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ABSTRACT

In this article, the authors describe an effort to recruit undergraduate STEM majors to secondary STEM teaching through engaging them in an early field experience by which the majors serve as peer advisors as part of a summer program for middle and high school students. The authors report on longitudinal data indicating that a fair number of peer advisors did go on to a career in teaching. Using qualitative data, the authors discuss how the participants reflect on opportunities for professional identity development as part of their experience in serving as peer advisors. Connections between these opportunities and participants' decisions to pursue secondary STEM teacher certification are suggested.

Keywords: STEM Teacher Education; Teacher Recruitment

The persistent challenge of preparing enough highly-trained secondary STEM teachers has been documented numerous times (Marder et al., 2017; Committee on STEM Education National Science and Technology Council, 2013; Hutchinson, 2012). High-quality STEM teachers promote greater interest and success of students in STEM (Marder, 2017). However, in low-income schools, we see a shortage of such teachers (Aragon, 2016).

With recruitment a top priority for K-12 schools, teacher education programs across the country have grappled with how to recruit strong STEM majors into their programs. STEM majors are often not drawn to careers in teaching because of perceived low pay, heavy workload, and a lack of opportunity for intellectual or professional advancement (Plecki et al., 2013). Financial incentives in the form of scholarships, loan forgiveness, and stipends have mixed results in terms of recruitment, with concerns about beneficiaries' true commitment to and endurance in teaching (Worsham et al., 2014). Despite the critical issue of recruitment of STEM teachers, research studying STEM majors in college who choose teaching and what compels them to do so is lacking (Coble et al., 2009; Luft et al., 2005).

Research examining what draws STEM majors to teaching, though thin, indicates that prior experiences with schools or K-12 students contribute to undergraduate students choosing to teach (Luft et al., 2005; Plecki et al., 2013; Ng et al., 2008; Hong et al., 2018). These studies find that undergraduate STEM majors who had worked as tutors, mentors, or in other teaching roles with K-12 students exhibited a greater commitment to becoming teachers (Luft et al., 2005). The influence of such teaching experiences were most effective at generating interest in a teaching career for those students who indicated an initial interest in teaching but were not currently enrolled

in a teacher education program. In Luft, Fletcher and Fortney (2005), undergraduate science students with varied interests in teaching were invited to take a field experience course designed to recruit them into a science teacher education program. Students taught mini lessons in K-12 science classrooms as part of the course. They found that those students who enjoyed the field experience indicated that it reinforced their initial commitment to teaching. Worsham, Friedrichsen, Soucie, Barnett, and Akiba (2014) describe a recruiting program in the form of paid internships for freshman and sophomore science majors. Students participated in informal teaching opportunities in museums, nature centers, and other informal educational settings. Similarly to Luft, Fletcher, and Fortney (2005), the researchers found that the science majors who were already committed to teaching remained committed. Again, the students stated how the experience solidified their desire for a career in teaching.

Some teacher education programs require that students have had some informal experience with K-12 students before enrolling in a preservice teacher program. Ng, Lim, Low and Hui (2018) describe how in Singapore, informal field experiences are required of preservice teacher education students before they are officially admitted to the program. They contribute much of the low attrition of Singaporean teachers to their early and substantial experience in schools. Kier and Chen (2019) describe having preservice teachers visit high-needs schools as a cohort under the direction of faculty to provide experience as well as to incite an interest in teaching in such schools. In both cited cases, the students were already planning on teaching such that the emphasis of the early experience was not on recruiting students but more on retention of students who already knew that they wanted to teach. Ng, Lim, Low, and Hui (2018) argue that resilience is crucial in teacher retention. As such, it is critically important to choose preservice teachers who have a true commitment to teaching based solidly in experiences with students and schools. They point out that even those students who are confident in their capability and desire to teach may drop out once the difficulties of working with students, as well as other difficulties, are realized. McLaughlin (2015) describes the benefits of having aspiring science teachers participate in family science activities for K-12 students. Students with no prior experience instructing students in science reported feelings of increased self-efficacy as future teachers after participating. Kier and Chen (2019) talk about preservice teachers having abstract notions of what it means to be a teacher in an urban school prior to student teaching that are mostly built on deficit notions, such as lack of parental support and lack of resources. Experiences in a variety of urban school settings provided students with a more nuanced understanding of urban schools (Kier & Chen, 2019). Early field experiences have the potential to provide aspiring teachers opportunities to assess their commitment and resolve to teaching by developing their important knowledge of school settings.

With an eye on recruiting a strong cadre of STEM secondary teachers, programs such as the Robert Noyce Scholarship Program through the National Science Foundation (NSF) have offered universities around the country funding in the form of scholarships to support STEM undergraduates to become secondary STEM teachers. Students who receive funding must commit to working in high-needs school districts in return for scholarships. NSF (2017) defines high-needs districts based on the specifications in section 201 of the Higher Education Act of 1965 (20 U.S.C 1021). A high-needs district must serve as least one school that meets the following criteria:

a. a high percentage of individuals from families with incomes below the poverty line;
b. a high percentage of secondary school teachers not teaching in the content area in which they were trained to teach; or
c. a high teacher turnover rate.

In addition to providing universities scholarships for declared STEM preservice secondary teachers, the Noyce program allows for funding for the recruitment of strong STEM majors early in their college career in the form of summer stipends for students. In 2011, our university received such a Noyce grant to help build our secondary mathematics teacher education program. As part of the project, we provided summer stipends to freshman and sophomore STEM majors who worked as *Peer Advisors* (PAs) in the *Houston Pre-Freshman Enrichment Program* (PREP) for middle and high-school students held at our university. While we do not typically think of a *peer* when describing someone who may be several years older both chronologically and academically, this was the title given to the undergraduates from the inception of the program in the early nineties when the school-age participants were largely juniors and senior in high school. When referring to these undergraduate students, we will use PA.

Our goal for the summer program was to spark an interest in teaching by providing these undergraduate PAs with a peek into secondary teaching through an early informal field experience. We found that in looking at longitudinal data, a large portion of these students went on to pursue careers in teaching, with some through a traditional undergraduate teacher education program and others post-graduate. This article describes how students reported the role of the early field experience in their decisions to pursue teaching.

Professional Identity Development

Izadinia (2013) remarks that our identity is a crucial piece of helping us decide goals and how to reach them. She writes,

> But, knowing what we want and who we dream to become impinges on knowing who we are and where we are at the moment. In other words, it is our identity that helps us with setting goals and shows us the route to take. Without making sense of our identities, we are not able to achieve what we want effectively as we are not clear as to where we are headed (pg. 694).

Teacher professional identity is widely accepted as a crucial factor in how teachers make decisions about students, curriculum, professional development, and pedagogical actions (Izadinia, 2013) as well as being linked to teacher self-efficacy (Hseih, 2016). Though widely accepted as important, professional identity for teachers or teacher identity is not defined uniformly across research. This lack of a single definition is likely due to the fact that professional identity is multi-faceted and defined both broadly and explicitly depending on the body of research. However, for this study we borrow from Ronfeldt and Grossman (2008), who adapt the development of professional identity developed by others outside of education to teacher education. They built on the work of Herminia Ibarra's model for professionals in the workplace. They write, "viewed through Ibarra's framework, professional education is a place to begin the iterative cycle of adaptation by providing opportunities to observe, experiment with, and evaluate provisional selves as an explicit part of crafting a new professional identity" (pg. 43). As part of this process of identity development, preservice teachers experiment with provisional selves, defined as, "possible selves that are actually tried out in professional education" (pg. 43). These temporary or transitional selves are tried on as preservice teachers interact with instructors, coursework, mentor teachers, and students during field work, all while working towards developing a professional identity to be better solidified as they transition into becoming full-time classroom teachers.

Ronfeldt and Grossman (2008) argue that teacher education is an ideal place for preservice teachers to begin this process of observing, experimenting with, and developing a professional identity. However, they leave out any discussion of what provisional selves might develop before preservice teachers enter teacher education programs, other than to say that they do begin teacher education with images of teaching, based on their experiences as students.

Teacher education programs are developed to help shape those professional identities based on theory and practice. However, this happens after a student has decided that he/she will pursue teaching. As Hong et al. (2018) suggest, beginning teacher identity formation research is robust, including a small body of research going back to preservice teacher identity formation during teacher education. Missing is literature on how professional identities develop among undergraduate students before they enter into the teacher education program, including what experiences contribute to these identities. Understanding what drives undergraduate students to teaching in the first place has the potential to help us understand what makes them leave or stay in the profession (Hong et al., 2018).

In this study, we explore how an informal field experience as a PA provided opportunities for STEM undergraduate majors to develop a professional identity as a teacher, and an opportunity to "try on" being a teacher before any formal teacher education.

Our specific research questions were:

1. To what extent did undergraduate STEM majors who worked as PAs in the Houston PREP program go on to a career in teaching, especially for those who initially expressed an interest in teaching?
2. How did working as a PA provide an opportunity for undergraduate STEM majors to identify as a teacher?

With respect to this second question, published research in professional identity development provided the theoretical lens through which we could analyze our data, and helped us to make sense of what the undergraduate STEM majors described in terms of their experience as PAs.

Data Collection and Analysis

The PAs were undergraduates paid to serve as mentors for middle and high-school students during a six-week STEM focused summer program. PAs did not have to express an explicit interest in teaching but did have to be STEM majors who had taken mathematics through precalculus and held at least a 2.5 GPA. As part of their duties, they attended classes with the students, helped the class instructor who is a certified STEM teacher from a surrounding-area secondary school, provided tutoring for the students, and facilitated a collaborative student project on an interesting STEM problem. While not meant to be a formal field experience to be completed as part of a traditional teacher education program, the PAs spent their days observing and assisting practicing secondary teachers who were hired to teach in the Houston PREP program. PAs met regularly with mathematics education faculty to discuss curricular materials, classroom management, and pedagogical practices.

The Houston PREP program is 30 years old and has employed over 100 undergraduate STEM majors as PAs over that time. In 2012, through our Noyce funding, we were able to further support the Houston PREP program by funding PAs who were mathematics majors. In total, over seven years, we funded 50 such PAs. To make our study more robust, we expanded our participant pool

to not only include those 50 PAs who were supported from our Noyce grant in the years from 2012 to 2018, but to include PAs who worked with Houston PREP beginning in 2008.

Survey Data

For this study, we attempted to reach out to all of the PAs from 2008 to 2018. Of the over 100 undergraduate PAs that participated in the program for this 11-year period, we were able to find updated email addresses for 54 of them. To answer the first research question we used Qualtrics survey software to create a survey with a mix of multiple-choice and open-ended questions regarding their experience working as a PA and its influence on their career choices. The multiple-choice questions asked about their current career, teacher certification status, and whether they considered a career in teaching prior to being a PA. Open-ended questions asked them to talk about the influence of working as PA on their decision to become or not become a teacher and to talk about what they learned from the experience. The survey was sent to all 54 PAs with working email addresses. We received responses from 35 participants, which we examined in hopes of finding a connection between working as a PA and pursuing a career in teaching. The results that we share later in this paper are from those 35 participants.

Journal Entries

To address the second research question, we analyzed journal entries from eight PAs who participated in a separate study that we conducted during the summer of 2012. Each of these eight PAs responded to the survey, as well, so that we had both their journal data as well as the longitudinal data. During the summer of 2012 the PAs kept journals about their experiences and submitted the entries at the end of the summer. Through that initial analysis, we discovered that the PAs began to see themselves more in the role of the teacher throughout the summer. This initial finding helped us to form the second research question: How did working as a PA provide an opportunity for undergraduate STEM majors to identify as a teacher? We did a secondary analysis on the original journal entry data. Secondary analysis of existing data can help with a deeper examination of complex issues, especially when the secondary analysis is conducted by the same researcher who did the original analysis (Sherif, 2018). To answer the research question, we analyzed the journal data, using the professional identity framework (Ronfeldt & Grossman, 2008) looking for indications of a developing teacher professional identity. Each of the eight participants submitted five separate journal entries for a total of 40 different journal entries. Ronfeldt and Grossman (2008) describe three elements of developing a professional identity as a teacher: observation, experimentation, and evaluation. The journal entries were analyzed individually by each author for indications of the three elements. We then looked across our individual analysis for agreement that the PA was describing an activity that matched one of the three professional identity activities described by Rondfeldt and Grossman (2008).

Limitations

We recognize the limitations to our study that is based solely on self-reported data. Self-report data asking participants to assess and report on their own behaviors can be biased and unreliable (Devaux & Sassi, 2016). There is a human tendency to present oneself favorably (Karpen, 2018). While this is a potential problem for research using self-report data, having our participants reflect on their interest in teaching before, during, and after the Houston PREP experience provides

important information about what influences undergraduate STEM majors to ultimately decide to seek teacher certification.

In addition, the two authors worked closely with the Houston PREP program each summer as mentors to the PAs. As such, we recognize that our closeness to both the overall project and to the individual students is a potential bias. Including participants from previous summers, when we did not work with the program hopefully mitigates some of the bias.

Results and Discussion

Survey Data

The survey data was used to answer the first research question, "To what extent did undergraduate STEM majors who worked as PAs in the Houston PREP program go on to a career in teaching, especially for those who initially expressed an interest in teaching?" Results from the following items on the survey were used to address this question:

- If you have graduated, what is your current career? (Open-ended)
- Prior to Houston PREP, did you ever consider a career in teaching? (Yes or No)
- Do you presently have a teaching certificate or are you working towards certification? (Yes or No)
- Did your experience in Houston PREP influence your feelings about becoming a teacher? (Yes or no) Why or Why Not? (Open-ended)

Of the 35 participating in the program and who responded to our survey, 20 of them (57%) were either currently teaching, working towards teacher certification, or anticipated pursuing alternative certification at the time of the survey. Of those 20, 16 (80%) indicated that they had considered a career in teaching before being a PA, and 17 (85%) said that the experience had an influence on their choosing to pursue a career in teaching. In the open-ended portion of the survey, these participants who reported that they were interested in teaching before becoming a PA said the following about the PA experience:

> "Now I am more positive that I want to be a teacher"
>
> "It reinforced the feeling"
>
> "My experience with the students helped determine whether I could see myself working with students in that age range."
>
> "I realized I liked helping students learn challenging material."
>
> "Even though I was a PA I observed the teacher and how they would teach and engaged with students. I also learned how to talk to students and build a positive relationship with them."
>
> "It gave me an insight of what it is like to work with such a big group of students.

Journal Entries

Journal entries were used to answer the second research question, "How did working as a PA provide an opportunity for undergraduate STEM majors to identify as a teacher?" Using the professional identity framework described by Ronfeldt and Grossman (2008), we tried to understand what the PAs were experiencing during this early field experience. We developed codes that aligned with the three components of the professional identity framework. The three

components of the professional identity framework are observation, evaluation, and experimentation. Each author combed through the journal entries using the codes. We then compared each of our individual results and came to an agreement which we share below. To protect the identity of the participants, we use a pseudonym for each participant in the results described below.

Observation of Professionals. Ronfeldt and Grossman (2008) discuss how preservice teachers often look to practicing teachers to identify features and characteristics of the type of teacher they would like to be one day. They also identify characteristics of practicing teachers that they see as undesirable. Our data indicated a similar finding. The peer mentors talked about watching the teachers during class and made clear statements regarding what they would do and would not do as a teacher. One peer mentor, Kora, said:

> First period (problem solving) was with Mrs. Collins, she was very straight with them at first, making them feel a sense of strictness, which is good. After a while she spoke a bit about herself and started to use humor. She attempted to learn everyone's names right away. I see that this is important because it will make the student feel (important?), or recognized as an individual instead of just another student called 'You there in the back.'
>
> Second period (Engineering) was with Mr. Urly, well...I suppose he has his ways of teaching in what I wouldn't want to follow. He's pretty strict, even I felt a bit scared.

Kora then described how Mr. Urly began teaching immediately by lecturing while drawing images on the whiteboard. She mentioned that the students were confused.

Another PA, Dhara, described one of the teachers she worked with, Mr. Davis.

> During problem solving, Mr. Davis keeps them engaged in the problems which they love to solve because they get so involved in them and are so interesting. Mr. Davis gets them new problems every day which they enjoy a lot. He makes sure he gets the students to speak up of their ways of solving the problem. This makes the kids share their point of view in the class.

Both Kora and Dhara not only identified what they viewed as positive and negative characteristics of the teachers; they also observed the pedagogical practices and the students' responses to these practices. This recognition of the pedagogical practices and not just the personality of the teacher is something that Ronfeldt and Grossman (2008) do not see in their participants early on and suggest that it is because they have few opportunities in teacher education to see practicing teachers actually practicing as teachers. Our findings suggest that the peer mentors were using the opportunity to be able to look beyond personality traits to see how these traits play out in terms of practice and student learning.

Experimenting with Evaluation. Experimenting with being a teacher is a second important component to developing a professional identity as a teacher. Ronfeldt and Grossman (2008) couple experimenting with evaluation and define it specifically as opportunities to get feedback from professionals. They write:

> As novices encountered a range of practitioners, they began to catalogue both desired and feared selves to piece together a makeshift image of the kind of professional they hoped to become. But untested images of what may be possible were not enough to prepare novices for new roles….It is one thing to have a clear and elaborated vision of a possible self and quite another to actually enact that vision (pg. 49).

The PAs in our study had daily opportunities to try out strategies with actual middle and high school students, and we saw evidence of their experimentation throughout. Sometimes they were able to receive feedback from the teachers in the classroom. Other times, we saw them reflecting on the consequences of this experimentation. Dhara described an episode in a mathematics class where she was trying to help students with a difficult concept. She wrote:

> The kids started working on their problems and I was going around I realized some of them were having difficulties. I went ahead and helped them understand it and get the answer. But when the instructor solved the problems on the board, they were done in a different way and many of the students had followed that way. I then informed Mr. Davis about me showing a different way to the kids. After that, Mr. Davis made me show the way to the class. The thing I noticed was that none of the kids knew what I was actually doing. That moment, I realized that it is not possible that the way I follow to solve problems is the same way that everyone follows. The main realization for me then was that to be a mentor I should first try and understand what the student's way is to solve the problems. Try to understand what they are doing is right or wrong and then guide them to the right path rather than enforcing my ways on them.

Dhara was able to try out a pedagogical practice with the support of the teacher but realized on her own the limitations to her approach. Kora described a self-realization moment after she tried to change her discipline approach with the students. She wrote:

> I think I'm too lenient with them so over the weekend I thought about how I could control my class better. On Monday I acted a bit stricter and my humor definitely stayed home. I tried to keep a straight face and be a bit more demanding from the students to be good but I felt weird. I felt like I wasn't me and I was unhappy. I'm usually smiling and joking around with the students and I think they noticed that I was acting differently. This didn't work, the class was just awkward and I felt uncomfortable being the mean teacher.

Another PA, Gabriela, wrote in her journal about an idea that she had after grading assignments for a computer science class:

> When I gave the results back to the professor he told me that he was going to curve the grades. That's when my AWESOME idea hit me. I told the professor not to give free points to the students when they didn't deserve it. So I told him to make the kids write the question they got wrong and the answer to the question on a paper, that way they could go over the test and see what question they got wrong and to find the answer. And I think that is a good idea because if they don't go over the test they will no know what questions they got wrong or the answer….The professor agreed with me, he even told me that the idea was really good and that he was going to tell the students to do it.

Another PA, Denise, described an approach she tried with a particular difficult student. The student was admittedly disruptive during one of the classes, but Denise felt that the teacher was being unnecessarily hard on the student. She wrote:

> It is a bit obvious and he [the teacher] does not hesitate to announce to the class how he feels about him [the student]. I constantly have to be on him [the student] to stay quiet or calm down. Currently I am trying some positive reinforcement and praising what he does good and trying not to get too upset when he is disruptive.

Denise recognized a problem between the teacher and the student, and came up with a solution on her own in hopes of rectifying what she sees as a problematic relationship between the student and the teacher. We see other examples of peer mentors working around the teacher and engaging

directly with the student to address a problem, especially when the peer mentor sees an issue with the teacher.

Conclusion

Our survey data indicates that the majority of the undergraduate STEM majors in our study went on to pursue a career in teaching, and most of those already had some desire to be a teacher before participating in the summer enrichment program. These findings support what other studies have indicated—that the early field experience assured those students who intended to teach that they did in fact want to become a teacher (McLaughlin, 2015; Luft et al., 2005; Worsham et al., 2014). This is an important finding, given that retaining undergraduate STEM majors who have an interest in teaching is as important as recruiting those majors who did not indicate an interest (Ng et al., 2018). With STEM secondary teacher education programs looking to recruit more STEM majors to the field of teaching, this study indicates that tapping into freshman and sophomore majors who indicate an interest in teaching and providing them with an early field experience is a promising direction for growing their program. Designing programs that provide STEM students with an opportunity to experiment with teaching could help with recruitment and support of preservice STEM teachers. Our study indicates how the experience of working as a PA gave the STEM majors an opportunity to begin to develop a professional identity as a teacher through observing, experimenting and evaluating -- three important components of professional identity development (Ronfeldt & Grossman, 2008). Of the eight undergraduate students who submitted journal entries, seven of them are currently working as teachers or pursuing jobs in teaching. For many of them, working as a PA was their first experience in a classroom not as a student. For example, Kora, a current high school mathematics teacher, noted in her reflection after the summer, "I came into [program name] unprepared, I had a blank slate of experience and knowledge about teaching and dealing with an actual classroom full of students." By the end of the summer, she said confidently, "I believe every student can learn and so I will share my knowledge and be that teacher that never gives up on their students. I do want to return to [school district] and give back to my community in every way I can." Most of the PAs indicated that the experience helped them to develop a sense of self-efficacy and the feeling that they could actually be a teacher one day.

With a few exceptions, most of those PAs surveyed, who indicated that they were not interested in teaching initially, did not indicate a change in opinion after the experience. This finding fits with other research on recruitment (Luft et al., 2005). Yet, one PA, Gabriela, did change her mind. At the end of the summer, her journal entry indicated that while she enjoyed working as a PA, she was planning on being a computer scientist. After working as a programmer for a short time, Gabriela is now a mathematics teacher who completed alternative teaching certification. In her survey, she reported that the experience in Houston PREP did influence her decision to go into teaching. Though rare, Gabriela's experience raises an interesting direction for future research in terms of understanding how and why STEM professionals change careers and move into STEM teaching.

References

Aragon, S. (2016). Teacher Shortages: What We Know. Education Commission of the States. Retrieved from http://www.ecs.org/ ec-content/uploads/Teacher-Shortages-What-We-Know.pdf

Coble, C., Smith, T., and Berry, B. (2009). The Recruitment and retention of science teachers. In Collins, A. and Gillespie, N. (Eds). *The continuum of secondary science teacher preparation: Knowledge, questions, and research recommendations*. Sense Publishers, Boston, pp. 1-21.

Committee on STEM Education National Science and Technology Council (2013). *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf

Devaux, M., & , F. (2016). Social disparities in hazardous alcohol use: self-report bias may Sassi lead to incorrect estimates. *European Journal of Public Health*, *26*(1), 129–134.

Hong, J., Greene, B., Roberson, R., Francis, D., and Kennan (2018). Variations in pre-service teachers' career exploration and commitment to teaching. *Teacher Development*, 22(3), 408-426.

Hsieh, B. (2016). Professional identity formation as a framework in working with preservice secondary teacher candidates. *Teacher Education Quarterly*, 43 (2), 93-112.

Hutchinson, L.F. (2012). Addressing the STEM Teacher Shortage in American Schools: Ways to Recruit and Retain Effective STEM Teachers. *Action in Teacher Education*, 34 (5), 541-550.

Karpen, S. C. (2018). The Social Psychology of Biased Self-Assessment. *American Journal of Pharmaceutical Education*, *82*(5), 441–448.

Kier, M. W. and Chen, J. A. (2019). Kindling the fire: Fueling preservice science teachers' interest to teach in high-needs schools. *Science Education*, 103(4), 875-899.

Izadinia, M. (2013). A review of research on student teachers' professional identity. *British Educational Research Journal*, 39(4), 694–713.

Luft, J., Fletcher, S., and Fortney, B. (2005). Early Recruitment of Science Teachers: Promising or Problematic Strategy. *Science Educator*, 14(1), 41-48.

Marder, M., Brown, R.C., and Plisch, M. (2017). Recruiting Teachers in High-Needs Stem Fields: A Survey of Current Majors and Recent STEM Graduates, American Physical Society Panel on Public Affairs.

McLaughlin, D. (2015). Investigating Preservice Teachers' Self-Efficacy Through Saturday Science. *Journal of College Science Teaching*, 45(1), 77-83.

Ng, P. T., Lim, K. M., Low, E. L., and Hui, C. (2018). Provision of early field experiences for teacher candidates in Singapore and how it can contribute to teacher resilience and retention. *Teacher Development*, 22(5), 632-650.

National Science Foundation (2017). *Program Solicitation NSF 17-541*. Retrieved from https://www.nsf.gov/pubs/2017/nsf17541/nsf17541.pdf

Plecki, M., St. John, E., and Elfers, A. (2013). Examining the views of undergraduate STEM majors regarding K-12 teaching as a profession. *Teacher Education & Practice*, 26(4), 739-759.

Ronfeldt, M., and Grossman, P. (2008). Becoming a Professional: Experimenting with Possible Selves in Professional Preparation. *Teacher Education Quarterly*, *35*(3), 41–60.

Sherif, V. (2018). Evaluating Preexisting Qualitative Research Data for Secondary Analysis. *Forum: Qualitative Social Research*, *19*(2), 26–42.

Worsham, H., Friedrichsen, P., Soucie, M., Barnett, E., and Akiba, M. (2014). Recruiting Science Majors into Secondary Science Teaching: Paid Internships in Informal Science Settings. *Journal of Science Teacher Education*, 25(1), 53-77.

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