Chapter 14
Going Beyond the Status Quo: A Longitudinal Self-Study of a School Based Science Teacher Preparation Program

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Introduction

Improving the preparation of science and mathematics teachers is a national priority (National Academy of Sciences, 2010; White House Office of Science and Technology Policy, 2014), given the perceived shortage of qualified STEM teachers. To address these needs, many programs were developed to attract qualified STEM candidates to teaching in the hopes that it will improve the teaching and learning of science and mathematics in schools, and in turn, increase the STEM pipeline (Ledbetter, 2012). Moreover, teacher preparation programs are currently under scrutiny, if not attack, as they are being held responsible for the perceptions of failing schools (Greenberg, McKee, & Walsh, 2013; Levine, 2006). Some of these critiques focus on the disconnect between the realities of schools and the focus on theory in teacher education (Levine, 2006), which resulted in alternative teacher preparation programs such as residency programs to emerge (Urban Teacher Residency United, 2014), with various degrees of success (Sawchuk, 2014). Within traditional preparation programs, the Council for the Accreditation of Educator Preparation (CAEP) emphasizes clinical preparation. In Standard Two, the accreditation organization calls for partnerships with school districts to design in-depth clinical experiences for teacher candidates.

In this environment, we found ourselves with an opportunity to develop a new program to prepare mathematics and science teachers, with a focus on embedding them in schools for an extensive period of time. Knowing that practical experiences are essential for novice teacher learning, as science teacher educators, an important aspect of our practice was to establish and develop collaborations with classroom teachers to provide spaces where our teacher candidates can practice their teaching.

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This self-study focuses on what we learned from the implementation of this program over 3 years, specifically in relation to our thinking about the relationship between science education faculty and teachers, and how the school experiences can be better integrated with coursework so that the experiences of teacher candidates in the program exemplify best practices in science education.

Given the current critique of teacher preparation programs, it is important to not lose sight of the proposition that extensive time in the classroom for a teacher candidate is essential, but is not the only factor that leads to success in teaching. The discourse on practical experiences can lead critics to discount pedagogical knowledge. Pinnegar and Hamilton (2009) suggest that self-study of teacher education practices begin with a provocation, which "can be a living contradiction or a puzzle or a wondering about where we want to be, what we know, and how we know it" (p. 105). The provocation for this work came from the complexities of the meaning of practical school experiences, and their relationships to the role of teacher educators at universities, especially in an environment where there are questions about the future of teacher education in the traditional context of colleges of education. Experience doesn't displace theory, but both are integral to the process of learning to teach. As Pinnegar and Hamilton explain: "theory and practice are both enacted in experience, and they are revealed as they bump against each other and potentially new theory and new practice merge" (p. 30).

To explicate these issues and unpack the various ways that "Experience" was being used, we focused our self-study on our individual selves, but also our collective selves as we studied the program as a whole, in relation to how we design meaningful practical experiences for our students. We wanted to study the ways in which a teacher preparation program supports innovative science teaching practices, rather than replicating traditional science teaching. Therefore, the research questions that we explored include:

1. In what ways can we, as science teacher educators, develop school-based experiences that promote inquiry teaching rather than replicate traditional methods?
2. In what ways can we learn and inform our practice while collaborating with teachers, specifically in learning environments that are supporting novice teacher learning?

Theoretical Background

Our practice (and reflection about our practice) was grounded in Dewey's notion of educative experiences, and the framework on critical reflective practice (Brookfield, 1995; Dewey, 1938/1997; Schön, 1983). Experience is a term used with various meanings in teacher education, but it has specific meanings in Dewey's philosophy. For Dewey (1938/1997), the purpose of education is to provide students with worthwhile experiences. These experiences need to be valuable on their own, in the present, as well as open the door to other worthwhile experiences. Not all experiences

can be counted as "worthwhile". To understand this notion of experience more clearly, Wong and Pugh (2001) contrasted a Deweyan experience to an ordinary experience. An ordinary experience is mere activity, without a clear development or flow. It stops rather abruptly, by external interruptions or internal distractions and it does not achieve its full potential. On the contrary, a Deweyan experience is more involved. It is rather like a play, where there is anticipation, a sense of possibility, a fulfillment, and consummation. At the core of a Deweyan experience is the idea of consummation. "The individual looks forward to, imagines what may or may not be, and is surprised, disappointed, or fulfilled when consummation occurs" (Wong & Pugh, p. 321). In this view, learning science means not only engaging with thought, but also emotions and drama (Wong & Pugh, 2001).

Extending this framework to science teacher education, learning to teach can be conceived as engaging in "worthwhile experiences" that engage body and mind through "an unfolding drama of inquiry where one part leads to the next, where the activity is compelled by the anticipation of what might be" (Wong & Pugh, p. 321). Conceiving of worthwhile experiences in this manner transcends practice-as-learning-by-observing (and imitating) a seasoned teacher, to practice-as-acting on creative ideas as they unfold in the classroom.

We focused on designing a program that can involve teacher candidates in transformative experiences that are grounded in practice, but not just seeking to mimic it. It was essential that teacher learning of content and pedagogy occurs "through engagement in learning activity that "mirrors" the kind of experiences that reformers hope teachers would provide their students" (Davis, 2003, p. 6). We focused on studying how embedded school practical experiences "open the possibilities for creative pedagogies" (Britzman, 2003, p. 26), rather than on replicating what exists in classrooms.

Explicating the meanings of practical experiences is essential, as many programs are looking into increasing "experiences" in the classroom, which is exemplified in the Council for the Accreditation of Educator Preparation (CAEP) Standard Two – Clinical Partnerships and Practice. However, practical experience, while essential, is not an uncomplicated term. There is a perception among teacher candidates (and critics of teacher preparation programs) that time in the classroom will teach them everything they need to know about how to teach (Britzman, 2003). In our work, we questioned this assumption, through embedding requirements to challenge candidates to incorporate inquiry methods, and problem based learning approaches in the classroom, while also focusing on reflection in action (Schön, 1983).

In studying our own practice, we relied on the framework of critical reflection (Brookfield, 1995). Reflection is ubiquitous in education circles, but not all reflection is critical. Critical reflection attempts to understand how dynamics of power frame educational processes, and aims to "question assumptions and practices that seem to make our teaching lives easier but actually work against our best long-term interests" (Brookfield, p. 8). We engaged in critical reflection through conversations with colleagues about our practice, through examining our own assumptions, and by listening to our students' voices.

Methodology

The theoretical framework used in this research, and the focus on critical reflection of our own practice, lead seamlessly into self-study research. In particular, the reflective turn (Russell, 2012) was used to study our practices in how we prepare science teachers. We framed our study through collaboration, and reflections with other teacher educators, graduate students, and collaborative teachers in the field. This collaborative framing and reframing is essential in self-study research (Samaras & Freese, 2009) and allowed us to critique our assumptions and challenge ourselves to think differently about issues.

Setting

Pinnegar and Hamilton (2009) outline that the setting of self-study can be individual, collaborative, or programmatic. For the purposes of this study, the larger setting was programmatic- a graduate 1-year program that prepares recent STEM graduates and career changers for teaching in urban schools. The program begins in the summer with intensive coursework, followed by a full year in the classroom with a collaborative teacher, while taking courses related to STEM pedagogy. Faculty in the program worked closely with the teacher candidates and the collaborative teachers to ensure that the experiences are designed to support teacher learning. The program also provided formal mentoring and support during the first 3 years of teaching, which allowed us to maintain a relationship with our graduates.

At the beginning of the program, we brought the collaborative teachers from local high schools and the teacher candidates together for an interview day, where they interacted with each other and provided feedback on their preferences for placements. Throughout the day, faculty used the feedback and their observations from interacting with teachers and candidates to set up matching pairs. Once these were identified, the candidates spent a full year as interns with the collaborative teachers, leaving for two afternoons each week to take coursework at the university. We highly encouraged a co-teaching model rather than a student teaching model for the internship. For these two reasons, it was important that all those involved reflect upon how to pair the teacher candidate with the collaborative teacher during such an intensive year. Additionally, we set up several experiences for our candidates to observe innovative science teaching practices, such as visiting classrooms in STEM schools or other innovative classrooms, and attending professional development sessions.

There were several components in the program that were linked together, but we chose to focus in this self study on examining our (collective) practices in relation to setting up learning experiences in school settings that are most conducive to establishing worthwhile experiences as described above (Dewey, 1938/1997), and on connecting the coursework on science teaching and learning to the existing

practices in the classroom. We operated with the assumption that we learn by participating in a community of practice (Lave & Wenger, 1991) and this was central to this study. The collaborative group included science educators, one math educator, and one STEM clinical faculty. In addition, curriculum specialists at partner school districts engaged with the group in planning and reflection. At various times, other faculty from the teacher preparation unit were also involved in planning experiences and in the reflective process. The make up of the group changed from the inception and planning phase, to the current year (year 4) of implementation due to changes in staffing, as well as changing responsibilities. For the purposes of this study, we focused on the process of learning and reflection that involved two science educators, math educator, and clinical faculty.

As a group, we met weekly to discuss our practices, both in teaching methods courses, and in working with teachers to engage the candidates in the most beneficial experiences. As we reflected and made changes to the program, we became increasingly focused not only on our teaching but also on how the practicum component of the program was an essential component of our practice of preparing teachers. The role of the clinical faculty was essential in bridging the two sets of experiences and providing connections between what we were learning about our teaching, and what we were learning about how our candidates experience the classroom settings. The clinical faculty attended the methods courses at the university and also visited candidates in their classrooms, observing and providing coaching on improving their teaching skills. She was also the liaison to the teachers in the classrooms who had a different perspective on what novice teachers needed to learn and do to become effective. While we collected data in the form of survey questions for the teachers, we also learned a good deal from the interactions of the clinical faculty with the teachers.

Data Collection

The data we collected to study the research questions came from three sources: faculty data, candidate data, and collaborative teacher data. The first set included individual faculty reflections and group reflections documented in meeting notes and email communications. Additionally, we collected data from our teacher candidates, which included survey data on their experiences in the program, work samples, course evaluations, and field teaching observation forms. Survey questions included items regarding aspects of the program that were most supportive of their learning, aspects needing improvement, as well as their experiences in various courses. Work samples included entry slips during coursework, reflections to prompts during their time in the classroom, and lesson plans that focused on student centered teaching strategies. For example, candidates attended workshops on Problem Based Learning and were required to design and implement PBL lessons in their classrooms.

Another source of data in this study included focus groups and informal interviews with the collaborative teachers and survey questions, which provided a different lens to study our practice, and enhanced triangulation of the data. Survey questions for the teachers included questions about their expectations of the candidates' pedagogical and content knowledge, the expertise that they feel the candidates bring to the classroom, areas of strengths and weakness, and questions about what teachers learned from the candidates. The informal interviews were conducted by faculty during observations and data was documented in meeting minutes or faculty reflection documents.

The timeline provided below clarifies the scope of data collection over the progression of the program:

Year 1: **Planning year**. During the first year of the program, a focus group was conducted with classroom teachers to gain input on the needs of novice teachers with a focus on schools as organizations, curriculum/content/instruction, technology, and professional development formats. Additionally, meeting notes and documentation from the planning committee provided us with data on our initial goals for the program, and how we approached setting up the program components (Cohort model, 1-year internship, Teacher/Teacher candidate interview selection process; Clinical faculty following the teacher candidates for the year).

Year 2: **Cohort one**. During the implementation of the program with the first cohort, we collected data from bi-monthly program faculty and staff meetings, journal entries from the authors, discussions with candidates about the program, visits and observations in classrooms, and a formal evaluation of the program (candidate surveys, teacher surveys, candidate outcomes).

Years 3–5: **Cohorts two through four**. Data collected included notes from bi-monthly program faculty and staff meetings, journal entries from authors, discussions with candidates, visits and observations during clinical, feedback from collaborative teachers, and a formal evaluation of the program.

Data Analysis

We analyzed the collected data inductively (Lincoln & Guba, 1984), looking for patterns throughout the various sources of data. Some of the data were already summarized from the program faculty meetings as we continuously examined and made changes to the program, and in yearly evaluation reports. We also re-examined data from our candidates to challenge and reframe our own reflection.

In addition, collaborations with other faculty members informed the data analysis to explicate the challenges and successes in implementing this program. We both read through faculty documents, candidate surveys and work samples, and teacher surveys. Themes were identified by the two authors individually, and then discussed with critical colleagues in the program for similarities and differences. Some themes

were confirmed through the discussions, and others changed as a result of the examination of critical colleagues.

Feldman (2003) suggests that self-study researchers improve validity and quality of their research through exploring multiple representations of their data into the narratives. We addressed trustworthiness of our representation mainly through the use of critical colleagues, who provided different perspectives in looking at the same data throughout the program development and implementation. As researchers, we revisited the data in an iterative manner and continued to clarify our own reflections through this process. As teacher educators in the program, we had varied theoretical commitments that framed our work. For example, one colleague challenged us to question our own assumptions about race through a perspective of critical race theory. In addition, practitioners in the program challenged how we viewed our role as university educators. These various perspectives from critical colleagues helped challenge our assumptions and reframe our perceptions of our own practice.

Findings

As we delved into the data collected, we decided to write narratives from our personal reflections, to put in perspective how our selves changed during this examination. We present these narratives first before discussing the themes that emerged from analyzing the various data sources and what we learned from them to improve our practice.

Narrative-Nidaa

Presented with the opportunity to design a teacher preparation program in secondary science and mathematics, I was elated to participate with colleagues in a community of practice to re-envision a school based program and to study teacher learning. I expected the process to be a transformative experience, for myself as a science teacher educator, and for our program as we redefine how we prepare teachers. The possibilities were remarkable. The constraints, while very much present, seemed surmountable. I was also excited to work with collaborative teachers as partners. I was tired by the discourse that presented the theory/practice divide where university faculty complained about the lack of best practices in the classroom, and teachers complained that university faculty lacked grounding in practice. I assumed that working together with teachers, we can create opportunities for learning for everyone involved: teacher educators, teachers, and teacher candidates. After all, "critical teachers must be seen as critical learners too" (Brookfield, 1995, p. 206). We are all learning in the process- teacher educators learning how to improve their practice, teachers learning from the candidates how to approach STEM teaching,

and how to mentor novice teachers, and teacher candidates learning how to become teachers of students who come from poverty.

Loughran (2007b) affirms that viewing the science teacher as learner cannot be separated from the teacher educator as learner. He further articulates that science teacher educators "challenge the taken-for granted in their practice" (p. 1059). Over several years of studying and revising the program, I wrestled with the tensions of the practical and the theoretical. Knowing that teacher educators are learners too, I found problematic the notion of adopting a "clinical model" without a critical stance to explicate the inherent meanings attributed to the value of experience- and the role of the teacher as critical learner. There seemed to be an assumption that I found problematic with the increased focus on a clinical model: first, the term brings baggage (clinical setting implying a deficit model- students as needing to be treated/fixed/cured…), and second, this stance implies the glorification of the value of experience.

Additionally, I found quite a bit of disconnect between the lives of the teacher candidates in the program, and the lives of their learners. Just as students learning science come to the classroom with their own preconceived ideas, teacher candidates engaging in different understandings of urban come with their own ideas of the world of students, teaching and learning. Many issues that surfaced in candidates' reflections, questions, or concerns during the program focused on trying to impose order in what they perceived to be a chaotic environment. In unpacking some of these concerns, I came to understand that they are as much about cultural differences as the perceived lack of classroom order. This was an example of how "in schools, colorblindness often obscures, while simultaneously fostering, deficit thinking, which is usually linked to membership in a racial minority or low economic status group" (Watson, 2011, p. 24).

I also found ourselves (science and math educators) lacking in the area of supporting minority candidates as they navigated the program. It is documented that we have an underrepresentation of minority teachers in the US (Ingersoll & May, 2011), and as a program, we were able to recruit a few. However, providing the same level of support to the minority students as to everyone else was not enough. A concerted effort was needed, which led me to question the complexities of asking novice teachers to connect with urban students and support their learning, when we may not be as successful in reaching and supporting minority teachers, even after purposefully recruiting them into the program. By focusing on meeting expectations of the program, we ended up obscuring race and "speak about students without explicitly revealing racial bias and to pretend that skin color is not important" (Watson, 2011, p. 24).

What have I learned? Through the process of making my reflections public, and holding myself accountable to my colleagues, my practices were transformed as I reflected on what I do and why I do it. For example, my science methods course used to focus on teaching science using inquiry, but the candidates in my classroom had somewhat limited opportunities to implement these practices, as the field experiences were limited to few hours a week. Working with candidates in a "lived experience" model, they were able to voice concerns about applicability of ideas

presented in class and challenge me to problem solve with them as they implemented those practices. I learned to value the perspectives that my students bring to the discussion and to use questions/disruptions of the given as opportunities for learning. More importantly, I grew to see my role as a learner and a problem solver, within a community of various perspectives, but who shares common goals, to build relationships with students so they can become scientifically literate.

Narrative-Gary

When I first arrived at the university, the program had been underway and the first cohort had been established. I knew little about the preparation and planning that occurred prior to my arrival but I quickly saw that the team was continually revisiting and revising the program. Monthly meetings (sometimes bi-monthly) and yearly reflections helped to fine-tune elements (such as supervision, mentoring, and professional development opportunities for the cohorts) and, I think, greatly improved upon a unique teacher preparation program. The collaborative nature of the university team and the collaborative teachers was especially enlightening. The program staff and faculty very much considered the feedback from the collaborating teachers, which quickly lead to changes in program components, and this seemed to make an impression on the teachers. Their opinions were valued and made impacts upon our own practice.

One thing that surprised me was that the teacher candidates at the beginning of the program did not seem to value the collaborative teachers as much as I thought they should. They seem to feel that they were they to help 'fix' the educational system and that the collaborative teachers were in need of help. This observation was noted at several points of the program and was addressed during the initial phases of following cohorts' programs. The idea that the collaborative teachers were mentors, experts, and resources, instead of being in need of help, began to be emphasized in the early coursework. This seemed to help change this mentality in the later cohorts. Another aspect that seemed to help was the close-knit university team. The clinical staff member would share observations with the faculty and candidate supervisors, allowing for a more unified approach throughout the program.

What have I learned? Such a program cannot survive without collaboration and effective communication. The collaborative teachers seemed to appreciate that their views and concerns were valued and contributed to the overall program. This was especially evident (to me) during the interview day for the fourth cohort. The large room was filled to capacity and the collaborative teachers from a number of schools and districts were eager to meet the new batch of teacher candidates. Careful consideration was taken when interviewing the candidates and when discussing where they should be placed. The teachers had a lot to say about each of the candidates and how they should be paired up for the upcoming teaching year. Over the years, the teachers became an integral part of the process and became more involved when interviewing all of the candidates. Their teaching experience and insight often gave

the program staff and faculty another perspective. Also, having been a part of the program over the years, the returning collaborative teachers knew exactly what to expect during the clinical year and offered advice to the newer teachers. They have proved to be an extremely valuable asset.

Themes That Emerged

One of the assumptions that we made as teacher educators when we designed the program was that there needs to be seamless integration between theory and practice, between what is learned in our methods courses, and what is learned in a K-12 classroom under the supervision of a mentor teacher. However, when we examined the data collected, emerging themes suggested some tensions between best practices emphasized in methods courses, and the realities of teaching. While some candidates were able to successfully implement inquiry science in their classes, others reverted to traditional lecture style in their teaching. While this phenomenon is not new or peculiar to our program, it caused us to examine what we are doing in our courses and in our program and to question our assumptions about the integration between ideas explored in coursework and practical experiences. In this section, we begin by presenting some themes that emerged from our examination of candidate data, and proceed to how these findings informed our practice.

But It's All About Classroom Management

We framed our course assignments in ways to encourage applications of best practices. For example, we embedded the course assignments in applications in the classroom setting, such as requiring the candidates to develop and teach inquiry lessons, and to develop a problem based learning unit that they teach to their students. We wanted the classroom discussion to focus on implementing best practices, but it often turned to classroom management issues. In our reflections, we noted a concern for controlling the classroom surfacing in candidates' questions, and conversations about best practices often turned to conversations about control. This was also clear in survey responses. For example, one candidate responded to the question about aspects of the program that supported becoming an effective teacher:

> *Instruction wise I feel that I am doing well. The classroom management portion I am still struggling with and I do not feel that I had good support from the University in this area. I do not feel that our classes adequately prepared us for classroom management. I am still trying to find my way of discipline because the students know that I am not a disciplinarian and therefore laugh when I issue a punishment. {Candidate survey response}*
>
> *I am left trying to teach with the class not in control, because my mentor never handled her class. I feel stuck with no support or understanding from anyone. {Candidate survey response}*

Some of these concerns can be tied to the candidate's uncertainty about working in urban environments. This view is exemplified in this quote from a candidate:

I also learned a great deal about the state of public education in urban environments. I believe my students will be better for having been in my class, I'm not sure how much but I think I had them doing the type of assignments, lessons, and projects that will serve them in future classes. Finding ways to motivate the underachievers and the apathetic students was very very challenging. Also, I have learned that the culture in many schools, including mine, just isn't conducive to closing achievement gaps and getting students to value education enough to change their mental approach to school. {Candidate survey response}

The turn of the classroom discussion to management and controlling students caused some frustrations for us. One of us resisted the turn of the discussion to how to control students. However, we realized as we examined the concerns of our students, that these concerns about order and control are not trivial. Rather than using theoretical work on rethinking what we mean by "managing the classroom", we began looking to use these incidences as problem solving activities. For example, we used an entry slip at the beginning of each class to make connections between the school experiences and course topics. As more of these entry slips focused on classroom management, we chose some questions weekly for class discussion, and encouraged our students to use readings, course activities, and discussions with mentor teachers to collectively problem solve the issues they brought up. While this strategy didn't resolve all the problems they identified, it allowed us to turn the discussions from venting activities to problem solving. Additionally, through discussions with critical colleagues, we explored with our students alternative perspectives. Rather than viewing issues of "lack of classroom control" as a problem of limited experience in the classroom, we were challenged to examine how the presentation of "classroom management concerns" obscure power relations in a classroom where students and teachers come from different cultural backgrounds.

Tensions Between Replicating Teacher-Centered Practices and Implementing Creative Pedagogies

One concern that emerged from our reflection, and that we saw the candidates express frequently, is the mismatch between the discussions of best practices and the observations and expectations in the classroom. This was definitely exasperated by the increase in the focus on testing that we are currently witnessing in schools. While this was not apparent for every classroom placement, it was nonetheless a concern, and it continued throughout the years of implementation. For example:

Many of [the candidates] are working with teachers who have the exact opposite viewpoints of the [program]. {Candidate survey response}

The teachers also complained about having the candidates leave their classrooms for coursework and questioned the value of taking courses on the college campus, when it means that the candidates lose time in their classrooms. The teachers were questioning where the expertise/learning should be happening, which speaks to the

issues of power in the relationships of faculty, collaborative teacher, and teacher candidate.

> *[They] seem bogged down with so much course work to fully give their attention to the classroom. {Collaborative Teacher survey response}*
>
> *No classwork during this semester, it's too overwhelming with everything else that we need to do. {Candidate survey response}*

The candidates were in a sense left with negotiating authority (Britzman, 2003), such that the tension between university expectations and classroom practice is really due to the challenge that they are visiting in someone's else classroom and are attempting to assert their teaching style, while also respecting a classroom culture that has been established. They felt a tension between expectations from faculty, and expectations from teachers. When the two expectations were aligned, the candidates flourished. When there was a mismatch, negotiations were often necessary in order to ensure candidate success.

As this issue unfolded in our reflections at the beginning of implementation of the program, we began offering professional development opportunities for both candidates and teachers, so that they were working together on common instructional approaches. We also acknowledged the demands that the program imposed on the candidates, and changed the framing of some of the assignments.

Relationship Building

The most positive aspect that was reflected in examining our practices in the program, was the essential role of building relationships with schools. One way this was emphasized was through the connections with the clinical faculty, who perceived herself as a bridge between what was learned in methods courses and what can be happening in the classroom. In this program, the clinical faculty member was a STEM educator who was also a career changer (from engineering) and she shared a similar background with the candidates. For example, one candidate mentioned:

> *I have learned the most from my interactions with [Clinical faculty], where she observes my work and provides direct, actionable feedback that I can apply quickly to improve my performance in the classroom. {Candidate survey response}*

Visiting classrooms several days a week, and continuing the process over the full year, she was able to establish relationships with the teachers and provide an invaluable lens in weekly faculty meetings. It wasn't feasible to bring the teachers to our weekly meetings, but it seemed that their voice was represented, as well as the voice of the candidates. In several meetings, she questioned assumptions we made about what can be implemented in the classroom. While many programs have a role for a clinical faculty member who supervises candidates more closely, it is not always the case that that person is engaged in critical reflection with other faculty members. Building time for critical reflection was a powerful component to establish relationships and foster collaboration.

Teacher Candidates as Change Agents

One of the stated goals of our program was to prepare teacher leaders, who can be transformative agents in their buildings. Some teachers viewed the teacher candidates as an apprentice (or in some cases, a burden), while others found value in a career changer bringing that experience to the secondary classroom. For example, the clinical faculty member notes in one of her reflections: "*The collaborative teachers are using a model of* '*what I do with a student teacher*' *from what I observe in the field*." And a collaborative teacher stated:

> It is a big responsibility having her there all the time. Yet, that is exactly what is needed to immerse her fully. So, it is not a complaint – it is just more time consuming on my part – during lunch, during my free period, etc. {Collaborative Teacher survey response}

However, when the relationship worked, it resulted in very meaningful and innovative classroom experiences, as two teachers (novice/expert) collaborated on novel ideas. For example, several candidates designed and implemented problem based units that were successful in the classroom. The success of the collaboration was evident by comments from teachers that they learned new strategies from the candidates, or that they wouldn't have attempted an idea if they didn't have them in the classroom. We also saw evidence in comments during the candidate-teacher interview day, when teachers were disappointed when they didn't get a candidate as an intern for the year due to having a larger numbers of teachers than candidates. In one instance, one of our graduates from the first cohort served as a mentor for a new candidate. Together, they reinvented how the science curriculum was structured, so that it became more focused on mastery learning, and allowing each student to work at his or own pace, with the teacher in the classroom focusing their attention on students who need them the most, and allowing peers to help each other. We examined this specific collaboration in our reflection: is this an anomaly due to the personalities of the two individuals? Would having our own graduates serve as mentors lead to better collaboration possibly due to similar perspectives on best practices? This can be seen as an anomaly, as teacher development can be idiosyncratic (Bullough, 2008), but what can we learn from successful cases for future changes in the program?

A few ideas emerged from this reflection that we are hoping to use in the future. We learned from these examples that approaching the traditional student teaching experience as a collaboration/co-teaching model is very important, but that we need to work more closely with the teachers to reframe this experience. Some of our candidates are going to need a lot of support, and the mentor teachers will be focusing on helping them grow. Other candidates bring outside expertise and intense motivation, and can work as partners with their teachers. In these cases, we can begin to focus our collaboration on working towards K-12 student success. More importantly, we also changed our thinking from focusing on candidates as agents of change, to examining our role as capable of being an agent of change.

The process of critical reflection was instrumental in making revisions throughout the years of implementing the program. The themes listed above were the main

drivers of some of the changes we made throughout the years. For example, while Cohort 1 was finishing their program, the team revisited the program expectations and coursework and decided to enhance the focus on pedagogical knowledge of STEM education. In addition, the team decided to provide more formative assessment opportunities in order to support the learning of the candidates. It also became clear that providing support for certification and employment opportunities earlier in the program would be beneficial to candidates. Ensuring successful clinical experiences required strengthening the support system with more site visits and concrete feedback.

These discussions continued while Cohort Two through Four progressed through the program. In particular, at the beginning, the summer course workload was restructured in order to improve candidates' learning experience. Providing more instructional materials or resources was another area for improvement. For example, professional development about Problem Based Learning was provided and resources were available in order to assist with the teaching of lessons. Since there were individuals from the various cohorts eventually obtained jobs as classroom teachers, there was the addition of virtual and onsite mentors for them as well.

Discussion

Loughran (2007a) affirms that self-study research requires evidence of transformation of practice, a need for interaction with colleagues and the literature, in addition to the need of researchers to interrogate assumptions and values. The process of engaging in self-study resulted in changes in our practices, with the collaborative reflection being a key driver of change. We also worked on challenging our assumptions about teaching and about designing components of the program. We outline below the main ideas that this self-study helped us bring to the forefront for ourselves and for others in our program. These issues are also important in the national discussions on preparing teachers.

Problematizing Experience

> *I know that even though she is anxious to please and learn – she doesn't have the comfort in front of the class. I have tried to help her with this, to encourage her – but I think it is just going to have to come with experience. {Teacher Survey Response}*

What does it mean to learn from experience? This was a theme that recurred throughout our study, and in our collective reflections on the program. Through various data sources, the theme of learning from experience emerged. Brookfield (1995) affirms, "Teachers have a choice either to work in ways that legitimize and reinforce the status quo or in ways that liberate and transform the possibilities people see in their lives" (p. 209).

This theme of transformation and possibilities applies to teacher candidates learning to teach, as well as to us, as science educators working with these candidates. Turning inwards, we examined how our own practice is legitimizing the status quo- that of viewing classroom experience as learning by osmosis- and how we can "work with the cultural and cognitive complexities represented by students' varying personalities, learning styles, genders, developmental levels, ideologies, and backgrounds" (p. 209). Through modifying requirements in our courses, we achieved some degree of success in challenging assumptions about "practical experience". More specifically, making concerted efforts to raise questions about the meaning of experience, and structure candidate reflections to explicitly question the practices they observe. We are also approaching the application of best practices as a collaborative effort. Rather than our candidates trying strategies (such as science inquiry, PBL, etc.) on their own, we are involving the teachers in implementing innovative approaches, through offering professional development activities to both groups.

Reflecting on the Meaning of "Urban"

The second theme that was front and central in our thinking about our practice was reflecting on the meaning of teaching in urban environment. Our candidates framing of the meaning of "urban" is not peculiar to the context of our program. In a study with novice teachers in urban schools, Watson (2011) found that while teachers expressed an interest in teaching in urban schools,

> They did not all necessarily want to teach who they defined as urban students. Those teachers who did not want to teach "typical" urban students desired to teach … "urban, but not too urban" students or in … an "urbanesque" school. These students were perceived as having cultural and symbolic resources that were more in line with those of suburban students. More specifically, these teachers wanted to teach students of color who exhibited their perceptions of middle-class-ness. (p. 31)

This anxiety about the environment where candidates were working can also be linked to their own background (which is also connected to race, gender, and class). In her reflection, the clinical faculty member noted that the candidates have been very successful in traditional environment. They were successful engineers, or chemists, or honors science graduates. They were able to succeed in traditional environment and therefore are having a hard time adjusting to a different culture. This is consistent with other research on STEM career changers (Grier & Johnston, 2012), which affirms that they contribute valuable experiences to the classroom, but also present challenges that are unique to this population.

This is an area that we still have more questions than answers. Turning the critical eye towards our practice, we are questioning how our program is serving the needs of minority candidates, who sometimes find the program requirements very challenging. As more calls for diversifying the teaching force (especially in the

STEM areas) are being made, we need to examine how our traditional teacher preparation programs are serving the needs of diverse candidates.

Establishing a Community of Educators-Learners

One of the questions that we began this study with focused on how we can work with practicing teachers to improve our own practice in preparing novice teachers. However, collaboration can bring tensions and challenges. For example, one of us experienced an encounter recently when a veteran teacher told a group of teacher candidates to forget everything they were taught in college, as it doesn't begin to prepare them for the realities of the classroom (the veteran teacher proceeded to apologize to me for making this comment in my presence, but he had to make the point!). We know this is a cliché, but we wanted to highlight this incident to frame and question our assumptions about collaboration. There are instances when collaborations work very well, but we also work with teachers who have very different ideas about good practices than we do. It would be easy to dismiss these teachers and move on to find new collaborators, but it is important to ask what we can learn from colleagues and teachers who have very different theoretical commitments than we do.

One of the approaches that we challenged ourselves to adopt was to shift the conversation to focus on problem solving. In other words, how do we use the various perspectives at the table-teacher educators, teachers, teacher candidates- to collaborate on investigating approaches to solve problems related to teaching and learning science in difficult classrooms. The example provided above with the teacher candidate and mentor teacher working together to rethink the science classrooms illustrates this approach, and while it is one instance, it offers a possibility of what can be accomplished with a fruitful collaboration.

Conclusion

What have we learned from this self-study about preparing teacher candidates in a school-based (clinical) model? As teacher education programs are being asked to move towards clinical models (CAEP), it is necessary to understand the types of experiences that lead to transformation, rather than replicating the status quo. Our goal for engaging in the process of self-study over the past 3 years was to explore how we can, as teacher educators, bridge the gap between the status quo and the possible. We began with questions such as what is the value of intensive school based experiences or internships? How much is enough? How do coursework build on school experiences? And how can experiences inform theory? Engaging in self-study allowed us to reframe the meanings of school based experiences, and taking a more critical stance on how these experiences socialize candidates into the roles of

teachers. We also began to examine how we can see our role as agents of change in more practical ways.

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