every aspect of the teacher's instructional curriculum and classroom management choices.	Gay, 2010; Ladson Billings, 1995; Freire, 1996; Swartz, 1996; Hooks, 1194
Positive Classroom Management	The teacher creates a classroom culture and climate based upon mutual respect, and positive socio-emotional interactions.	Fenstermacher & Richardson, 2005; Noddings, 1992; Siedel & Shavelson, 2007
Evidence of Content Knowledge	Evidence of rigorous content knowledge is observable in teacher lessons, classroom management, and student interactions.	Bransford, NRC (U.S.), 2000; Goe, Bell, & Little, 2008

Field Experiences

Research investigating traditional field experiences in teacher education has revealed that effective teacher preparation programs have unique and increased opportunities for candidates to work in the field (Boyd, et al., 2008). However, the quality of such experiences must match the sought outcome. In most university-based educator preparation programs, teacher candidates are placed at a K-12 school to learn under a cooperating teacher on that campus during their final semester. In addition to the cooperating teacher, a university supervisor, who is tasked with observing and evaluating the teacher candidate during clinical teaching, is assigned.

There are problematic challenges with these traditional methods for facilitating field experiences. Darling-Hammond (2009) argues that "often, the clinical side of teacher education has been fairly haphazard, depending on the idiosyncrasies of loosely selected placements with little guidance about what happens in them and little connection to university work" (p. 11). In fact, often when teacher candidates are placed in K-12 school settings to complete their clinical teaching experience they are placed alongside classroom teachers who have not been provided preparation or support to implement a purposeful mentoring experience (Zeichner 2010). Additionally, there is a disconnect, limiting teacher candidates' "opportunities to observe, try out, and receive focused feedback about their teaching of methods learned about in their campus courses" (Zeichner 2010, p. 91).

Acknowledging these challenges and limitations and recognizing that quality field experiences are paramount for graduating effective teachers (Cochran-Smith & Lytle, 2009; Zeichner, 1996), the T4 Noyce Program employed university supervisors specifically for their teacher candidates. It began with a twenty-year secondary mathematics teaching veteran who then had moved to the Regional Service Center. After three years, an experienced science teacher was also hired (also having experience delivering professional development through a Regional Service Center and building connections with a wide variety of districts). These two STEM teaching mentors met biweekly with T4 scholars prior to their clinical teaching experience, then served as supervising teachers for the field experience, and finally acted as induction mentors once these scholars entered the classroom.

Reflection in Teacher Education

Another element of importance when considering teacher effectiveness is reflection. Since the early 2000's those in teacher education programs have called for the inclusion of reflective practices (Ottesen, 2007; Loughran, 2002; Rodgers, 2002; Birmingham, 2004; Admiraal & Wubbels, 2005). However, the definition of such practices and methods for implementation are varied and often unclear. For our purposes, we view reflection as a tool to promote understanding and to gain insights to facilitate a transformation of thought or practice. Thorsen and DeVore (2013) assert that:

In order for teacher educators to understand and develop methods for promoting and assessing reflection, they must facilitate conversations about desired learning outcomes; help candidates analyze personal, moral, and ethical practices; and evaluate educational policy or political outcomes that may be desired as a result of reflection.

Furthermore, teacher educators must be able to identify and analyze the reflective elements present or absent in artifacts and know how to nurture more sophisticated reflection. (p. 90)

Studying the reflective practices that were facilitated through the T4 Noyce Program an understanding of how reflective practices can bridge the gap between theory and practice was gleaned.

Theoretical Framework

This research utilized a sociocultural framework as a lens for examining the reflective activities. A sociocultural perspective of teaching acknowledged that teaching is a social act, contingent upon and embedded within social and cultural interaction (Vygotsky, 1978). In addition, Vygotsky argued that interaction and collaboration between people is needed to aid in development (1978). The collaboration and interactions that this research centered on occurred between the T4 scholar and their mentor teacher, the T4 scholars and their students, the T4 scholar and their colleagues, as well as the collaborations that occurred between T4 scholars.

Methodology

Our research utilized a qualitative approach and was predicated upon a case study design, focusing on three T4 scholars as they grew from preservice mathematics teachers to teachers of record (Merriam, 2002; Yin, 2003). Such an approach correlated with the theoretical framework as qualitative research examined the way in which "human behavior is significantly influenced by the setting in which it occurs" (Bogdan & Biklen, 2007, p. 4-5). Additionally, qualitative researchers were concerned with the process in addition to the outcome (Bogdan & Biklen, 2007). The qualitative lens facilitated opportunities to examine T4 scholars' journeys to become effective educators. The research was guided by the following research questions:

1. What benefits do STEM teachers gain in teaching effectiveness from their undergraduate experience within the T4 Noyce program?
2. What observable evidence exists of these benefits in their practice?
3. How did the reflective opportunities embedded within the T4 Noyce Program impact teacher effectiveness?

Data Sources and Analysis

The data sources, which were collected over a period of seven years, included interviews with participants, written documentation from Noyce STEM teacher mentor, videos of participants teaching in their classrooms, and annual administrative evaluations of the participants. The diversified data and the utilization of the constant comparative method (Glaser and Strauss, 1967) for data analysis until theoretical saturation was achieved (Glaser & Strauss, 2017) ensured Lincoln and Guba's (1985) guidelines of trustworthiness were followed.

Participants

T4 scholars are actively recruited, both at the host university and at 11 community colleges. Identifying STEM teacher candidates well suited to and well served by the T4 program was critical. The program required that candidates be at least halfway through their undergraduate coursework and have at least a 2.75 GPA.

The T4 scholars who participated in this study were three of the nine scholars, Amanda, Beth, and Desire, who were enrolled in the first cohort of the program. All three began the program intending to certify in grades 7-12 Mathematics. They began the program with between 67 and 79 credit hours toward a 120-hour degree and all three graduated two years after beginning the program. All three entered a high-need mathematics classroom the fall after their graduation and have taught continuously since that time.

Themes and Discussion

From the data collected, three overarching themes emerged regarding the impact of the T4 Noyce Program:

1. Meaningful in-content-area field experiences were important for the development of the T4 scholars as teachers of record.
2. Extended collaboration between the T4 scholars was perceived as critically important.
3. Reflective opportunities, facilitated by a dedicated mentor, revealed a distinct connection between reflection and action.

Meaningful Field Experiences

The first cohort of T4 scholars consisted of nine students. Due to the length of the program, and the number of participants, much became known about the scholars and their needs. This knowledge enabled the program coordinators to facilitate purposeful field experiences, including their clinical teaching placements. Beth, who was placed in a mid-sized high school substantially larger than she had intended to apply to, explained:

I think they also tried to put us in schools, when we were doing our student teaching that would challenge each of us individually. And so I know that I thought I wanted to teach in a small school and I actually got put into [a midsized] high school, so that was a totally different diversity than what I was expecting to see. So, they kind of tried to place us somewhere where we would kind of get to see a different field than what maybe we thought we would be the most comfortable with.

If Beth had participated in the traditional certification program at the university, she would have been afforded the opportunity to choose the location of her clinical teaching. As she admits, she would have likely chosen a school she was most comfortable teaching, not giving her the opportunity to gain experience with a more diverse population.

Beth, Amanda, and Desire also pinpointed specific field experiences that T4 scholars participated in as a strength of their preparation. Beth emphasized an opportunity to attend ESL training.

Because T4 allowed us to be more aware of things that were going on. So they recommended we do the ESL training ahead of time, and I don't think a lot of students knew about it because they weren't involved. So that was

another opportunity where we got to go sit in an ESL classroom for so many observation hours and that was kind of an added benefit to also us getting our certification.

While this specific field experience was not an opportunity to practice, its strength lies in the fact that learning and effective preparation can also happen “as long as the work being done is centered in authentic classroom materials” as the ESL training was (Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005 p.402.).

Similarly, when asked about the strengths Desire revealed that completing the T4 program gave her confidence: “Just kind of having that back there helps with, ‘Okay, well I can do this in my classroom.’ And I know that I know what I’m doing. Even though I haven’t even started yet to like actually have confidence in that I had the training that I needed.”

Collaboration of T4 Scholars

The data revealed several forms of collaboration among the T4 scholars. Beth explained that through her participation in the T4 program she gained insight to a variety of backgrounds. She explained that “we had people from Dallas and Houston who grew up with a lot more diversity than we did and just hearing their perspective, hearing like how they felt when they were in school, so just hearing that perspective just opened your eyes so much.” By creating cohorts based on program admission dates the T4 scholars were able to engage in prolonged interactions with the same group of peers. We know that with extended interactions students are more likely to feel comfortable sharing personal experiences (Seifert and Mandzuk, 2006). The experiences that were shared were important enough for Beth to recall several years post-graduation. Beth’s understanding of the importance of perspective reveals her strengths in culturally responsive teaching.

Beth and Amanda also commented on the ways in which the relationships they formed in T4 impacted their first-year teaching experience. Beth explained, “it is even just having each other to kind of share emotional experience with in our first year, having people to call and be like, ‘Okay, well, they just threw us an entire book and said here you go.’” Amanda reiterated, “And I really think having my friends’ support has been really helpful to, like, ‘Well, what did you do? This isn’t working for me.’ And then just kind of piggyback off of each other’s ideas for the T4 program.”

In addition, three of the participants, Beth, Desire, and Amanda formed a close bond throughout their time in the T4 program. This bond turned into a professional collaboration years after their graduation. In fact, the T4 mentor teacher noted that “Desire, Beth, and Amanda work together to create material even though they are at different school districts.” Essentially what these three teachers have created is their own community of practice (CoP). CoPs are a group of individuals who share knowledge, abilities, and experiences and are an important tool, especially for early career educators as they limit the seclusion many teachers experience (Baranr & Cagiltay, 2010).

Teaching is often a very isolated profession as teachers spend most of their day in their own classrooms, without much interaction with their colleagues (Vavasseur & MacGregor, 2008). This kind of isolation often means that beginning teachers are not able to engage in the types of collaborations they often did in their educator preparation program and can be attributed to teacher attrition (McCluskey et al., 2011).

In addition to combating isolation, “a new body of research suggests that teaching experience and pedagogical preparation matters for student achievement when teachers have opportunities to learn from their peers” (Berry et al, 2009, p. 1). In fact, “studies suggest that teachers at any experience level stand to gain from collaborative work. Teachers who have consistent opportunities to work with effective colleagues also improve in their teaching effectiveness” (Berry et al., 2009, p.2). Beth, Desire, and Amanda were able to create and sustain this important type of collaboration for years, as it continues today. While not all T4 scholars engaged in this type of partnership, it is an important finding, providing T4 instructors with a blueprint for promoting CoPs among future program participants.

Mentor Facilitated Reflections Enable Action

During their five-year participation in the T4 program, Amanda, Beth, and Desire collaborated with one university mentor, Lisa. Lisa served as their connection to the university, observed them in the field, provided feedback and continued mentorship. In this capacity, Lisa was able to assist the scholars when they faced challenges. For example, Amanda faced some challenges in her teaching career regarding classroom management. Lisa noted that Amanda's main challenge in the classroom was her inability to "discover her style of classroom management."

Initially, Beth and Desire also faced challenges with classroom management. Lisa observed that Desire "had a little difficulty with classroom discipline in the beginning as she is so sweet and soft spoken." This struggle was further documented by the classroom mentor teacher who noted that "discipline in the classroom is still a struggle for [Desire]. She does ask whenever in doubt about how she should handle a situation." Lisa revealed that most of her conversations with Beth "center[ed] around classroom management strategies."

The struggles of all three was not surprising, as studies have shown that many teacher candidates and in-service teachers received little, or ineffective, classroom management preparation (Birman et al., 2000). But Lisa was able to provide continued support for her mentees. In fact, Lisa utilized "T4's professional development classroom management strategies" to facilitate one-on-one mentorship in order to assist." These strategies, which were utilized throughout the program, were important because when educator preparation programs "have coherent visions of teaching and learning" and "integrate relation strategies across course and field placements" there was a "greater impact on the initial conceptions and practices" of teachers (Darling-Hammond, et al., 2005, p. 392). These conversations were important as Desire explained:

For me, it was just having Mrs. [Lisa] as our student teaching supervisor because we have that relationship with her beforehand. She was able to be honest in some of the things that we struggled with, and I think that is something that is very beneficial for the T4 program that we had someone we already knew be our student teacher supervisor, so that she could tell us this is what you need to work on and us not be offended or upset or hurt by it.

Not all the mentor facilitated reflections centered around challenges. In fact, many of the conversations between Lisa and the T4 scholars were a time in which Lisa was able to offer praise. Amanda noted that having Lisa "telling you what you are doing right, what your strengths" was a great "confidence booster."

Furthermore, the fact the Lisa was a former STEM educator was important. Beth commented that when she had trouble with a group of students, Lisa gave specific advice.

Okay. Well, it came from a veteran and it may be easier for me to buy into than like things than our administrators might say, because most administrators have not taught math or were not in the environment like we are in. It's a totally different world, and especially when you're a young female. And so it's nice to hear from someone who has been in your shoes.

Darling-Hammond et al. (2005), concurred, arguing that while many preparation programs focused "on generic conceptions of knowledge and skill development, it now seems clear that, to be enacted, teachers' learning should be developed in ways that derive from and connect to the students they teach" (p. 403).

Additionally, the bi-weekly communications between Lisa and the scholars were influential. Desire described it as "almost like a beacon of hope because we knew that there was always going to be someone we could call." As Loughran (2002) explained, "this important interplay between experience and reflection is also influenced by the time of reflection, which has a dramatic impact on what can be seen and acted on (p.35)." With continuous communication there was less of a time lapse for the T4 scholars to reflect and consult.

Conclusion and Implications

The results of this study indicated that developing effective pre-service and early career teachers *can* be enhanced with a prolonged mentoring program that enables teachers to engage in reflective practices with content area experts.

However, the authors acknowledge the unique opportunities of the T4 program. Most educator preparation programs serve much larger numbers, and simply do not have the financial means or the ability to employ content area experts. Despite these limitations, the need to increase the effectiveness of early career teachers remains and we assert that elements of the T4 program could be considered and adapted.

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