THE JOURNEY OF A STEM UNDERGRADUATE TO A SUCCESSFUL RURAL MATHEMATICS EDUCATOR AND THE IMPACT OF THE ROBERT NOYCE SCHOLARSHIP PROGRAM

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Abstract

The transition from an undergraduate STEM student to a successful STEM teacher who persists for more than 5 years teaching in a high needs school is a tenuous journey. Only one third of STEM teachers persist in teaching for more than 5 years, and in rural areas the number of STEM teachers who leave each year is even higher. The goal of the Noyce Scholarship program is to increase the number of effective STEM teachers in the public-school classroom. For most undergraduate STEM majors, their challenges in coursework, certification, and personal issues are highly individualized and need specific intervention. This qualitative case study examines the journey of one STEM undergraduate, how the Noyce program responded to the participant's individual challenges, and the success and persistence of that Noyce recipient in the STEM classroom. Case studies such as this can provide critical information to EPP's and STEM scholarship programs about the challenges and needs of STEM undergraduates and teachers, so that key changes can be made in those programs to better support and increase the number of effective STEM teachers who will stay in the classroom.

Keywords: *STEM, educator preparation programs, mathematics educator, rural public schools, early field experiences*

Introduction

In 2012, Stephen F. Austin State University started its first cohort of Noyce scholars. This inaugural group of nine scholars would all go on to certify to teach mathematics or science in the state of Texas. All but two of the group are still in the classroom. This group is unique among undergrad STEM majors because the majority persisted to finish their degree and certify, they have stayed in the field for more than a year, and they have continued to stay in the field for more than 5 years. Because this group of STEM teachers has been extremely successful, the more research that we have produced, the more focus groups and reflections we have done, the more surveys and interview transcripts we have analyzed, we have realized that the best way to document and share our students' success is through the stories of the teachers we have impacted through the Noyce program. While the Noyce scholarship provided a baseline of support through the undergraduate program and four years after graduation, each scholar had unique needs and the Noyce program mentors were able to make individual decisions for each scholar to design a personalized support system based upon those needs. That individualized support system has shown

Volume 14, pp. 140-150
ISSN: 2166-0190 online

tremendous success for our students and our program, and we will share how that system worked on an individual basis, through this intrinsic qualitative case study. The research question framing this study is: How did the Noyce program influence the preparation, persistence, induction and retention of Mr. Adams, a Noyce scholarship recipient?

Literature Review

Nationwide STEM teachers are in high demand and often hard to find, especially in rural schools (NAS, 2010; Milgrom-Elcott, 2019; Sutcher, Darling-Hammond, & Carver-Thomas, 2016). The STEM teacher preparation pipeline for our own regional comprehensive university, Stephen F. Austin State University (SFASU), situated in a remote rural location, is less of a pipeline and more of a sieve. Outside of the Noyce program only 25% of science teaching majors and 17% of mathematics teaching majors persisted to graduation with a teaching certificate between 2007-2018. For the Deep East Texas area that includes 12 counties, 36 cities, and 40 school districts, this means that the university's traditional undergraduate certification program has produced only 25 mathematics teachers, and only 22 science teachers between 2007 to 2018 to meet the STEM education needs of the Deep East Texas region. This institutional information does not include the success of the Noyce scholarship program which is also at the same university. At SFASU, the Noyce program is called Talented Teachers in Training for Texas (T4) and has a 100% retention rate. T4 has graduated 93% of the participants in the program with a STEM teaching certificates and the remaining 7% remain in the program, on track to graduate in December 2020. Of the 41 current program graduates, 100% have either already begun teaching in a high need school or have accepted a position to teach beginning in Fall 2020. Only 2 of the 41 graduates have defaulted on their Noyce teaching commitment, which corresponds to two years of teaching STEM in a high-need school for each year of receiving the scholarship. Of the nine participants in the first cohort, of which the subject for our case study was a member, 6 completed their high-need STEM teaching commitment and continue to teach in a high-need STEM school even after that commitment. One participant deferred her commitment to teach high-need STEM but is currently in the classroom teaching high-need STEM. Another completed her four-year high-need commitment and is now no longer in the teaching profession. The last of the nine left secondary teaching in the first year of his teaching commitment, and is now pursuing work in research chemistry. According to the Houston Chronicle, in 2019, 1 in 3 teachers quit in Texas before their sixth year (Zelinkski, 2019). According to Carver-Thomas and Darling-Hammond (2017) there is higher STEM teacher turnover in schools that are Title 1 or rural. Most of the schools in the Deep East Texas area are rural and almost all of them qualify for Title 1 funds. The SFASU T4 program seeks to well prepare high quality STEM teachers to teach in Title 1, rural and urban school districts. While the rest of Texas has a 25-30% STEM teacher turnover rate, in the T4 program at SFASU, 85% of STEM teachers graduated from the SFASU T4 Program are still in the classroom.

Carver-Thomas and Darling Hammond's (2017) research findings indicate that teacher preparation programs can mediate the increasing national teacher turnover problem by creating teacher residency programs, and providing high quality mentoring and induction programs. These key elements allow teachers to experience a high number of practice teaching experiences under the careful eye of training mentor teachers and university mentors, and critical reflection within and after those experiences helps the pre-service teacher be prepared for challenges in the teaching field.

Darling-Hammond (2010) indicated that good teacher preparation programs are intentional about field experiences, that field experiences begin early in the Educator Preparation Program (EPP), and are intensive, meaning, not just an hour or two here or there. They include long days observing, helping,

ISSN: 2166-0190 online

teaching beside experienced teachers, and then being given the opportunity to critically reflect on those experiences. They also include specific content area tools/components, opportunity to evaluate state/local curriculums that can then be applied within the field experiences. These carefully crafted and deconstructed field experiences allow teachers to see examples and non-examples of classroom management, rapport, curriculum, instructional methods, in class procedures that are combined to create a vision of what kind of teacher the pre-service teacher candidate sees in themselves. These types of field experiences produce high quality teachers (Darling-Hammond, 2010).

Significance

This study and similar studies are significant because high quality STEM teachers who stay in the classroom are needed across the US (Carver-Thomas & Darling-Hammond, 2017), the journey from STEM major to STEM teacher is not well documented or understood and is treacherous, particularly because the supports and resources that worked for one particular student may not work for other students. Detailed investigation into what assists STEM teachers in persisting to graduation, certification, and then to become effective teachers is necessary to improve the current STEM major to STEM teacher pipelines at all public universities. The Noyce program, funded by the NSF, is key in the capability of universities, especially such as the one in this case, to produce high quality STEM teachers. This case study is significant to the NSF, policymakers and legislators designing budgets for national and state support for mentoring programs for STEM teachers, and also university personnel involved STEM teacher preparation. STEM teachers are key to the success of our nation in its ability to value science and mathematics as a society, and to be competitive and innovative on a global level in STEM fields. Though STEM teacher attrition is an extremely costly challenge, the value of quality STEM education far exceeds simple monetary terms. In times when leaders and influencers debate the accurate use of science and data, equipping the next generation with STEM literacy is paramount.

Context of the Study

The culture and demographics of Deep East Texas reflect the culture and demographics of the Southern United States. Race and gender are systemically and socially the key to available STEM career pathways that students are presented with from elementary to high school (Catalyst, 2019). The individual in this case study is a white male from a low socioeconomic status home in a rural and remote location. While we acknowledge the privilege due to race and gender of our participant, we acknowledge and lament the countless PK-12 student that were never presented STEM teaching as a viable pathway because of their race and gender. While our student did face hardships in his past, his race and gender were not one of the things that was a challenge. However, his low socioeconomic background is indicated by research findings to decrease the likelihood of high achievement in high school STEM classes and also decreases the likelihood of successful attainment of a STEM college degree (Rozek, Ramirez Fine & Beilock, 2019).

University EPP, Induction and Novice Teacher Support

During the traditional EPP at this university in Deep East Texas, there is no formal EPP mentoring program, which is not uncommon across the EPP's in the US. The Noyce scholarship program provides each participant with a high quality and long-term mentoring network consisting of an experienced mentor teacher, and a group of faculty mentors that also function as undergraduate advocates for each participant.

ISSN: 2166-0190 online

The Noyce program also provided each participant with an early intense field experience combined with opportunity for critical reflection, bi-weekly meetings consisting of mentoring and education curriculum and instruction, funding to travel to attend teaching conferences, and community building meetings twice per semester, as well as regular one-on-one check ins from various people in the mentoring network. After graduation, participants are invited to induction workshops that are also certified as professional development, mentor teacher observations, and frequent check ins by Noyce faculty and staff. The Noyce grant also periodically provides teachers with classroom supplies of the teacher's personal choosing. Many of the Noyce scholars work in rural districts that do not have items such as mathematics manipulatives, or easy access to consumable items, so the Noyce staff have asked for "wish list" items and supply them. This constant support from the beginning of the participants' involvement in the program creates a community not only with the Noyce faculty and staff but also among the participants. They often contact each other informally to exchange ideas about curriculum, information about job opportunities, and opportunities to attend conferences together. Each Noyce participant experiences the program differently based upon their specific needs. The Noyce faculty meet on a biweekly basis to discuss individual and group Noyce participant needs/supports to implement. This allows the participants to get individualized support as they need it.

Methodology

A qualitative case study research methodology was chosen for this project because this research is an exploration and in-depth analysis of a variety of data sources collected over a period of 8 years for one student as they completed their undergraduate STEM degree and transitioned to the career of STEM teacher. Creswell stated, "case study research is a qualitative approach in which the investigator explores a bounded system (a case) …over time, through detailed, in-depth data collection involving multiple sources of information (e.g., observations interviews, audiovisual material, and documents and reports), and reports a case description and case-based themes (2007, p. 73). Case study was appropriate for this research because enabled focus to center on one teacher candidate's experience in the Noyce scholarship program and provide thick description of that experience. Stake (1995) recommends case study for documenting the intricacies of the subject of the study and the environment and influences on that subject. Stake stated that case qualitative case study research is "naturalistic, holistic, ethnographic, phenomenological, and biographic" (Stake, 1995, pp. xi-xii). The "thick description" element of a case study is "necessary for judgments of transferability" and "raise[s] the reader's level of understanding of the focus of the study" (Erlandson, et. al., 1993, p. 164).

The underlying framework for this case study is twofold: to document key themes captured in the journey of an undergraduate STEM major to STEM teacher, and to examine how those ideas were influenced by the subject's participation in the Noyce program. Stake (2005) recommends intrinsic case studies as forms of program evaluation. According to Merriam (2009) and Lincoln and Guba (1981) case studies are an effective method of evaluation reports. According to Merriam (2009) case studies as program evaluations can be persuasive because of the thick description, naturalistic context, and simplified data that can "illuminate meaning, and can communicate tacit knowledge" (p. 49).

Data Sources

The data artifacts were collected over a period of 8 years, between 2012 through 2020. They include: participant interviews, participant surveys, participant reflection artifacts and emails; mentor

ISSN: 2166-0190 online

teacher surveys, observations, and interviews; principal surveys, observations, appraisals and emails; Noyce faculty mentor interviews, surveys, and observations, and emails; graduate student researcher observations, analysis of videos, and interviews; archival data from participant experiences such as reflections on conference attendance, master teacher job shadow, and mentoring reflections. The great variety of data sources from a period of 8 years and from a variety of different roles, interactions, and viewpoints is key to creating an accurate portrayal of the participant, and ensures theoretical saturation for the themes.

Data Analysis

The data analysis is framed in grounded theory (Glaser and Straus, 1967). Within this intrinsic case, each data sources were evaluated using open coding for codes and emergent themes using the constant comparative method. After themes were identified and coding was completed, the data analysis and codes were evaluated by a critical friend who also analyzed the data sources, codes, and emergent themes to increase integrity and also provide a unique on the data analysis (Appleton, 2011). Within case study research, it can be difficult for a researcher to navigate the gray areas between theoretical sensitivity and implicit bias, the addition of a critical friend who was not affiliated with the Noyce scholarship program, data collection, and had no knowledge of the participant was used as a second set of eyes to examine the data analysis, identified codes and themes. However, the critical friend was an experienced qualitative researcher, who is also a PhD in Curriculum and Instruction, experienced teacher, and also an asst. professor teaching in an EPP. This critical friend allowed the researcher to help support integrity and trustworthiness within the research (Appleton, 2011).

Results

Within the data analysis four primary themes emerged. The results are sorted by themes with corresponding evidence for those themes.

Theme 1: The Noyce program provided Mr. Adams with the early intense field experiences and feedback necessary to help him take his previously formed altruistic motivation for teaching and create a firm student-centered vision of himself as a teacher. The Noyce program supported him as he created a classroom environment facilitating excellent student rapport.

The participant began his undergraduate journey as a STEM major with evidence of an internal altruistic motivation to be a STEM teacher in order to connect with students and be a positive influence in their lives. This altruistic motivation was regularly reinforced by the experiences and mentoring provided by the participants involvement in the Noyce scholarship grant. In his first early intense field experience, a job shadow in which he shadowed a mathematics teacher in a local public school for a week, he stated in a reflection about the experience,

> "I want to do that on a daily basis, it is not about the money. Honestly, if it were I wouldn't be interested in teaching. I wanted to help them not only succeed in life, but help build their foundation of core values such as honestly, integrity, and respect, by being a positive role model in and out of the classroom. These core values help prepare students for their choice of the work force, military, or even to get to a higher education."

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This statement from the first field experienced that Mr. Adams ever had indicates that from the beginning he was driven by altruistic motivations to teach. In another field experience Mr. Adams observed of the teacher, "He also didn't respect them. He just acted like they were good for nothing and couldn't learn." While Mr. Adams had positive examples of teaching during field experience, it seemed that he was equally impacted by the negative experience of watching a teacher who had no respect for the students. These early field experiences seem to have facilitated Mr. Adams' mental construction of who he wanted to be as a teacher. He stated in another reflection, "I plan on making the classroom as relaxing and creative as I can. With this in mind it all starts with attitude, hopefully if I come in with a positive attitude the students will feed off that then the environment will be a positive one." This indicates that these early field experiences combined with critical reflection facilitated Mr. Adams as a future STEM teacher in constructing an internal framework for what kind of teacher he wanted to be. Early intentional and intensive field experiences combined with critical reflection are keys to quality teacher education programs (Darling-Hammond, 2010).

Mr. Adams clearly began his STEM undergrad to STEM teacher journey with the idea that he wanted to make a difference in the lives of his students. He persisted in achieving that goal and maintains that reputation within his school district. The Noyce program allowed him the early intense field experiences needed to develop the framework for his teaching philosophy and then the Noyce mentors provided consistent positive feedback to provide the impetus for him to make his philosophy a reality. Positive rapport with students is indicated by research findings to be key in the academic success of students (Frisby, Slone, & Bengu, 2017), but Mr. Adams' intent to connect and help students seems to go far beyond just the academic success of his students, as he stated in an interview in Spring 2016, where he shared a story about one of his students, "I actually had a kid call me, and thank me for saving his life! He said, '*I have* (*added by researcher for clarity*) been messed up for a really long time, and I was going to commit suicide but because of you I didn't!'. I got the kid help and he is doing better now!". The Noyce program not only allowed Mr. Adams to create a clear picture of himself being able to create authentic relationships with students, but it also gave him the reinforcement and positive feedback that helped him mature that viewpoint as he grew as a teacher.

Theme 2: The early field experiences allowed Mr. Adams to form an accurate perception of STEM teaching and prepared the participant for challenges of teaching.

The participant was able to develop an accurate perception of STEM teaching through his involvement in the Noyce scholarship grant and the increased number of field experience hours provided to him, this early intense field experience prepared him to be ready for the demands of STEM teaching. After the Master Teacher Job Shadow, in which the participants spend a week shadowing a STEM teacher before they begin their teacher certification coursework, Mr. Adams stated in his reflection, "It did give me a heads up of what I'm getting into." In 2016, when he was interviewed about his choices of instructional methods, he stated,

> "I thought along with the T4 program and the SFA teaching program they did a great job of showing me what teaching really is. Showed kind of lesson plans, planning and the time it takes. They did their best to put you in the classroom and show you what it looks like. With T4, every other week we were meeting new people, principals, teachers, etc. Gave a lot of experiences and the more experience you have the more you learn."

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Some of the difficulties with traditional approaches to professional experience programs may relate to the fragmentation of coursework and classroom practice (Eames & Coll, 2010). Consequently, many pre-service teachers do not find it easy to integrate what they are learning at university with what they are experiencing at the school. In addition, the nature of the mentoring from professional experience supervisors available to pre-service teachers can be inconsistent (Atputhasamy, 2005). As noted by Sim (2006, p.78) traditionally-oriented supervisory practices may provide only limited support for preservice teachers to "explore, discuss, and reflect on their developing understandings." The challenge for teacher educators is to devise new kinds of professional experience programs that help pre-service teachers integrate theory and practice (Eames & Coll, 2010), which the Noyce program was able to do through biweekly meetings to critically reflect on field experiences, give Mr. Adams support in forming an accurate perception of STEM teaching, and help him envision ways to create a student centered classroom environment, while encouraging him to be cognizant and prepared for the challenges of STEM teaching. In the same interview from 2016, Mr. Adams stated, "Through the T4 program, I immediately entered the classroom with several internships working with experienced and inexperienced teacher - each offering their own advice." One crucial element in helping prospective teachers to identify some of the shortcomings in traditional teaching practices and encourage them to broaden their range of pedagogical approaches is by engaging in critical reflection on the lessons they observe and teach (Chamoso, Cáceres, & Azcárate, 2012). The Noyce program facilitated regular opportunities for not only observation, but encouraged critical reflection on those observations. It is also important that pre-service teachers are given multiple opportunities to experiment with novel teaching approaches that are perhaps quite different from those they experienced when they were students themselves. In doing so, pre-service teachers will be better able to appreciate the importance of a variety of mathematic pedagogies and reframe their ideas about what constitutes quality learning and teaching (Star & Strickland, 2008). In 2019, Mr. Adams reflected after a conference, "As teachers you will have your ups and downs. Anyone can handle the good times, but the bad time you need a little extra. It is more helpful if that extra push is coming from people who you trust and have been tested with you." He knew from his experiences in the early field experiences that he was going to face a variety of challenges, but he also knew that he had the support of the Noyce faculty and staff, and that he was capable of weathering the challenges he would face. Marder, Brown, and Plisch (2018) found that most STEM majors had inaccurate perceptions of the aspects of teaching as a career, and those inaccurate perceptions were part of their choice to NOT to pursue teaching as a career. Early field experiences are the antidote to inaccurate perceptions of STEM teaching.

Theme 3: Early on, Mr. Adams rejected the traditional hierarchical view of teacher/student relationship, and the Noyce grant gave him the positive feedback he needed to preserve that transgressive perspective in mathematics education.

Within secondary mathematics education, many pre-service teachers have a firm hierarchical traditional viewpoint placing the value of the teacher's knowledge above the value of the student's knowledge. Many times, those teachers are unfamiliar with any alternative pedagogical approaches and often create lessons that are teacher centered (Ebby, 2000). The participant entered into the Noyce scholarship believing he should learn equally from his students, a transgressive viewpoint from traditional mathematics teaching (Ebby, 2000). Mr. Adams' student-centered growth mindset allowed him to be reflexive in his instructional and classroom management choices and make changes based on what his students needed. Within the participants initial interview for the Noyce program in 2012 he stated, "They say teachers are supposed to teach the students, but the students, they teach the teachers too." This same idea was reiterated in a survey in 2016, after his first semester of teaching, when asked about his choices

ISSN: 2166-0190 online

for instructional methods, he said, "However, the people I give the most credit to are my students. I have to understand my students and how they learn. If I can relate the mathematics to them using something they enjoy, I will succeed in teaching them mathematics. Each of my students have different likes and interests, so I get to explore and discover new ways to teach the same concepts to each individualized needs." And again, in an interview, when asked about how he chooses instructional strategies for his classroom, his response was, "It depends on the kids and their personalities". Again, he reflected on his choice to cue in to student needs to make classroom decisions in 2018 when he had to respond to a death within the school community by changing his instructional plans to meet student needs, he said, "Today, mathematics didn't matter." His instructional choices and lessons are created with the student individual and group needs in mind. Throughout the data, it was evident that he viewed his students as people to learn from, not in a hierarchy, where his role as a teacher was superior to them. Evidence of this was also observed on separate in class observations by a variety of people, his choices of instructional methods based on his students was observed in his class by the school principal during his student teaching semester, his cooperating teacher for his student teaching, the Noyce mentor teacher, a classroom video analysis by an outside observer. In 2016, after Mr. Adams' first year of teaching, his principal stated, "[Mr. Adams] identifies with his students and works proactively to establish positive relationships with them. In doing so, he is also able to find what instructional strategies work best with them." The Noyce program mentoring encouraged Mr. Adams to preserve his transgressive non-hierarchical viewpoint of the student-teacher dynamic in the mathematics classroom throughout his undergraduate experiences and as he transitioned to novice teacher and then as he became an experienced teacher.

Theme 4: The Noyce program removed key barriers for Mr. Adams to achieve certification in a timely manner and without increased financial burden.

The Noyce program was able to break significant barriers in Mr. Adams undergraduate teacher certification process that might have prevented his persistence to teaching certification. Mr. Adams was initially denied admission to the semester of clinical teaching, because his content test results would not have posted before the deadline required by the College of Education. A faculty advocate reached out to the dean of that office and was able to get an exception for him so that he was able to student teach. Had this not occurred he would have had to either sit out for a semester and then reapply to clinical teach, or skip clinical teaching entirely and enter the classroom before beginning alternate certification. Because of the advocacy for Mr. Adams, he did his clinical teaching in the small rural school district where he is still employed at today. This type of barrier is common in EPP's within Texas because of the many laws surrounding educator preparation that often are not based upon current research, but are based on the current political agendas of legislators.

Finally, the Noyce scholarship money is key in the ability of students from low-income backgrounds to successfully achieve teacher certification and also choose to stay as a teacher in rural areas. The beginning salary for a STEM teacher at Mr. Adams' district is around $34,000 per year. This $2833 per month paycheck before taxes, mandatory retirement contributions, and health insurance, is low not only compared to the nationwide average, but about $10,000 lower than the average salary of a teacher in the state of Texas. For many, working as a teacher for a rural district is a significant detractor to rural districts being able to retain teachers (Swaby, 2019) and 39% of Texas teachers work a second job to help pay their bills according to a volunteer survey from the Texas State Teachers Association in 2018 (Robison, 2018). Mr. Adams will begin his 5th year as a mathematics teacher of record at his small rural district in the fall, and will finally be quitting one of his two secondary jobs (as a driver for a mortuary).

ISSN: 2166-0190 online

Findings

While it is absolutely possible and probable that Mr. Adams could have become a STEM teacher without his participation in the Noyce program, he would have spent extended time in his undergraduate time due to the denial of his clinical teaching application, and would have incurred an increased amount of debt to finish his teacher certification. Based upon the themes evident in this case, the Noyce program not only supported Mr. Adams during his undergraduate experience, but influenced and supported his own personal framework and vision for what kind of teacher he wanted to be and he has indeed achieved his own personal teaching goals. The scholarship support, early field experiences, the sustained support from faculty and staff mentors, the bi-weekly meetings and community building activities, and the special advocacy for him as an undergraduate were key to him being able to successfully transition from STEM undergraduate to STEM teacher. After he began his job as a STEM teacher, our research findings indicate that the support from the Noyce program continued to provide consistent reinforcement and support for his growth in the classroom not only within his instructional methods, but his weathering challenges and pursuing positive connections with his students. The combination of the training, mentoring, and financial support from the Noyce program has assisted Mr. Adams in becoming a successful and high-quality STEM teacher who has chosen to stay in a Title 1 rural school for 5 years.

Implications for Educator Preparation Programs in Texas

The findings of this study indicate that educator preparation programs in Texas should allow pre-service teachers time and space to reflect on their own strengths as they move through the undergraduate program. Those strengths should be acknowledged by pre-service teacher education faculty and the pre-service teachers should be encouraged to build on those strengths as they gain knowledge and experience throughout the EPP. Additionally, the power of personal and individualized attention to pre-service teacher educators cannot be underemphasized from the findings of this study. When Mr. Adams was faced with barriers during the EPP, faculty advocates who had taken the time and effort to get to know him personally were able to intervene and help him overcome those barriers. It is recommended based on the findings of this study, that EPP's across Texas create small groups of students within EPP's that can be mentored by multiple faculty members in both content areas and in teacher education fields, so that adequate support is provided to pre-service teachers. This is especially critical in STEM fields, where content requirements are stringent and the teacher certification process in STEM fields often requires specialized mentoring to provide adequate support for persistence to certification. Finally, the state of Texas should consider investing in a financially supported novice teacher resource infrastructure through EPP's that allows EPP faculty and staff to provide substantial time and energy supporting novice teachers in their first two years of teaching. For Mr. Adams, this provided needed encouragement, resources, and also validation for his individualized strengths developed within his experiences in the EPP and Noyce program.

Conclusion

Carver-Thomas and Darling-Hammond (2017) recommend that in order to decrease teacher turnover specifically in STEM teaching fields, teachers need to be able to be prepared in programs that provide high quality mentoring and induction, and they need to be offered scholarships that reduce the debt burden of teaching. Marder, Brown, and Plish (2018) state that financial incentives would increase the interest in teaching for 80% of STEM majors and that most STEM majors have inaccurate perceptions

ISSN: 2166-0190 online

of teaching and compensation for choosing teaching as a career. The Noyce program provides financial support, high quality long-term mentoring, and critical reflection combined with early intensive field experiences. The findings from this study indicate that the Noyce program indeed works to prepare high quality STEM teachers in a profoundly individualized way, gives them a longitudinal mentoring support system from undergraduate experiences to years after graduation, and removes key barriers to persist to teacher certification and stay in high-needs areas such as Title 1 and rural schools. The case study of Mr. Adams can serve as an example of how programs can structure and facilitate critical reflection, long term mentoring, and after-graduation support in combination with systemic institutional and financial supports to prepare and retain high quality STEM teachers in rural areas.

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ISSN: 2166-0190 online