

Urban and Suburban Institutions: Preparing Science Teachers for Culturally Diverse Classrooms

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## Abstract

This study examines urban and suburban Noyce programs at two public universities concentrating on preparing secondary science teachers for service in high need schools. Past studies of these two universities revealed inherent weaknesses in the preparation of preservice teachers' (PST) at the suburban university, leading to revisions in the teacher education program. This study focuses on two key questions: (1) Compared to results at the urban university, what were the effects of changes in the teacher education program and placements at the suburban university and (2) Were there differences in the outcomes at the urban university related to PSTs participation in total immersion programs vs. modified immersion programs? The results utilized self-efficacy beliefs and pedagogy reflecting culturally responsive practices, using quantitative and qualitative methods for data collection. Self-efficacy was measured using Siwatu's (2007) Culturally Responsive Teaching Self-Efficacy (CRTSE) and Riggs & Enoch's (1990) Science Teaching Efficacy Belief Instrument (STEBI). Pedagogy practices were analyzed using interview transcripts. This study found that there was a significant increase in self-efficacy beliefs for both universities from pre to post, but there were no differences between universities. Additionally, researchers found there were no quantitative differences in outcomes between total and modified immersion teaching experiences at the urban university. At both universities, PSTs placed in high need schools were more likely to report student-centered instruction and relevant approaches in planning and instruction as well as culturally responsive teaching practices was related to the placement. When reflecting on their teaching experiences, total immersion PSTs related richer and deeper experiences than modified immersion PSTs who in turn were better prepared than PSTs placed in non-high need settings. Overall, the interview data showed that (1) field placements in high need schools continued to be critical components and (2) the total immersion program yielded the richest examples of culturally responsive pedagogy. Variances in teacher education programs, field placements in high need schools, the level of immersion in the schools, and support from classroom mentor teachers can impact the beliefs and practices of PSTs as they prepare for their first years of teaching.

This paper reports on a 5 year study at 2 public universities, one suburban, the other urban with Noyce programs focused on preparing secondary science teachers for service in high need schools. Impetus for programs like Noyce was grounded in the need for 100,000 new math and science teachers articulated in the 2007 report *Rising above the Gathering Storm: Energizing and Employing America for a Bright Economic Future* and in a continuing shortage of qualified secondary STEM teachers.

Research on training for culturally diverse classrooms in science teacher preparation programs has been scant to non-existent (Bryan & Atwater, 2002; Seiler 2013). The necessity for this research lies in the demographic shifts that are occurring across the landscape of public education in the United States. Census projections point to major shifts in numbers of minority students enrolled in public schools by the year 2043 (Crouch, 2012; US Census 2012). Due to changes in immigration and birth rates the US will become a pluralistic country with no one racial or cultural group being in the majority. According to the Center for Public Education (2015) "the population that schools educate is increasingly made up of children of color and Hispanic origin". These trends are regional with significant shifts occurring in the South, West and various cities in the North. The majority of the changes in demographics is due to immigration of Hispanics and Asian groups. In 2009 the impact of this trend on public schools was evident by 23% of children having at least one foreign-born parent (Crouch, 2012). In addition, nearly 20% of the US population 5 years and older speak a language other than English at home (Crouch, 2012). Given that academic English proficiency is a key factor in student success and it takes 4-7 years for English Language Learners (ELLs) to achieve proficiency in academic English, the need for teachers experienced in working with the ELL population is essential.

Based on the growing need for teachers proficient in working with culturally and linguistically diverse (CDL) students, the current demographics of US teachers illustrate another aspect of this need. According to the latest National Center for Education Statistics report on 9-12 grade teacher demographics in public schools, 84.5% of those teachers were White non-Hispanics and 53.6% were female (NCES, 2013). Nearly two of five students are Black or Hispanic, yet more than four of five teachers are White non-Hispanic (NCES, 2013), thus most students of color will have White teachers throughout much of their K-12 experience, with the majority of those teachers being female (Zumwalt & Craig, 2005).

The task of preparing preservice secondary science teachers to be conscious of the importance of their students' lived cultures and how their cultures impact the instructional and learning cycle falls to science teacher educators. This attention to cultural influences necessitates having a working definition of culture that is accessible to PSTs many of whom may have had limited understanding of the influence of culture and language on cognition (Settlage, Southerland, Smith, & Ceglie, 2009). Coupled with the realization that new teachers frequently bring with them negative and stereotypic views about students from different backgrounds, and these socio-cultural differences often result in conflicting cultural values, miscommunication, and ineffective teaching (Irizzary, n.d.; Rodriguez, 1998; Settlage, et.al., 2009; Sleeter, 2008), this limited understanding underscores the importance for science teacher educators to clearly communicate the meaning of culture as it relates to science instruction. Although there are multiple definitions of culture as it relates to science education (Carlone, Johnson & Eisenhart

(2014), the definition that resonates with how these science educators/researchers framed our goals for our PSTs is cultural production.

Cultural production theory explains the fluid nature of cultural practices when local practices intersect larger social structures every day; these local practices may reflect or contest the dominant culture (Carlone, Johnson, and Eisenhart, 2014; Seiler 2013). For example, in a Mid-Atlantic medium-sized city, African American youth appropriate the dominant hip hop mode of dress to create their own style of dress and mannerisms. They don baggy pants, oversized white t-shirts and backwards ball caps with intact paper labels, but they may add a belt that is utilized when in school or in the presence of respected adults. Their addition of a belt allows them to adapt to the mores and expectations of their local community while asserting their youth cultural mode. In much the same way, teachers can appropriate cultural practices in the service of instruction. This occurs in classrooms as teachers attempt to access their students' cultures to enhance instruction. For example, students are tasked with producing a hip hop rhyme using genetics content. The teacher validates her students' culture by integrating one of their practices (hip hop rhyming) while continuing to provide instruction. In a sense, cultural production defines what occurs in classrooms when the culturally conscious science teacher deliberately appropriates students' cultural practices in the service of instruction.

Over much of the research cycle for this study, Sleeter's (2008) recommendations for preparing effective educators of economically and culturally diverse students, especially Blacks and Latinos, served as a guide. Her research findings recommend that teacher preparation programs include the following three pillars: (1) university-based coursework that deliberately cultivates cross-cultural awareness as well as self-awareness as a "cultural being"; (2) school-based field experiences in a high need, culturally diverse setting – ideally immersive, protracted, and with cooperating teachers who are able to teach diverse and disadvantaged students effectively; and (3) community-based field experiences in a cross-cultural setting – such as tutoring at a local youth program.

### **Design/Procedure**

The aim of this study is to compare two Noyce programs focused on preparing secondary science teachers for service in high need schools. To guide this research, two research questions were developed. The questions guiding the study are: (1) What were the effects of changes in the teacher education program and placements at the suburban university compared to results at the urban university and, (2) Were there differences in the outcomes at the urban university related to preservice teachers' participation in total immersion programs vs. modified immersion programs?

Over several years, Noyce programs at Universities A and B underwent substantial modifications from inception to current time. The need for changes came forth due to research findings from previous studies at the two universities (Matkins, McDonnough, & Matkins & McDonnough, 2010) and recruitment challenges. Although the modifications introduced new elements to both programs, the essential focus continued to be preparing secondary science teachers for high need schools.

At University A, year one was spent establishing program support structure, convening the Advisory Council, recruiting and training Noyce Teaching Fellows (NTF), and recruiting undergraduate and graduate Noyce Scholars (NS). That spring four undergraduates and six

Master of Teaching candidates were enrolled in the Noyce program. During the 2nd year, in an effort to increase program enrollment, a partnership was established with the local Teacher Residency Program, a USDOE funded urban residency initiative designed to increase the number of highly qualified secondary teachers. These Noyce Teacher Residency (NTR) PSTs have a total-immersion (TI), year-long experience in the local urban school district based on the urban teacher residency model. The other Noyce-funded PSTs will be identified as Noyce Scholars (NS). In contrast to the Noyce Teacher Resident Scholars (NTRS) PSTs, Noyce Scholars (NS) have modified-immersion (MI) experiences that occur in multiple local, high need districts.

Unlike University A, University B was geographically distant from high need schools. In the first three years of this study, the majority of the PSTs were placed in non-high need schools. There were occasional high need placements, and research with those PSTs, and comparisons with the University A NS PSTs, showed that changes were needed in University B's program if the goal was to prepare PSTs for teaching in high need schools. At University B, from year one to the current year (year five), modifications occurred in the curriculum of the science methods courses, in the nature of the placements of the preservice teachers (PSTs), and in professional development activities with the cooperating teachers in the placements. The program evolved to a majority high need placement model. There was no opportunity for a total immersion (TI) program at University B.

### **Total-immersion Program Description**

A growing recognition of recruiting, preparing, and retaining teachers for urban classrooms was the catalyst for the urban teacher residency model (Urban Teacher Residency United, 2010). The total immersion program at University A is based on the Urban Teacher Residency United (2010) Seven Standards of Teacher Residency. The principles are as follows: (1) Tightly weave education theory and classroom practice together; (2) Focus on learning alongside an experienced, effective mentor; (3) Group teacher candidates in cohorts; (4) Build constructive partnerships with districts, schools, communities, universities, and unions; (5) Serve school districts; (6) Support residents once they are hired as teachers of record; and (7) Establish and support differentiated career roles for veteran teachers.

Unlike other alternate route programs, non-traditional candidates in total immersion programs who have no teacher education background complete their master's degree while developing a strong conceptual understanding of the research, theory, and practice behind effective urban teaching. Another unique aspect of this model is that these candidates are recruited and prepared for a specific school division. The teachers are assigned to one school to complete a full academic year of student teaching while completing their master's degree. The residents are assigned a clinical resident coach (CRC) and instruction coach who have participated in rigorous and powerful training workshops framed by the Santa Cruz New Teacher Center, the *Professional Learning Series for Mentors and Coaches* (New Teacher Center, 2015). These interactive workshops focus on the knowledge, skills, and understandings critical for those who work with beginning and veteran teachers to improve instruction. Once accepted into the program, the total immersion PSTs receive a living stipend and reduced tuition in exchange for a minimum four-year commitment to teaching in that specific urban school district. At Univ A, these preservice teacher residents also receive additional funding through the Robert Noyce

Scholarship Program and are expected to fulfill those program requirements, becoming Noyce Teacher Residency Scholars (NTRS).

Non-traditional candidates are accepted into the total immersion (TI) program at Univ A based on academic major, minimum of a 3.0 GPA, an application, phone interview, completion of all teacher licensure exams, and completion of the on-site selection process. The selection process includes: (1) teaching a mini-lesson to students from the school division; (2) participating in a group activity around an urban issue; (3) an interview; (4) a writing sample on an urban issue, and (5) the Haberman Star Teacher survey (2005). During on-site recruitment, the candidates are also exposed to the tool *Is this for me?* that was developed by the program. This tool asks candidates to envision their life in a program and profession that demands at least 60-hour workweeks, dual roles as a teacher and learner, and have little personal time. This recruitment process ensures that residents will be a good fit for the school division before they are invited to become a part of the program.

### **Modified-immersion Program Description**

University A's modified-immersion (MI) teacher preparation program was created to fill the unique needs of Noyce-funded Scholars (NS) while adhering to existing program constraints. All Master's of Teaching (MT) candidates are required to take a 1-credit science practicum in the fall prior to student teaching. These practicum placements were usually in a school district different from the one where the candidates would eventually student teach. In response to the need for specific Noyce scholar preparation for high need school cultures the decision was made to change the usual pattern for fall placements and place the Noyce scholars in the same classroom for an entire year with a veteran teacher who has a record of successful work with diverse students. Scholars carry out their science practicum in the fall and student teach in the spring in the class of these veteran teachers. These classroom teachers, the Noyce Teaching Fellows (NTF), undergo a rigorous selection and training process before Noyce scholars are placed in their classrooms.

In order to attain Noyce Teaching Fellow (NTF) status, applicants first undergo a rigorous screening process which involves completion of paper applications in the form of five short essays describing their areas of expertise and their experience in high need settings. Evaluation of the essays was carried out by the Advisory Council consisting of science supervisors from each district participating in the Noyce program, three Univ-A professors representing the three main branches of science (physics, chemistry and biology), and a coaching consultant. Based on the outcome of the application, an initial classroom observation was scheduled for each eligible candidate. During the observation period student interactions, student responses and motivation, classroom learning environment, and rigor and lesson design were evaluated. Within these categories, specific indicators of mentoring capability were measured using a four point system. Qualitative data was also collected and used by the Advisory Council to choose the final Noyce Teaching Fellows.

In order to ensure long-term success within each school, strategic relationships were established between the Noyce Teaching Fellows (NTFs), administrators at the school, the Advisory Council and University A staff. Intensive summer training in the Santa Cruz New Teacher Center model of coaching (New Teacher Center, 2015) was provided to the Noyce Teaching Fellows. Virtually every aspect of coaching was covered in the training, including

experience with the co-teaching model and synthesizing effective feedback. The training session was extended virtually through the use of online resources for the remainder of the year using monthly forums and an online discussion group to allow for the professional development of the NTFs as a learning community engaged in reflective practice.

Noyce Scholars, unlike their peers in the traditional MT program at University A, have the advantage of starting the school year with their Noyce Teaching Fellows. They also have an opportunity to build relationships with the school faculty and staff and develop a degree of comfort in a high need school setting. Most importantly, NS have time to build relationships with the students in the NTFs' classes, thus eliminating the struggle usually encountered by student teachers at the beginning of their placements. In the spring semester, the NS fills the student teacher role in the classroom of the NTF, using the co-teaching model.

### **Changes in programs at University A and University B**

Even prior to the Noyce program's inception at University A (Univ-A), the lead professor designed the curriculum in its science methods coursework sequence to include knowledge and practices of contemporary science education, including strategies for culturally responsive pedagogy (CRP). Refinements to the curriculum include more current course readings and assignments that support the development of CRP. Noyce Scholars' (NS) and NTRS' grounding in CRP is supported with readings about the warm demander stance (Bondy & Ross, 2008), and course assignments requiring the integration of students' cultures and interests. In addition, NS at Univ-A were all required to complete a course in multicultural perspectives. The course is designed to enhance cultural competence in diverse classrooms and schools. Major topics include race, ethnicity, linguistic, gender, abilities and sexual orientation differences. Key concepts include structural, curricular and instructional facets of working successfully in diverse educational settings. Personal and theoretical constructs of race, ethnicity, culture, disability and other related concepts are explored. Instead of the course in multicultural perspectives, NTRS were exposed to multiculturally-related topics in an urban education context in courses designed specifically for the cohort.

University B's (Univ-B) secondary science education program has undergone more substantial changes than Univ-A. The Univ-B Noyce program began in 2009, when the first cohort of Noyce scholars entered the preservice science education program. Preservice teachers (PSTs) at Univ-B completed two additional courses designed for Noyce scholars, in addition to the coursework and field experiences included in the approved program of studies. One course, the additional one-credit practicum, evolved quickly from the 2009 design. In later years, the practicum course included structured field trips to high need schools, with the entire Noyce group traveling together. The second course was a one-credit biology course that looked at strategies for learning and supporting more efficient concept development. The science methods coursework was revised substantially in response to our early research findings showing a contrast in outcomes from Univ-A and Univ-B in terms of fluency and comfort with inquiry-based practices (Goff, Matkins & McDonnough, 2013). At Univ-B, PSTs complete a two-course, seven-credit sequence in secondary methods; in 2009 multicultural aspects of the curriculum were virtually unchanged from previous years. Recognizing that a key difference between the two programs was the lack of a multicultural course at Univ-B, beginning in 2010, the science methods courses began including special readings focused on key issues in culturally responsive pedagogy (e.g., Sleeter, 2008; Irizarry, n.d). Also, a book club approach was adopted for

discussion of a popular nonfiction book dealing with cultural issues, *The Immortal Life of Henrietta Lacks* (Skloot, 2010; Author, 2013). Additional assignments focused on various aspects of cultural responsiveness.

Along with curriculum changes, Univ-B responded to the results from previous years of this ongoing study by reaching out in year four to its distant neighboring high need school districts for placements for its Noyce scholars. As a result, five key understandings about the importance of placements in high need settings at both universities emerged (Goff, et. al., 2013; Matkins, et. al., 2014):

1. PSTs began their programs with naïve, generalized, idealized, and abstract beliefs about cultural others, as revealed by Pre interviews. By the Mid and Post interviews, PSTs who had field experiences in a high need context exhibited a sensitivity specifically attuned to individual students in their field settings. PSTs who did not have this experience did not express the same awareness.
2. For PSTs in high need schools, self-efficacy for science teaching and for culturally responsive teaching dropped midway through the licensure program, probably a sign of “culture shock” (Sleeter, 2008) provoked by an alien setting (to these PSTs). But by the end of student teaching, efficacy in both domains rose well above the Pre measures. For PSTs not in high need schools, self-efficacy also rose significantly from the start of the program to the end, but without the midstream dip.
3. PSTs in high need schools gave evidence of adapting instruction to engage their students in popular culture, to establish real-world relevance, and to connect to the culture of specific classrooms. PSTs who were not placed in high need schools did not provide strong evidence of such adaptations.
4. PSTs placed in high need schools displayed a much greater willingness to experiment with novel instructional strategies and to adopt and apply research-based best practices in science teaching. Even if they had endorsed inquiry, cooperative learning, explore-before-explain pedagogy, etc., during the Mid interview, PSTs not placed in high need schools were less likely to embrace or actually employ those practices during student teaching.
5. PSTs placed in high need schools described many deliberate, targeted efforts to adapt classroom routines, policies, and management strategies to the realities and challenges of their field setting. This was notably absent in the final interviews with PSTs not placed in high need settings.

These understandings have guided the current year’s research into the outcomes of the two programs. Following the previous years of research on the Noyce Scholars programs at the two universities, some major differences remained within the programs, and between the universities. At suburban Univ-B, the program has just recently developed the ability to place some of its Noyce Scholars in high need settings; with the remainder placed in suburban, majority- majority schools. Thus, Univ-B continues to produce non-immersion as well as modified immersion Noyce Scholars. Urban Univ-A has been able to place its students in high need schools since the onset of this multi-year study. In addition, an aspect of Univ-A’s program not previously examined, the immersion level of the preservice teachers, is examined in this study.

## Findings/Analysis

The five-year study at these two universities involved both quantitative and qualitative measures, comparing PSTs responses at Univ-A and Univ-B in order to determine PSTs preparation for culturally responsive teaching. Self-efficacy was measured in two domains: (1) science teaching, using the STEBI of Riggs & Enochs (1990) and (2) culturally responsive teaching, with Siwatu's CRTSE instrument (2007). Interviews were conducted with a representative sample across science content areas. In 2009, the authors developed a protocol for evaluating interview data for culturally responsive pedagogy (Matkins & McDonnough 2010); this protocol has been used consistently throughout. Data from both the self-efficacy instruments and the interviews were collected at the beginning, middle, and end of the secondary education program.

### Quantitative Results

The size of this sample may undermine the reliability of these results. Further, the standard errors reported in the graphs show how the amount of variation yields estimates that are not as precise as with larger sample sizes. The current study reports how the sample was determined and how the data were measured and analyzed to improve the readers' interpretation of the reported effects and to understand the appropriate level of confidence in the findings.

**Cumulative Comparison Analysis.** A comparison of Univ-A and Univ-B was conducted to examine self-efficacy beliefs in the two Noyce programs. Because time series analyses for each program showed no statistically significant differences between years, participants were aggregated to increase the sample size for each university. Over the duration of both programs (2009-2014), growth in self-efficacy for culturally responsive teaching, using Siwatu's Culturally Responsive Science Teacher Self-Efficacy instrument (CRTSE, 2007), was similar for both universities. In fact, there was not a statistically significant difference in culturally responsive teaching beliefs between the two schools over the course of the licensure process ( $F(2, 43) = 2.363, p = .101, \eta^2 = .464$ ). Although there was no difference between universities regarding CRTSE scores, both universities had a significant increase in culturally responsive teaching. Figure 1 (CRTSE) shows the increase in self-efficacy of culturally responsive teaching beliefs from the beginning of the program to completion.

Self-efficacy for science teaching (STEBI), developed by Riggs & Enoch's (1990), revealed a slightly different pattern. Univ-A scholars did not experience a significant change in self-efficacy over the duration of the program; however, they maintained a balanced and high image of science self-efficacy throughout. Scholars attending Univ-B experienced a gradual increase in science self-efficacy scores, with the highest scores being reported after completion of student teaching ( $F(2, 36) = 2.432, p = .000, \eta^2 = .559$ ). Figure 2 (STEBI) shows this relationship. This change, pre to post, for University B preservice teachers was statistically significant.

*Figure 1. Changes in culturally responsive teaching self-efficacy beliefs (CRTSE) between Univ-A and Univ-B. The repeated measures comparison over time is statistically significant for both universities (ANOVA). Error bars show standard error in the mean.*

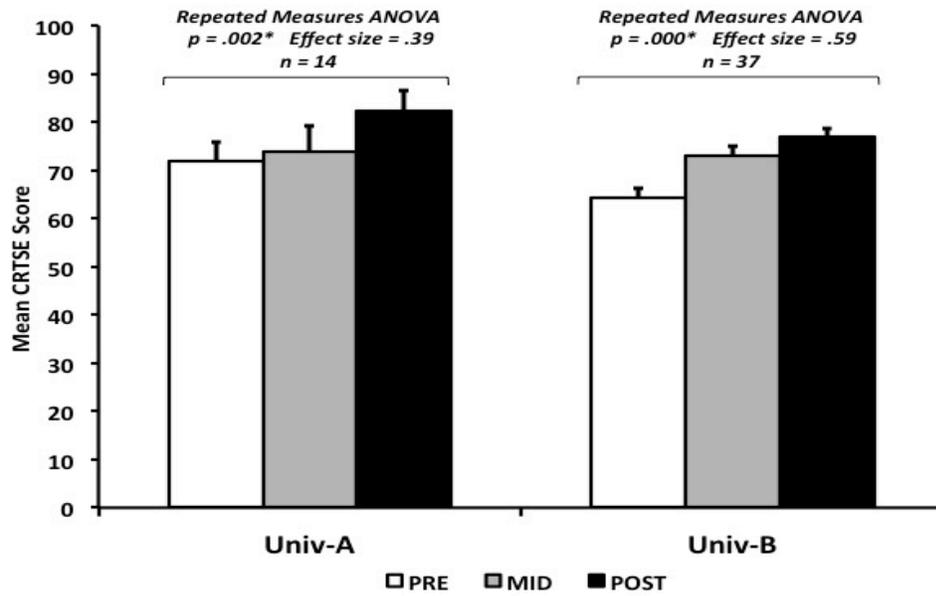
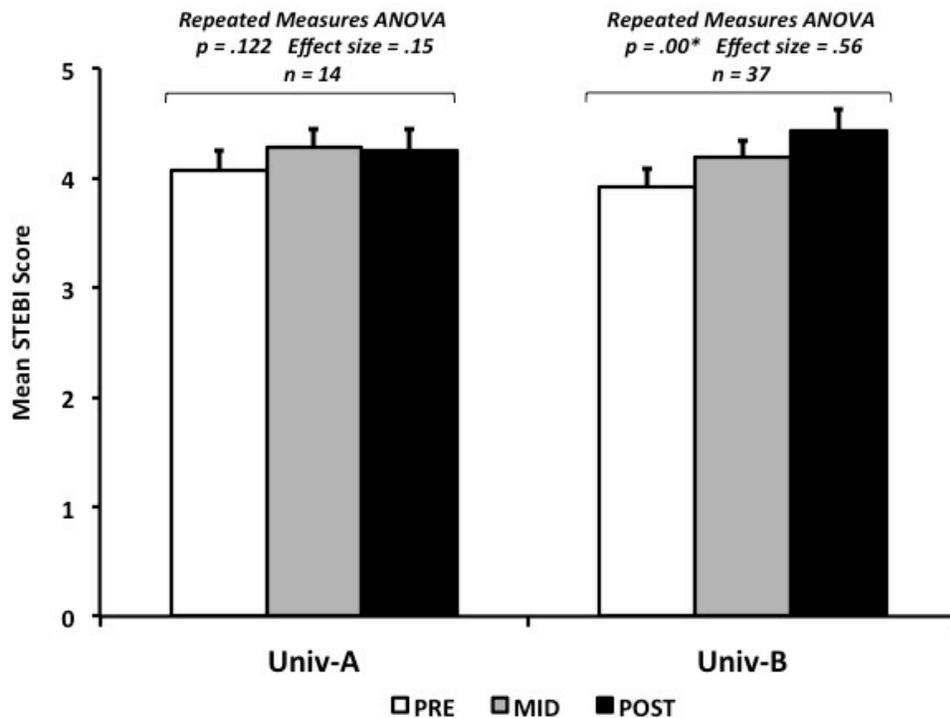


Figure 2. Changes in science teaching self-efficacy beliefs (STEBI) between Univ-A and Univ-B. The repeated measures comparison over time is statistically significant for Univ-B (ANOVA). Error bars show standard error in the mean.



**University-A Immersion Comparison Analysis.** Univ-A scholars experience two different student teaching experiences. Total immersion (TI) scholars complete a full academic year of student teaching in a specific school division while completing a master's degree. Modified immersion (MT) scholars enroll in a science practicum in the fall and student teach in the same class during the spring. T-tests were conducted to determine if the type of immersion experience had an impact on the scholars' ratings of their culturally responsive pedagogies and science self-efficacy.

As stated above, Univ-A scholars had a significant increase in CRTSE trends. Figure 3 (CRTSE, immersion) validates these findings. Multiple *t*-tests were conducted to examine the mean differences between immersion groups at three time points. Analyzes yield no significant findings between total immersion (pre  $M = 71.19$ , mid  $M = 72.31$ , post  $M = 84.05$ ) and modified immersion (pre  $M = 72.54$ , mid  $M = 75.72$ , post  $M = 80.29$ ) experiences at any time point. As a result, the CRTSE survey results suggest that the immersion experience does not influence scholars' perceptions of their own culturally responsive teaching pedagogy.

STEBI, Figure 4, displays no significant gains in science self-efficacy for either immersion experience. Similarly to the CRTSE results, there is no statistical difference in scholar reports of science self-efficacy beliefs between total immersion (pre  $M = 4.09$ , mid  $M = 4.36$ , post  $M = 4.25$ ) and modified immersion (pre  $M = 4.04$ , mid  $M = 4.17$ , post  $M = 4.25$ ). These outcomes may result from both cohorts developing the same strong conceptual understandings of theory and practice in urban teaching while completing the same coursework for their degree.

*Figure 3. Changes in culturally responsive teaching self-efficacy beliefs (CRTSE) between Total Immersion (TI) and Modified Immersion (MI) for Univ-A. The repeated measures comparison over time shows statistically significant growth for both TI and MI participants (ANOVA).*

Comparisons between the groups did not yield any statistically significant differences between the groups (*t*-test). Error bars show standard error in the mean.

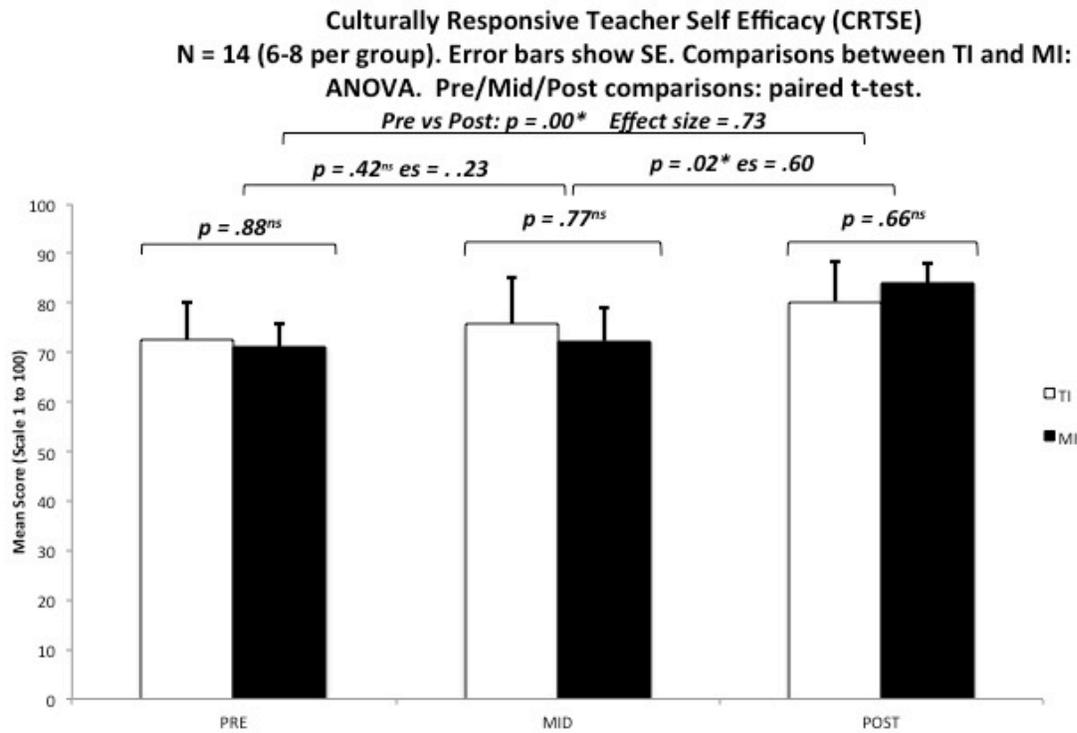
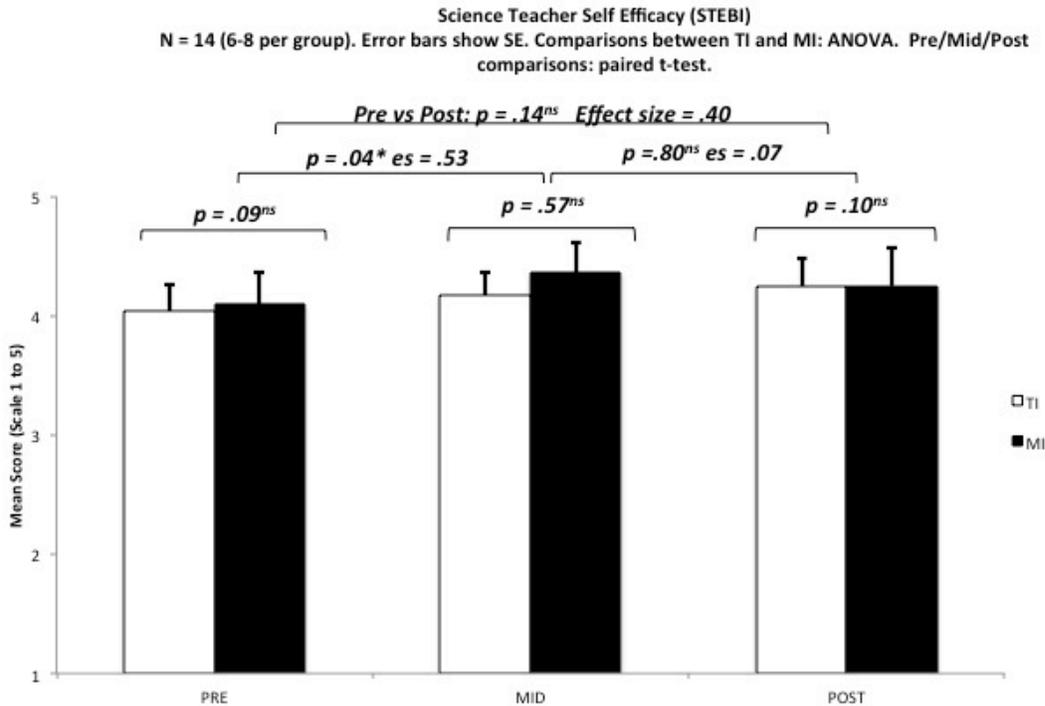


Figure 4. Changes in science teaching self-efficacy beliefs (STEBI) between Total Immersion (TI) and Modified Immersion (MI) for Univ-A. The repeated measures comparison over time is not statistically significant for either TI or MI participants (ANOVA). Comparisons between the

groups did not yield any statistically significant differences between the groups (t-test). Error bars show standard error in the mean.



## Qualitative Results

Early results from the interview data (Goff, et. al., 2012) revealed a marked contrast between the responses of PSTs at Univ-A and Univ-B. At Univ-A, PSTs showed a commitment to student-centered instruction and to relevant approaches in their planning and instruction, in contrast to PSTs at Univ-B who expressed a reluctance to stray from direct instruction approaches:

One of my favorite days was after we did the electrostatics lab. That day was fun because everyone was playing, it was all like the actual inquiry stuff and I didn't even have to prompt them to do it, they just had this stuff and they just couldn't stop playing with it, and I was like wheeee! ...we were starting a new topic, we had just this fun stuff that had never really, I mean, just sticks and fur and stuff. .... "What happens if...?" - that's my favorite question now...As opposed to, do this thing and if you don't see the right answer, then you're wrong. (Mary, Post, Univ-A)

I played a rap song, it was very quiet, but weeks after I had kids coming up to me and singing the chorus to the song...I knew it was corny and I don't know if they thought I thought it was cool, but I acted like I thought it was cool. (Jay, Post, Univ-A)

Erica (Univ-B), not placed in a high need setting, at the end of her student teaching, is much more cautious about inquiry approaches. "A lot of them get it when I explain it to them, like one on one, but they won't just read a passage, or they won't read a worksheet and they don't get anything out of that." (Post)

The instructor at Univ-B began revising the methods courses as the early data unfolded, and in subsequent years several important factors emerged. First, student teaching in a high need school correlated with interview results consistent with culturally responsive pedagogy (CRP). This “authenticity” factor became apparent in subsequent Univ-B responses, with PSTs placed in high need settings for student teaching, such as Lisa and Monica (quoted below), commonly showing an enhanced understanding of CRP.

Just make sure it’s engaging and hands-on. The kids love to write on the Smart Board [laughs]. Lots of group work, lots of hands-on. Make sure I’m constantly circulating, answering questions. If I see one kid with a question, I usually answer it for the whole class and demonstrate for the whole class, ‘cause usually that means there’s more than one kid with the same question. They just either haven’t raised their hand or they’re not writing anything down, ‘cause they don’t want you to know they don’t know it. (Lisa, Post, Univ-B)

I think the main thing is being authentic and organic and in the moment AND ‘I’ve got a plan.’ I’ve always got a plan. We have our best moments when I loosen up a little bit and get to discuss something that is just important to the students. The more relevant I make it to their lives the more they are going to pay attention to it the next day. .... I did a transformation lab with my juniors, my IB juniors, it was very successful. We got to make the e. coli, we transformed it with green florescent protein from the Pacific jellyfish. And they were just over the Moon. .... They were making transgenetic organisms.... They felt like scientists that day and that was a gift. (Monica, Post, Univ-B).

As Univ-B implemented additional high need placements for the PSTs, it became apparent that the authenticity of the placement was a necessary but not sufficient condition for PSTs to implement culturally responsive pedagogy (CRP). Though outcomes from the PSTs placed in high need settings included adaptation of instruction, use of specific classroom routines and behavior management strategies that reflected student culture, and experimentation with novel instructional approaches that included a commitment to the “explore before explain” of the learning cycle, PSTs experienced difficulties with cooperating teachers (CT) who did not understand and/or support the CRP practices.

Yeah, a lot of opposition on that one. I was able to convince them to let me do it a few times, but most of the time I had to do, “Let’s go through the lecture real quick first and then let’s do the lab,” because they were, “My kids won’t get it, my kids won’t get it,” and the collaboration teachers were like, “No, they will wig out if you don’t have this and this. It has to be exactly like this.” But I can really see how the few times that I was able to do it, it really changed in the way the kids would see the “aha” moment come more often when they explored first. And it was almost like they got there themselves, as opposed to me telling them all the information, ‘cause who wants that? They don’t enjoy that; they like to learn themselves and have it backed up by what I tell them, and I enjoy doing it that way. (Abby, Post, Univ-B).

Concurrent with the outcomes showing the potential negative impact of the cooperating teacher (CT), Univ-B implemented a professional development program for cooperating teachers. Key goals of the program included providing information about the university teacher

education program, developing ongoing relationships between CT's and the university content area education faculty, and providing information to the CT's about the pedagogical approaches emphasized at the university and why they were emphasized.

At Univ-A, where the majority of placements were in high need schools, interview data consistently showed that PSTs utilized CRP. Antonio (Univ-A), who had the modified immersive placement, was able to implement a differentiation strategy specific to the needs of his students. His placement with a veteran teacher who had extensive experience working with ESL students enhanced his experience and deepened his knowledge of effective differentiation strategies:

So there are different reading levels in there and I also [had], ESL students, so using that model, I had them write the English definition and then for the ESL students, they could write it in their own words, like Spanish ... and then they also drew a picture. So, not just a definition, there is a picture there to that goes along with it. ... (Antonio, Post, Univ-A).

Preservice teachers' (PSTs) awareness of the need to adapt instruction based on their students' interests and particular needs was shown in University-A PSTs' stories. For example after explaining a lesson she taught on genetics, Jamie emphasized the importance of trying multiple strategies to ensure student success in her class:

One of the things that I think I did a good job this semester was applying...to their everyday lives. So...I gave them examples of incomplete dominance and co-dominance and taught them about snapdragon color, until I brought in some snapdragons and showed them here are the red, here are the white, the pink, they took these and mixed them together and got pink. Until they actually visualized it, [then] they were like, all right! ... (Jamie, Post, Univ-A)

#### Differences Between Total and Modified

Both groups attend a student teaching seminar, *Investigations and Trends in Secondary Science Teaching*, that is the second science methods course in the program. This is where the similarities end. Noyce scholars in modified immersion settings (NS) complete practicum work in the fall, with limited time in their science classrooms, and student teach in the spring. The Total Immersion (TI) Noyce Teacher Residency scholars (NTRS) are imbedded in their classrooms four days each week for 38 weeks. They attend a weekly seminar in the evening that is a continuation of the classroom management and curriculum development courses they started the previous summer. The instructor uses problems of practice from the residents' classrooms to encourage reflection, especially in the area of professional growth.

The enormous amount of hours the Noyce Teacher Residency Scholars (NTRS) spend in high need schools exposes them to the complexities of urban teaching in ways that are not possible for the Noyce Scholars (NS). Case in point, Jerrie was in a classroom with a clinical resident coach (CRC – the acronym given to the classroom teacher who hosts the NTRS) who taught 4 different versions of 10th grade Biology. The classes ranged from one with highly motivated honors students to one with chronically absent, failing students some of whom had severe behavioral issues. Jerrie recounts one particularly trying incident:

"I had [my] worst day.... a student throw a stool over the balcony downstairs where the nursery was. And I didn't see which student did it ...the assistant principal called up to me and said, 'hey were there students outside at that time and I said yes, *I need a list of those students!*' ...The following class, the assistant principal came in [my] classroom and said there was an incident that occurred the other day and students are going to pay for it, blah blah blah and Ms. Jerrie, can you announce those students in front of the whole class. So, he just put me on the spot. ... I gave them the list of the students, the assistant principal talked with them in the hallway one by one and then as they [sat] down, they start to say, 'you're a snitch, you're a snitch'. It like spread across the room, the whole room and all of the students were calling me a snitch and at the moment I didn't know how to deal with that. Like, how do you deal with this? [So I said] 'if you didn't do anything you have nothing to worry about and if you want to discuss this matter further then see me after class' and that's all I could think about at that moment. And luckily they stopped or it was just one or two students that kept going, but it wasn't enough to take away from the lesson or the day (Jerrie, Mid, Univ-A).

This experience forced Jerrie to create and implement classroom management strategies and assume the stance of "teacher in control" in order to create a classroom atmosphere in which she was able to instruct. Jerrie's total immersion (TI) experience strengthened her ability to diagnose and respond to the many issues involved in classroom teaching particularly in a high need school. These types of experiences were not unusual for the TI scholars. Unlike their modified immersion (MI) peers they faced challenges on a daily basis relatively early in their residency. Challenges notwithstanding, they also had opportunities to institute classroom routines and structures to a much greater extent than their MI peers. Table 1 highlights some of the differences evident in the two types of placements as they relate to Culturally Responsive Technical Core of Instruction, Classroom Structures and Routines and Classroom Management.

In Table 1.A Chico discusses an elaborate classroom management system she and her CRC had introduced. Her students fully understood consequences for their actions because they had a visual reminder and the expectations for behavior were "explicit every day " (Chico, Post, Univ-A). Implementing this type of behavior management system with a teacher in training was only possible because the Noyce Teacher Residency Scholar (NTRS) was viewed as the other "teacher" by the students in that classroom. In contrast, Jamie, a modified immersion Noyce Scholar (NS) talks in the abstract about a classroom management strategy: "So I need to, I think especially in a high needs environment, make sure that I set up a really valuable set of class norms at the beginning of the year [so] that the students opportunity to practice those norms" (Jamie, Post, Univ-A). Although she has been in this classroom intermittently since the beginning of the academic year she did not have an opportunity to implement a behavior management system in concert with her Noyce Teaching Fellow.

## **Conclusions**

The research questions that guided this study and will guide these conclusions are:

Question One: Compared to results at the urban university (University A), what were the effects of changes in the teacher education program and placements at the suburban university (University B)?

Question Two: Were there differences in the outcomes at the urban university related to preservice teachers' participation in total immersion programs vs. modified immersion programs?

Quantitative results, from the Culturally Responsive Science Teacher Self-Efficacy survey (Siwatu, 2007), continued to show no difference between universities in the outcomes at the conclusion of the program. Though the Univ-B students showed more gain at the end of the first semester, by the end of the program the students at both universities were equally self-confident about their ability to teach in a culturally responsive manner. The overall gain, pre to post, in confidence for culturally responsive teaching practices was statistically significant for both universities, strongly indicating a positive impact of the teacher education programs at both institutions. The same general pattern was found with the results from the Science Teacher Self-Efficacy beliefs instrument, the STEBI-B (Riggs & Enoch's (1990), although PSTs at Univ-A did not show a statistically significant increase in this category of self-efficacy. Given the differences between universities with the kinds of placements, i.e. the prevalence of high need placements at Univ-A and that Univ-B continued to utilize non-high need placements out of necessity, it is possible that these instruments are not sensitive to changes that may be affected by placements in high need settings. This conclusion is supported by the lack of difference seen in the instrument data between PSTs experiencing the total immersion program and the PSTs experiencing the modified immersion program at Univ-A.

Qualitative results painted a richer picture of the differences within programs and between the universities. At Univ-B, students placed in non-high need settings continued to relate their stories of teaching and their ideas of teaching approaches often in the abstract with many fewer references to culturally responsive practices and with fewer and weaker references to awareness of student circumstances and the development of relationships with students, in contrast to students at the same university who were placed in high need settings. Comparing the interview responses of Univ-A pre-service teachers (PSTs) to Univ-B PSTs yielded similar results, with Univ-B PSTs' responses paralleling the responses of Univ-A PSTs placed in high need schools. These results support the conclusion that curriculum changes alone are not sufficient to prepare preservice teachers (PSTs) for teaching in high need schools; in-depth field experiences such as student teaching in high need schools are needed to prepare PSTs to teach in a culturally responsive manner.

Comparisons between total immersion (TI) and modified immersion (MI) pre-service teachers (PSTs) at Univ-A point to the added value of TI placements. Responses from scholars in the CityTR program indicate that the significantly larger number of hours spent in high need schools and other aspects of the CityTR program may better prepare PSTs for the complexities they will encounter. Total immersion PSTs had the opportunity to develop, implement, and review behavior management and instructional strategies in concert with their CRCs. Their TI experience also allowed time for them to develop deep understandings of the complex issues inherent to teaching in high need schools. Their continued presence at faculty meetings, parent teacher conferences, and extracurricular activities provided the backdrop for them to be aware of cultures in high need schools, thus better preparing them for teaching assignments in those schools.

Urban teacher residency programs are gaining supporters nationwide because of their programs' successes in retaining urban public school teachers beyond their first three years of

teaching. The retention rate beyond three years of residents who complete Urban Teacher Residency United (UTRU) certified programs (such as CityTR) is 85% compared to 50% for all urban public school teachers (Urban Teacher Residency United, 2015). Given the relatively higher cost of total immersion programs, it is important to critically evaluate the benefit of programs such as CityTR. Our results indicate (1) that the preservice teachers (PSTs) who are placed in high need settings are better prepared for teaching in those schools than who are not placed in high need schools, and that the Noyce Teacher Residency Scholars are better prepared for culturally responsive teaching in high need schools than either non total immersion category. Combined with the retention data about the UTRU programs nationwide, it seems that teacher preparation programs committed to effecting positive change in high need schools should be looking more closely at total immersion experiences for their preservice teachers.

### **Further Study**

Though there is national data on the retention of teachers who were trained through residency programs, this study did not look at the retention of the preservice to inservice teachers in either program. Given the cumulative results of all UTRU residency programs, it is possible that Univ-A's total immersion (TI) program will yield teachers who stay in the profession longer. Since research has shown a correlation between K-12 student achievement and teachers' years in the profession, we may find that total immersion programs are worth the cost. Future studies focusing on retention and quality of instruction of both universities' Noyce Scholar program completers are warranted.

Another factor that emerged in earlier studies and continues to impact the outcomes of these two programs is the interaction of the preservice teacher with the cooperating teacher (CT). This research has not investigated the impact of the training of the CTs, whether the CT is minimally trained, as at Univ-B, or receives intensive professional development in coaching and mentoring, as in the CityTR program, or somewhere in between, as with the Noyce Teaching Fellows CTs. Are the CTs really different in the manner in which they interact with and support their preservice teachers? Since the expense of the CityTR comes in part from the cost of the training and stipends provided to the CityTR CRCs, it would be useful and prudent to determine if those costs yield results that make them worthwhile. At Univ-B, where a residency program has not been instituted, the training of and interaction with the CTs in the high need schools where partnerships are emerging has been increasing in duration and scope, year by year. We have looked at the impact of the systems that are in place to prepare preservice teachers at these two universities, and at the short-term outcomes from those systems; but we have only looked at a few aspects of those systems. How much training and support do CTs need to be effective at the levels needed not only to yield effective new teachers, but also to yield teachers who stay in the profession?

In research, consistent results over multiple years provides an added level of confidence to conclusions reached in early years of a study. One conclusion that these researchers feel very confident in stating is that placement of pre-service teachers in high need settings are of paramount importance in the development of culturally responsive science teaching practices and habits. In comparisons over the past four years, the results have consistently shown the benefits of such placements.

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