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A Longitudinal Essay Analysis of Noyce Scholars' Growth in Self-View on Teaching Science in High-Needs School Districts

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ABSTRACT
In the United States, principal investigators of the National Science Foundation's Noyce Scholars program are challenged with identifying college STEM majors who have a fledgling interest in science teaching and preparing them to teach in high-needs school districts. The purpose of this longitudinal research project was to quantitatively and qualitatively identify STEM majors' self-view on becoming a science teacher when they applied to one college campus based, Noyce Scholars program, and to describe how their self-view on becoming a science teacher in a high-needs school district evolved from their college years into their early careers as science teachers. To address the purpose of the study, researchers quantitatively analyzed emergent themes in a series of three reflective essays written by sixteen Noyce Scholars over a five-year period. The first essay was part of their Noyce Scholars program application; the second essay was written approximately three-years later during their undergraduate coursework; and the final essay was written during their induction year as a science teacher in a high-needs school district. Essay analyses revealed that the Noyce scholars' self-view of teaching science in high-needs schools spreads from a narrow focus on personal experiences as students, to an in-service self-view characterized by broad understandings of some of the challenges, rewards and pedagogical competencies needed to teach science in a high-needs school.

Introduction

There is an international shortage of qualified STEM teachers prepared to teach in high-needs schools (Kearney, 2016). The situation is acute in the United States (Goldhaber et al., 2015; Jeong et al., 2015). In response, United States' National Science Foundation (NSF) Robert Noyce Scholars program provides funding to teacher training institutions with a commitment to preparing STEM

teachers for careers in high-needs school districts. High-needs school districts are often characterized by high teacher turnover and teachers teaching subjects for which they are not licensed (National Center for Educational Statistics, 2013). Most ubiquitous among high-needs schools is that they enroll large percentages of students from low-income households (Ingersoll & Perda, 2010).

The science achievement of students who come from low-income households and attend high-needs schools is far below that of students from more affluent communities (Adamson and Darling-Hammond, 2012). Household wealth is associated with IQ (Duncan, 1994), overall school achievement (Sirin, 2005), and math achievement (Chen et al., 1996). The National Center for Educational Statistics (2015) reports that low-income students fail to graduate at five times the rate of middle-income families. Research investigating why income is linked to achievement and rates of graduation points to the adverse effects of income on factors that influence cognitive processes such as working memory space (Noble et al., 2005) and the extent to which children can regulate their emotions (Evans & Rosenbaum 2008). Low-income is associated with long-term household and family stress (Klerman, 1991) and research suggests that long-term stress is linked to adverse brain development in children (Conger, 1994). Furthermore, due in part to the inability of high-needs schools to retain their most qualified teachers (Siwatu, 2011) students attending high-needs schools are often instructed by those least qualified to teach (Desimone & Long, 2010). The need for science teachers in the United States and internationally, highly qualified in the content of their discipline, and pedagogically readied and motivated to meet the needs of students in high-needs schools, is great.

Researchers have studied and described the motivations and pedagogical competencies of successful teachers serving in rural (Browne-Ferrigno & Maynard, 2005) and urban high-needs schools (Miranda, 2012; Moseley et al., 2014; Osisioma & Moscovici, 2008). Jeanpierre (2007) reported that the perceived effectiveness of new science teachers serving in low socio-economic status schools was attributed to their beliefs about the capabilities of their students. Jupp and Slattery (2012), Ng and Thomas (2007), and Tobin, Roth, and Zimmerman (2001) all report that teachers capable of identifying with, and understanding the needs and interests of their students, were able to develop and deliver culturally relevant and effective instruction in high-needs schools. Ladson-Billings (2006) describes the need for teacher education programs to include experiences that enable pre-service teachers to more fully consider their own cultural practices and beliefs as a first step to understanding the powerful role of the culture of the students they will be teaching. Likewise, Proweller and Mitchener (2004) report that teachers' identity with youth is a crucial indicator of success. Bower et al. (2015) describes the importance of teachers understanding the communities in which their school exists and devoting time in the curriculum to the social and emotional development of the students

The research supporting this study briefly summarizes an international problem, and it describes some of what's known about the dispositions of successful teachers in high-needs schools. Through the longitudinal essay analyses detailed in this paper we aimed to describe Scholars' self-view as future science teachers in high-needs schools when they applied to our Noyce Scholars program; how their self-view developed while in college; and characteristics of their self-view while in the midst of their early teaching experience.

The purpose of this research was to identify how Noyce Scholars' (hereafter referred to as Scholars) view of themselves as science teachers in high-needs schools (hereafter referred to as self-view) evolved over a five-year period. This study begins with an analysis of their Noyce Scholars program application essay. The research is advanced further with an analysis of a reflective, pre-service essay written after approximately three-years of participation in a Noyce Scholar curricula enhanced science education program. Finally, we analyzed a third essay written after having completed the final 2 years of undergraduate coursework and having just begun their high-needs school science teaching careers.

Methods

Participants

The sixteen subjects in this research were undergraduate Secondary Science Education majors whose attendance at a college in rural, upstate New York was supported in part with a scholarship from NSF's Noyce Scholars program. Scholarship recipients must agree to teach in a high-needs school district at the rate of two-years for every one-year of scholarship funding received. The sixteen participants referenced in this study are in the early stages of completing their high-needs teaching requirement in school districts around the United States (Table 1). They are representative of the first cadre of twenty-two participants in our Noyce Scholars programs. At the time of this research, the six non-participants were either college seniors or seeking full-time employment. The sixteen participants applied to the Noyce Scholars program at different stages in their academic lives. Four applied to the college and the Noyce Scholars program as high school seniors, eleven were freshman/sophomores in college at the time of application and one had already earned a B.S. degree before deciding to enroll in college as a Physics Education major. All came from, and went to public school in either the rural or suburban communities in New York State. None reported having attended any of the urban schools in New York State's major metropolitan areas, including NYC.

Description of the Three Reflective Essays Analyzed in this Study

The three essays written by each Scholar were staggered over a five year period. Table 1 provides information about each Scholar as well as descriptive statistical data on each essay. The first, or application, essay was written in response to this prompt; "*Explain a past experience, positive or negative, with a teacher or in an academic setting that has made you consider pursuing a career as a teacher.*" There was no prescribed minimum word length for this first essay.

Table 1. *Participants, Essay Sentences (S) Words (W) and Teaching Position*

Pseudonym, Gender (M,F) and B.S. Content Degree with Education	Application Essay Stats		Pre-Service Essay Stats		In-Service Essay Stats		Location, Subject, Grade- High (HS) or Middle School Science (MSS)
	S	W	S	W	S	W	
Ellen, F, Biology	24	457	26	543	57	382	NYC, Bio, HS
Claire, F, Biology	16	290	12	268	54	400	NYC, Bio, HS

Sam, M, Earth Science	17	413	24	523	26	730	NYC, MSS
Vicky, F Biology	10	165	29	530	19	269	NYC, MSS
Abby, F, Earth Science	11	228	30	593	120	1,831	NYC, Earth Sc
Allan, M, Physics	11	190	20	478	23	373	NYC, Physics
Luke, M, Physics	17	353	24	544	34	790	NYC, Physics
Erika, F, Earth Science	29	305	23	603	26	505	NY (urban) Earth Sc
Ashley, F, Chemistry	15	256	27	581	23	465	FL, (urban) Chem
Mary, F, Biology	9	163	21	521	33	595	FL, (urban), Bio
Alexi, F, Earth Science	26	381	19	698	37	831	NY, (rural), Earth Sc
Kayla, F, Physics	10	211	26	566	29	739	NY, (rural), Physics
Laura, F, Chemistry	15	271	22	509	27	599	NY (rural), Chem
Colleen, F, Earth Science	28	467	27	598	23	509	NC (rural), MSS
Matt, M, Physics	22	423	30	647	21	510	NY (rural), Physics
Kate, F, Chemistry	10	185	30	560	30	598	ME (rural), Chem
Mean	17	297	24	547	36	633	
Standard Deviation	8.8	105	4.9	92	25	357	

The pre-service or second essay was written three-years after writing the application essay. All sixteen students were juniors or first-semester seniors in college. None had begun their final student teaching semester. All had participated in the range of Noyce Scholars program activities described below. In this second essay writing task, we used the application essay as a stimulus to evoke reflective thought into their self-view as future high-needs school science teachers. Specifically, they were sent the following prompt and asked to respond in a five-hundred word essay; "*Think about your Noyce Program Application Essay (provided to you). What do you think about now when you envision yourself as a teacher in a high-needs school?*" All sixteen Noyce Scholars wrote the second (pre-service) essay as requested.

Essay three, the in-service essay, was written during their early induction months as science teachers in high-needs schools. Table 1 shows that ten were teaching in high-needs urban school districts. Among these ten, seven were in New York City (NYC); one in Troy, New York and two in the state of Florida. The remaining six were teaching in high-needs rural schools located in New York State (four), North Carolina (one) and Maine (one). The in-service essay prompt was as follows: "*Look back at your application essay (provided), and the essay you wrote after 2 years in the Noyce Scholars Program (provided). Now, what do you think about being a science teacher in a high-needs school district?*" Like the second, pre-service essay, we requested they respond in five-hundred words. The in-service essay prompt required them to reflect on both their Noyce

Scholars program application essay (written six-years earlier), and essay two (the pre-service essay) within the framework of their early career teaching experiences.

Noyce Scholars Program Description

As stated above, the purpose of this research was to identify how Noyce Scholars' view of themselves as science teachers in high-needs schools evolved over a five-year period. Although it is not our goal to establish a causal relationship between the essays and the education the Scholars experienced, a description of the educational programming the scholars participated in provides a useful context when reviewing the results of the essay analysis.

The Scholars wrote the application essay as high school seniors or before they were enrolled in the science education program thus before participating in any programming. The Scholars participated in approximately two years of freshman-sophomore college coursework and Noyce specific programming before writing essay two (pre-service essay). Given that the Scholars are majors in a science discipline (biology, chemistry, earth science or physics) much of that academic time was focused on content courses. Simultaneously, education coursework taken by these freshman/sophomores included 'Introduction to Education' and particularly relevant to preparing teachers for careers in high-needs schools, a course titled 'Diversity in Education'. A review of that syllabus, followed by a conversation with the professor about the goals of the course identified that the course focuses on helping prospective teachers address issues of personal bias regarding privilege and poverty. Excerpted from the course description is the following "…engaging education majors in a process of inquiry into and reflection upon how their own socio-cultural positions of race, gender, and social class will influence both the schooling experiences they create and the educational outcomes of the students they will teach". Noyce programming included participation in seminars on topics such as assessment led by local science teachers; participation in 'Science Saturdays' where the Scholars planned and taught enrichment activities for local rural middle school students. Moreover, as freshman and sophomores, the scholars participated in a week-long science teaching internship experience in one of New York Cities' high-needs schools. Structured reflective writing tasks and cohort meetings were required during all NYC internship experiences. Earlier published research (Bischoff et al., 2014) speaks to the effects the NYC high-needs school teaching experiences had on the dispositions of some of these same sixteen Scholars.

Prior to being prompted to write the third essay (while teaching in a high-needs school), the scholars completed the upper level content course work required of their degrees and a range of education courses including "Introduction to Special Education," "Adolescent Educational Psychology" and "Science Methods." The latter course was instructed by the Principal Investigator of this NSF Noyce grant and co-author of this research. Noyce programming included continued seminars, 'Science Saturday' teaching opportunities and, many of the 16 Scholars participated in additional NYC science teaching internships with required reflective writing tasks and cohort meetings. Linked to specific courses in the education degree, each Scholar completed 100 hours of structured classroom participation in a high-needs rural school. Their senior year included student teaching for a full semester in a local

high-needs rural school or in one of New York City's high-needs schools. Essay 3 (in-service) was written several months after college graduation during their induction year as high-needs science teachers. In summary, these 16 followed the college's standard undergraduate science education program enhanced by Noyce specific programming which included clinical experiences outside their comfort zones (week-long NYC science teaching experiences) and a range of Noyce programming opportunities.

Identification of Emergent Themes

The essay analysis included engaging in an iterative emergent theme identification process (Creswell, 2005; Gay, Mills & Airasian, 2006). Over the course of several weeks, the evaluators would meet, read a cross-section of essays and record thoughts regarding 'emergent themes' on a whiteboard. The goal was to identify emergent themes that would enable the researchers to systematically code each sentence in every essay with a high degree of inter-coder reliability. Ultimately five 'Broad Emergent Themes (BETs)' and fourteen subthemes materialized in which each statement in all forty-eight essays could be generally classified.

The BETs and the fourteen subthemes with examples from the essays are as follows: BET 1, Experience: A statement specifically referring to a teaching or learning event in which the Scholar participated. Subtheme 1, Personal Experience: "*The teachers that I had throughout my school career definitely had an impact on my decision to become a teacher.*" (Allan, application essay). Subtheme 2, Noyce Specific Programming Experience: "*The Noyce trips to New York and then student teaching in NYC have helped to reassure myself that it is what I want to do.*" (Ashley, pre-service essay). Subtheme 3, Current Professional Experience: "*I quickly learned that my rural Maine students come from an entirely different high-needs background than my NYC students.*" (Kathy, in-service essay).

BET 2, Challenges: A statement where the Noyce Scholar specifically describes a challenging situation. Subtheme 4, Student Challenges: "*Back in college I had no idea what it would be like to have zero parent involvement with their child's education and having students that are criminals and only come to school so ACS isn't called on their parents/foster parents.*" (Abby, in-service essay) Subtheme 5, Regulatory Challenges: "*The new teacher evaluation system has had a direct impact on my effectiveness rating and ability to continue teaching for the New York City Department of Education*" (Allan, in-service essay). Subtheme 6, Professional Frustrations: "*I knew I was definitely in over my head when (as a first year teacher) I was handed chemistry, physics, honors physics, physical science and STEM without any curriculum.*" (Kathy, in-service essay).

BET 3, Career Goals: An affirmative statement about becoming a teacher, a statement about where they plan on teaching, or a statement describing some other professional goal they wish to accomplish. Subtheme 7, Career Plans: "*I now see myself teaching in a much more diverse classroom in a busy city.*" (Mary, pre-service essay). Subtheme 8, Desire to Impact Students: "*I do not want to be judged on my success as an educator based on how well my students do on an exam but instead I want to be judged on how well my students treat others and what kinds of people they become.*" (Matt, in-service essay).

BET 4, Satisfaction and Confidence Statements describing a sense of satisfaction with their work or a sense of confidence in their ability to teach. Subtheme 9, Satisfaction: "*Every day I learn something new from my students and from myself; I learn to be better for them and for their education.*" (Ellen, in-service essay). Subtheme 10, Confidence: "*Even if my classroom does not have technology, I do believe I can work with what I have, think on my feet, and be almost as successful in enriching the educational experience of the class.*" (Matt, in-service essay).

BET 5, General Teacher's Perspective statements describing general teacher knowledge, relationships with students, classroom management or familiarity with content and pedagogy. Subtheme 11, General Teacher Knowledge: "*The two classes that I teach are for the lowest level readers; about 40% of the students that I teach are for English language learners.*" (Vicky, in-service essay). Subtheme 12, Knowledge of Content: "*Currently I am working on a project with my elective Science and Technology class that has most of them really excited.*" (Colleen, in-service essay). Subtheme 13, Positive Classroom Management: "*I am impressed with myself on how well behaved my students are when they are in my class.*" (Erika, in-service essay). Subtheme 14, Relationships with Students: "*Perhaps my youth gives me an unfair advantage, but I'd like to think that it's because I honestly try to get to know each of my students on a personal level.*" (Claire, in-service essay).

Reliability of the Data Coding

Each Scholar's three essays were then placed in a single spreadsheet file that contained an individual worksheet for each essay. Within each worksheet, each sentence was placed in its own row with the fourteen subthemes as column labels. As a rigorous way to ensure reliability in the data coding process, we decided on a binary categorization system where each researcher would independently classify each sentence a 0 (no fit to emergent theme) or 1 (fit to an emergent theme) for each of the fourteen subthemes. Our categorization rules allowed for a single sentence to be coded with more than one emergent subtheme. Moreover, in the event a specific cue word an analyst was seeking was missing, he was allowed to code a sentence to a subtheme if the sentences before and/or after the particular sentence under analysis were viewed to be a continuation of the previously coded subtheme. The goal was to quantitatively capture, as fully as possible, the self-view of the Scholars. Once all of the essays were independently analyzed, we were able to collapse them onto one final table and tally the frequency with which each sentence was coded with each subtheme. This system allowed an expression of the 'strength' to which a sentence was viewed to express an emergent subtheme. For example a tally score of 3 meant that all three researchers agreed on the subtheme code for a particular sentence and a tally of 2 meant that two of the three researchers coded a sentence with the same emergent subtheme. In Table 2, emergent themes with tally scores of 2 or 3 (high inter-coder reliability) are referred to as 'strongly linked' to a subtheme, and tally scores of 1 are referred to as 'linked' to a subtheme.

Results

Descriptive statistics of the quantitative essay analysis are shown in Table 1. One student's 1,835-word third essay was far in excess of the requested

five-hundred words, while all of the other essays across all participants were consistent with the request. Given the range of words and sentences within the essays, the results are reported and described in Table 2 as percentages. To provide a quantitative as well as qualitatively rich analysis of the data, commentary on numerical values will be supported by qualitative examples from the essays.

Broad Emergent Theme One, Experience

The first numerical entries in Table 2 are 11% and 81% in the subtheme of 'Personal Experience' in the application essay. Thus, 11% of the sentences in the application essay were coded by one evaluator as 'Personal Experience' (linked to that emergent subtheme), and 81% of the sentences were coded by two or three evaluators with this subtheme (strongly linked to an emergent subtheme). With 81% of the sentences strongly coded 'Personal Experience', this subtheme dominated the application essays. This category fades to 12% strongly coded in the in-service essay demonstrating that as the Scholars moved through their undergraduate coursework, 'Personal Experience' is replaced by more immediate college level experiences in their self-view. An examples of 'Personal Experience' coded sentences from the application essays is as follows: "*My tenth grade biology teacher influenced me to become a science teacher.*" (Mary, application essay).

Table 2. Average percentage of sentences in respondents essays with the measured level of emphasis (n=16 respondents)

Broad Emergent Themes	Application Essay		Pre-Service Essay		In-Service Essay	
Subthemes						
Experience	Linked	Strongly Linked	Linked	Strongly Linked	Linked	Strongly Linked
Personal Experience	11%	81%	12%	12%	8%	12%
Noyce Specific Experience	0%	0%	14%	29%	3%	13%
Current Professional Experience	3%	3%	13%	5%	17%	61%
Challenges						
Student Challenges	9%	3%	17%	14%	2%	22%
Regulatory Challenges	0%	0%	2%	0%	10%	5%
Professional Frustration	3%	0%	8%	1%	14%	12%
Goals						
Career Plans	9%	28%	16%	23%	14%	13%
Desire to Impact Students	8%	14%	15%	21%	15%	16%
Satisfaction and Confidence						
Professional Satisfaction	6%	3%	13%	4%	17%	16%
Confidence	16%	3%	23%	15%	8%	12%
Professional Knowledge and Skills						
Content and Curriculum	12%	4%	9%	5%	6%	5%
General Teacher Knowledge	11%	1%	22%	14%	23%	14%
Positive Classroom Management	1%	1%	9%	5%	6%	5%
Building Relationships with Students	16%	1%	11%	12%	15%	11%

With 14% and 29% of the pre-service essay sentences coded as 'Noyce Specific Experience', this subtheme emerged as a major referent. The NYC

internship surfaced as a major category of reflective thought in response to the essay prompt "*Think about your Noyce Program Application Essay (provided to you). What do you think about now when you envision yourself as a teacher in a high-needs school?*" Two examples of 'Noyce Specific Experience' coded statements are: "*Because of Noyce I feel more equipped to teach in a high needs school, I witnessed the structure, struggles and challenges of these classrooms.*" (Ellen, pre-service essay). Claire, who now teaches biology in Brooklyn, NY, wrote "*The urban teaching experiences have been irreplaceable and the fact that I have had numerous opportunities has been amazing.*" (Claire, pre-service essay).

Essay three (the in-service essay) was written while the Scholars were teaching in high-needs schools. Many statements (17% linked and 61% strongly linked) referred to their 'Current Professional Experience.' In almost all cases these statements were coded with at least one other subtheme. For example, when Ellen wrote "*I teach Earth Science and Life Science at the same time during one period, with very minimal supplies*" (Ellen, in-service essay), she was referring to her 'Current Professional Experience', and this statement was also moderately-strongly coded as 'Professional Frustration.'

Broad Emergent Theme Two, Challenges

The next BET in Table 2 is Challenges, in which there are three subthemes. These are 'Student Challenges,' 'Regulatory Challenges,' and 'Professional Frustration.' There is a clear pattern of increased emphasis on 'Student Challenges' across the three essays. The Scholars write little of this in the application essay (9% linked and 3% strongly linked). It strengthens in the pre-service essay (17% and 14%) and emerges as a stronger subtheme in the in-service essay (23% and 22%). An example of a challenge statement from the pre-service essay is "*Of course there are external factors that make teaching students in high needs districts different than teaching those that come from financially sound districts but at the heart of it all the job is the same; to motivate and educate students who, while not always acting like it, want to better themselves.*" (Matt, pre-service essay). An example from in-service essay is "*In my school district, there is a large population of students enrolled in free or reduced lunch and many students living in poverty.*" (Alexi, in-service essay) Statements coded as 'Regulatory Challenges' resided almost exclusively in the essays of two first-year teachers in NYC whose comments reveal frustration with school or system-level policies. An example of a statement coded as Regulatory Challenges was "*I believe that the political landscape and the New York City educational system play a pretty big role in my opinion that teaching in a high-needs urban district is not for me.*" (Allan, in-service essay).

Professional Frustration was almost absent in the application essay (3% linked and 0% strongly linked), strengthened slightly in the pre-service essay (8%/ and 1%), and then emerged with 12% of the sentences strongly coded in the in-service essay. The few sentences coded 'Professional Frustration' in the pre-service essay focused on future salaries and the economic difficulty of living in a high-needs urban area on a teacher's salary. For example, Abby wrote "*On a starting teacher's salary, I may not be able to afford to buy supplies for all my labs* (Abby, pre-service). Two examples from the in-service essays are "*The school culture and attitude towards learning has perhaps changed with the*

generation, but the general lack of motivation is completely disheartening."
(Claire, in-service essay). Luke wrote *"There are days where I hate my job; this
is for a variety of reasons. Sometimes I have parents yelling at me for a variety
of reasons via email, sometimes I get done with a lesson and feel as though no
students understood what I taught them."* (Luke, in-service essay).

Broad Emergent Theme Three, Career Goals

Emergent subthemes 'Career Plans' and 'Desire to Impact Students' were
placed in this category. Regarding Career Plans, almost all Noyce Scholars
applied to the program with the intent of becoming or at least exploring the idea
of becoming a teacher (28% strongly coded for career plans). However, there was
no specificity in the application essay 'Career Plans' sentences about becoming a
science teacher in a high-needs school. It seems most had little notion of what
they were actually applying to and ultimately committing to do for the four
years following college graduation. Although the percentage of sentences
strongly coded 'Career Plans' changes little into the pre-service essays, the
specificity of the career plans statements becomes much clearer. An Example of
'Career Plans' statement from an in-service essay is "*It wasn't until I went to
New York City with the Noyce program and helped in the classrooms that I
realized I want to teach in a high-needs area.*" (Erika, pre-service essay). Kayla,
whose participation in 3 NYC trips cemented the idea that she is not interested
in high-needs urban teaching (and now teaches physics in a high-need, rural
community in upstate NY) wrote "*I see myself being in a small rural school with
a large percentage of students on free or reduced lunch but not a very high
teacher turnover rate.*" (Kayla, pre-service essay). Two years later, Kayla wrote
"*I am currently working in a small, rural high needs school district, which has
been a dream come true.*" (Kayla, in-service essay).

The emergent subtheme 'Desire to Impact Students' was frequent in the
application essays (8% and 14%), strengthens in the in-service essay (15% and
21%) and then remains strong (15% and 16%) in the in-service essay. In his
application essay, Luke described an experience where he helped high school
classmates learn physics: "*Helping others to learn has been a very empowering
feeling for myself ever since.*" (Luke, application essay). On her pre-service
essay, Laura wrote "*Being a successful teacher in a high needs school district is
not only about being teaching a subject, but by becoming an influential person in
the students' lives.*" (Laura, pre-service essay). An example from an in-service
essay reads "*I work with challenging students, I do the best I can with what I
have and just hope I'm making a difference to at least one.*" (Ellen, in-service
essay).

Broad Emergent Theme Four, Satisfaction and Confidence

Culminating in 17% linked and 16% strongly linked on the in-service
essay, subtheme 'Professional Satisfaction' strengthened across the three essays.
An example of a 'Professional Satisfaction' statement from a pre-service essay is
"*To have a career doing the two things I enjoy most, teaching and chemistry, will
be perfect.*" (Kathy, pre-service essay). An example from an in-service essay is
"*Although it is a lot of work, in less than a year, I have seen so many parents
turn from wanting nothing to do with the school, to asking teachers to work with
them to help their student succeed.*" (Colleen, in-service essay). A statement
speaking to a new teacher's 'Confidence' in his/her abilities to succeed as a high-

needs science teacher is "*I believe that it will take years of experience and professional development to become a master teacher in a high needs school, but with a positive mindset and attitude, I believe that I can run a successful science classroom.*" (Laura, in-service essay).

Broad Emergent Theme Five, Professional Knowledge and Skills

This BET was separated into four subthemes. Statements referring to knowledge of 'Content and Curriculum' never gained much momentum across the essays. One example from Laura's in-service essay is "*In order to pursue successful teaching in a high needs district; I must teaching with confidence, and exude a strong knowledge of the content that is being taught.*" (Lauren, in-service essay).

The 'General Teacher Knowledge' subtheme emerged in the pre-service essay and, at 23% linked and 14% strongly linked, remained strong in the in-service essay. For example, "*I will relate chemistry to real life so that it is easily understandable; something they will not just forget once the tests are over.*" (Lauren, pre-service essay) and, "*My extended knowledge of chemistry will allow me to determine which concepts need to be explained in a different way, or taught using vaguer or more specific terms.*" (Kathy, pre-service essay) was moderately-strongly coded as both 'Knowledge of Content' and 'General Teacher Knowledge'. Two-years later while teaching chemistry in rural Maine, Kathy referred to her 'General Teacher Knowledge' when she wrote "*I realized that my primary interest was adapting my instruction to the students and environment I would be teaching.*" (Kathy, in-service essay)

Regarding 'Classroom Management', on her application essay, Abby wrote "*He (referring to a high school teacher) created a positive classroom atmosphere that was welcoming and hands-on.*" (Abby, application essay). While teaching in high-needs rural school, Kayla wrote "*I try to make science and learning fun for my students in every way that I can, and they seem to be responding quite well,*" (Kayla, in-service essay) indicating her focus on creating an engaging and well-managed classroom.

Building relationships with students strengthened in the pre-service essay and remained strong in the in-service essay. A series of examples from Sam speaks to the importance of this category in the Scholar's self-view on teaching science in a high-needs school. On his pre-service essay, Sam wrote "*Students just need a person to tell them 'you can do anything you want as long as you put in the effort and never give up on yourself.'*" (Sam, in-service essay). After reflecting on his earlier essays and eighteen months of teaching experience in the Bronx, he wrote "*You are playing a parent, mediator, therapist, friend, role model, and if you are lucky enough, a teacher that is required to teach a curriculum*" followed later in the same essay by "*Those are the days that make everything count and worth it, and help you realize that by making the choice of becoming a teacher as an 18 year-old freshman entering college, was easily the greatest choice that you made in your life.*" (Sam, in-service essay)

Discussion

Credibility of the Data

Researcher bias is a warranted concern influencing the credibility of the data. All three researchers had extensive contact with these sixteen during college activities, Noyce programming including NYC internship trips, advisement and some classroom teaching. Moreover, as described in our NSF grant we've maintained email contact with these 16 Scholars during their induction teaching years, responded to pedagogical queries (as is customary in our program), and we've visited the classrooms of the NYC teachers. Another warranted concern is the lack of triangulation of the data via field observations or, reports from observers not connected to this project.

In response to these warranted concerns we offer the following. All 16 responded to the in-service essay prompt because of the professional relationships we have with them. There is no evidence to suggest that the essays are not candid, reflective and thoughtfully portrayals of the Scholars self-view on teaching in a high-needs school. Earlier published works involving evaluation of reflective journals written by this cadre of Scholars (Bischoff et al, 2014) aligns with the data presented here. Moreover, independent coding of every sentence from all forty-eight essays was designed to minimize the potential for researcher bias.

Overview

The three sequential essays written during this period demonstrate that the years spanning college entry to mid-college experience and then to early-career teaching are those in which remarkable self-view transformations take place. This self-view transformation helps clarify our understanding of the complexities of teaching science in a high-needs school.

The application essays were dominated by 'Personal Experience' statements in reference to an influential teacher, vague 'Career Plans' statements about becoming a teacher and, a 'Desire to Impact Students.' An intrinsic desire to help students has been documented as a motivation influencing teaching as a career choice (Watt & Richardson, 2007; Yilmaz-Tuzun & Topcu, 2008).

Two years into their undergraduate curricula and the application essay they wrote shows up in an email, along with the prompt "*Think about your Noyce Program Application Essay (provided to you). What do you think about now when you envision yourself as a teacher in a high-needs school?*" No longer do students write about that influential middle or high school science teacher. They reflect on the teacher training they've participated in 'Noyce Specific Experience' (14% linked and 29% strongly linked), particularly the influential power of the week-long NYC teaching experiences. Liou and Lawrenz (2011) reported that Noyce Scholars self-perception of preparedness to teach in a high-need school was related to how relevant they viewed their undergraduate training. Concomitant to reflecting on their 'Noyce Specific Experience', their self-view contains strong referents to 'Student Challenges,' a strengthened 'Desire to Impact Students' increased 'Confidence' and a strong focus on the importance of 'Building Relationships with Students.' There is a remarkable broadening in their self-view on what it means to be a science teacher in a high-needs school across these two essays.

Some five years after applying to the Noyce Scholars program, and soon after they began their careers, they received yet another essay prompt and attached are the essays they wrote five and three years earlier. They read the essays, reflect on their current position as actual science teachers in high-need schools, and write back. Across the board they refer heavily to their 'Current Professional Experience.' Paralleling the focus on their current position are many statements referring to 'Student Challenges,' the importance of 'Positive Classroom Management' and 'Professional Frustration.' These increases are counter-balanced by slight reductions in sentences strongly coded as 'Desire to Impact Students' and 'Confidence.' The steady increase in sentences strongly coded as 'Professional Satisfaction' are grounded in a much broader self-view of what it means to be a science teacher in a high-needs school. Ladson-Billings (2011) describes the challenges and complexities novice teachers will face in terms of meeting the needs of all students in culturally diverse and high-needs school. In-service essay three, written by the Scholars after their final year(s) of college and into their high-needs teaching careers was the broadest and most balanced in terms of the frequency of coded subthemes. Much unlike the Application Essays which focused very heavily (81% Strongly Coded) on 'Personal Experience', the breadth and more balanced representation of subthemes in essay three speaks to the Scholars increased understanding of the complexities of teaching in a high-needs school and in meeting the varied needs of diverse student populations.

In conclusion, the reflective essays written by these sixteen Scholars demonstrate remarkable growth in their self-view. The longitudinal analysis of the essays provided a window into their self-view as future high-needs schools science teachers when they applied to the Noyce Scholars program and how their self-view broadened while in college as Noyce Scholars in Science Education. Finally, the essays they wrote while teaching science in high-needs schools demonstrated the emergence of an increasingly balanced self-view. This balance incorporates understandings of the challenges students bring to school and the frustrations they experience as new teachers. In these challenging environments, their confidence begins to waver. Fortunately, increased 'Professional Satisfaction' is accompanied by a broader understanding that they must 'Build relationships with Students' if they hope to achieve their strong and steady 'Desire to Impact Students.'

Implications

The results of this research have implications for programs dedicated to training undergraduate science majors for careers as high-needs science teachers. Similar to the findings of Ganchorre and Tomanek (2012) our results show that undergraduates (with little personal or professional educational experience in high-need schools) can commit to learning about how to teach in a high-needs school and demonstrate much early career success. That early career success is marked by a self-view on what it means to be a teacher in a high-needs school that is far more sophisticated than their narrow (and perhaps naïve) application essay. For these sixteen, the Noyce Scholar enhanced undergraduate program (which included cohort meetings, discussion groups, Saturday Science Teaching opportunities, etc.) and most importantly, clinical experiences in both high-needs rural and high-needs urban schools combined with reflective writing tasks, enabled them to self-evaluate, deeply consider

their chosen career, and decide on whether to seek employment in a high-needs rural or urban school. In the big picture, the challenge of this Noyce Scholar undergraduate program was to take the applicants, all of whom had very little idea of what they were applying for as future teachers in high-needs schools and ready them to begin their careers. We did so by providing them with varied clinical experiences, on-campus professional development opportunities, and a structure that enabled them to learn about themselves and begin to think about (certainly not fully understand) the needs of students in high-needs schools (rural and urban) and the pedagogical competencies and dispositions necessary to succeed in these very different but challenging environments. The results of our essay analysis show much growth in breadth of self-view on what it means to be a science teacher in a high-needs school. The results add to our understanding how clinically rich undergraduate programs, which include immersion experiences in educational environments outside of personal comfort zones (Holt &Garcia, 2005) under the guidance of experienced teachers (Yendol-Hoppey, 2009) combined with reflective writing tasks (Saka et al., 2013; Siry & Martin, 2014) and cohort meetings can serve as powerful pedagogical approaches. These pedagogical approaches can facilitate deep self-view transformations about what it means to be a science teacher committed to serving in a high-needs school.

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