

The development of adaptive expertise practices: Results of a STEM teacher preparation
program case study

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Abstract

Given recent shifts of the nation's overall racial composition and relatively stagnant teacher demographics (NCES, 2013), teacher preparation programs are beginning to fall short at preparing tomorrow's teacher (Sleeter, 2001; Siwatu, 2011). Therefore, this study explores the development of adaptive expertise practices for four prospective teachers who were placed in urban and high need schools during field experiences. Using a case study approach to pilot content analysis procedures, results were generated to gain a greater understanding of the different modes of adaptive expertise cultivation within an urban context. First, the four individual cases were reported separately to highlight the unique processes associated with acquisition of adaptive practices. In a comprehensive examination of the teachers' experiences, researchers found that all four teachers exhibited basic epistemic and dispositional aspects of adaptive expertise early in the program such as epistemic distance and case sensitivity. Higher-level learning, such as cognitive and metacognitive processes, were accomplished through opportunities within their field placements. Since this is a pilot study, more research is needed to determine if this information is translatable to other teacher preparation programs geared at preparing teachers for urban environments.

Introduction

The United States is projected to experience major demographic shifts over the next 50 years. Presently, non-Hispanic whites are considered the majority of the population as it is the largest racial group and comprises more than 50% of the nation's population. In 2044, a majority-minority crossover is expected to occur in which non-Hispanic whites will no longer be considered the largest racial group. By 2060, non-Hispanic whites are estimated to only represent 44% of the total population (Colby & Ortman, 2014). These changes are largely due to shifts in immigration laws, increased birth rates of minorities, and social transformations such as increased interracial relationships (Humes, Jones, & Ramirez, 2011; Wang, 2012; Hatton, 2015). While the nation is expected to see this change in the future, this majority-minority crossover is already occurring in younger generations. Currently, American public schools are entering into a new demographic era. According to the National Center for Education Statistics (NCES, 2013), the number of Hispanic (25.75%), African-American (15.43%), Asian (5.16%), American Indian (1.06%), and multiracial students (2.82%) in public K-12 classrooms are expected to outnumber non-Hispanic whites (49.78%) by 2014. However, this change does not mean that all U.S. schools are becoming more diverse.

Trends in the nation's school enrollment have drastically changed since 1968. As a nation, white enrollment has decreased 27%, while black and Latino enrollment has increased by 1% and 18%, respectively (Orfield, 1983; NCES, 2012). Yet, the typical white student is still enrolled in schools where the racial composition is predominantly white, Latino and black students are typically in schools where their classmates are black or Latino, and Asian students experience schools largely white or Asian (NCES, 2012). In the most populated urban areas,

Latinos account for the largest enrollment with 42% (Orfield, Frankenberg, Ee, & Kuscera, 2014). The suburban rings around metropolitan areas, which were historically white schools, are now only half white with those numbers declining. As a result, areas once considered a “chocolate city, vanilla suburb” are now a “diverse multi-hued city and checkerboard suburbs” (Orfield et al., 2014, p. 13). Understanding these trends is critical for teachers entering into these working environments and the teacher preparation programs who aim to adequately prepare them.

Though there have been notable changes in the demographics of the nation’s youth, the majority of science and mathematics teachers have remained relatively stable. According to the most recent National Center for Education Statistics (2013) report on public schools 9-12 grade, natural science teacher demographics were majorly White (84.5%) and female (53.6%). Mathematics teachers had similar compositions with white and female teachers at 81.5% and 57.3%, respectively (NCES, 2013). Further, many White Americans live in communities and attend schools with low numbers of culturally and linguistically diverse persons. Therefore, many of America’s public school teachers likely have not had previous experiences in high-minority or high-poverty school systems (Hollins & Guzman, 2005). In addition, Whipp and Geroime (2015) found that teachers tend to work closely to where they grew up and in schools similar to the ones they attended. This presents an array of issues for the profession, such as increased attrition rates in high-minority and high-poverty schools as well as feelings of unpreparedness to teach in urban settings (Chizhik, 2003, Dill & Stafford-Johnson, 2003; McKinney, Haberman, Stafford-Johnson, & Robinson, 2008; Siwatu, 2011).

Preparing novice teachers for all classroom contexts, including urban settings, has traditionally fallen to teacher preparation programs with limited success. Influenced by Dewey

(1938), an important component for most teacher preparation programs is the use of field experiences. Many programs use this experience as an opportunity for teachers to practice teaching skills, gain pedagogical knowledge, and connect theory to practice (Liaw, 2009; Maistre & Paré, 2010). However, researchers are beginning to express a growing concern for the nature of pre-service teachers' field placements and whether they are structured in ways that would successfully assist the development of teachers who are able to effectively teach in urban classrooms (Haberman, 1996; Knoblauch & Woolfolk Hoy, 2008; Siwatu, 2011). For instance, Ladson-Billings (2000) found that most field experiences occurred in schools not reflective of the cultural or linguistic diversity within our nation. Further, Sleeter (2001) stated that most pre-service field placements occurred in White, middle-class communities that are similar to the teachers' childhood. Therefore, when teachers are placed in urban schools and witness the challenges inherent to those communities, they feel less prepared and confident (Sleeter, 2001; Siwatu 2011).

More recent research examines the efforts by teacher preparation programs to increase candidates' multicultural awareness and sensitivity by requiring coursework in multiculturalism and field experiences in high needs schools. Sleeter's (2008) research points to the success of a three pronged approach that combines coursework that specifically nurtures cross-cultural awareness, school-based field experiences in a culturally diverse setting, and community-based field experiences in a cross-cultural setting. She contends that all three are usually necessary for Whites to transcend the deficit perspectives, diminished expectations, diversity blindness, and dominant pedagogies – all born of lifelong socialization and cultural isolation – that stand in the way of effectively teaching underserved populations (Goff, Matkins & McDonnough, 2014).

It is important to note that models developed for teacher preparation programs should be built on theories that guide the evaluation of prospective teachers' knowledge and performance. Since a major concern for preparing teachers for urban contexts involves their inexperience in these environments, a theory must embody the efficient and innovative use of knowledge. According to Hammerness, Darling-Hammond, & Bransford (2005) adaptive expertise is described as the "gold standard for becoming a professional" when the focus on changing realities of practice is a continuing necessity for teachers (p. 360). More specifically, this conceptual framework embraces the need for deepening knowledge and developing adaptive practices when previous experiences have left the teacher with inadequate skills and abilities. Given the majority of teacher candidate backgrounds are not in urban contexts, successful teachers in these environments must acknowledge their deficiencies and learn how to approach novel problems.

Theoretical Framework

Today's constantly evolving classrooms, especially in urban settings, demand teaching expertise in content and pedagogical knowledge as well as considerations for how those skills relate to the teacher, students, and classroom circumstance. Therefore, the traditional term *expert*, used to describe the level of teaching experience, is not always relevant. According to Hatano and Inagaki (1986), the terms *expert* or *expertise* relates to the acquisition of knowledge across collective experiences. In order to recognize the complex and variable acquisition of becoming an expert of teaching, Hatano and Inagaki (1986) contrast between two distinctive knowledge domains known as *routine* and *adaptive* expertise.

Regarding Hatano and Inagaki's (1986) framework, the focus for routine experts is to be proficient at performing a specific set of skills in response to familiar challenges. The situational

characteristics associated with routine expertise often allows for high level functioning in a stable environment, also known as efficiency. Unfortunately, this alone is becoming increasingly insufficient for the ever-changing classrooms of our nation (Bransford, Derry, Berliner, & Hammerness, 2005; Hatano & Inagaki, 1986; Inagaki & Miyake, 2007). These teachers can be limited by inflexibility, overconfidence, and bias in their particular context (De Arment, Reed, & Wetzel, 2013). As classroom environments are constantly transforming, teachers must have habits of mind and the skills necessary to navigate those changes (Crawford, Schlager, Toyama, Riel, & Vahey, 2005). According to Lin and VanderPutten (2007), students, particularly those in urban settings, are extremely diverse in the values that they bring and the ways these values develop within the classroom. As a result, teachers need to develop an adaptiveness that recognizes when general rules and principles do not apply to problems or situations at hand.

Unlike routine experts, teachers with adaptive expertise demonstrate the ability to be flexible and innovative in their application of procedural knowledge (Hatano & Inagaki, 1986). According to Crawford and colleagues (2005), adaptive experts present a creative approach to problem solving and the construction of knowledge rather than the simple application of knowledge (Crawford, 2005). For instance, teachers may engage with students from different cultural backgrounds; therefore, these teachers must be proficient in judging when their own levels of understanding are no longer adequate (National Research Council, 2000). In a sense, adaptive experts must improve on their procedural knowledge to find better solutions to problems within practice (De Arment et al., 2013; Hammerness et al., 2005). Thus, developing adaptive practices becomes extremely beneficial for teachers employed in unfamiliar settings.

Crawford et al. (2005) believe that understanding the development of adaptive expertise can help researchers gain insights into the innovative processes associated with teacher learning,

which are vital for teachers of the 21st century. Therefore, they developed a framework that comprises two main aspects of adaptive expertise: (1) epistemic and dispositional aspects of adaptiveness and (2) adaptive cognitive and metacognitive processes. According to this theory, epistemic and dispositional aspects of adaptiveness refer to the characteristics of the teacher as knower. Specifically, does the teacher possess the skills and frame of mind necessary to recognize that prior knowledge and experiences do not apply to a current situation. Regarding the second component of this theory, adaptive cognitive and metacognitive processes refer to the ability to seek, monitor, and assess feedback about problem-solving processes and outcomes. This assessment allows one to accurately judge the adequacy of current knowledge, search or seek new information when necessary, and problem solve. The specific dispositions, skills, and processes used to address these two components of adaptive expertise, as conceptualized by Crawford et al. (2005), are summarized in Table 1.

Table 1. Aspects of Adaptive Expertise

Epistemic and Dispositional Aspects of Adaptiveness	Adaptive Cognitive and Metacognitive Processes
<ul style="list-style-type: none"> ● Maintain an epistemic distance between prior knowledge and model of a case or problem at hand ● An epistemic stance that views the world as complex, messy, irregular, dynamic, etc. ● Comfort or willingness to reveal and work at the limits of one's knowledge and skill ● An inclination toward learning rather than merely applying knowledge 	<ul style="list-style-type: none"> ● Data-oriented forward reasoning (hypothesis-based reasoning) ● Causal reasoning ● Seeking and analyzing feedback about problem-solving processes and outcomes ● Monitoring results and performance ● Monitoring own learning ● Assessing own knowledge states ● Assessing adequacy of current knowledge for solving case at hand

Note: Table from Crawford et al. (2005)

According to Crawford et al. (2005), adaptive epistemic distance and dispositional aspects of adaptiveness require three important features. First, adaptive reasoning and problem solving involves maintaining epistemic distance between the evidence or situation and prior knowledge. Therefore, a teacher must not assume that his or her current knowledge is adequate for the case at hand. Instead, one must be “able to reframe the problem as new information emerges and is able to recognize where her current knowledge may not be adequate” (Crawford et al., 2005, p. 7). Second, an individual must be alert to the unique characteristics of a given problem, case, or set of data, also known as case sensitivity. This knowledge allows the teacher to view the world in a complex manner and to understand that each case will not be the same as prior or similar cases. Finally, metacognitive skills are needed to recognize where one’s current knowledge is no longer adequate for the situation. This means that the teacher must reveal that he or she does not know something and must treat the given problem as an opportunity to learn. According to Crawford et al. (2005), epistemic and dispositional aspects of adaptiveness characterize the adaptive cognitive and metacognitive processes required for adaptive reasoning.

Given the focus on problem solving, Crawford and colleagues (2005) conceptualize the components of cognitive and metacognitive processes into four forms: (1) data-driven forward reasoning, (2) causal reasoning, (3) cognitive flexibility, and (4) self-regulation. These features emphasize the importance of exploring relevant data and evidence to make conclusions about the particular case. First, data-driven forward reasoning refers to the teacher’s ability to make and revise tentative hypotheses based on a string of data and observations before a conclusion is made. Second, teachers must “formulate a specific model underlying the problem or a deep functional representation of the causal components of the problem” when utilizing causal reasoning in adaptive practice (Crawford et al., 2005, p. 8). Third, teachers must exhibit signs of

cognitive flexibility, meaning they consider multiple hypotheses of a problem and change their problem solving strategy in light of new information. Finally, teachers must monitor their new knowledge through self-regulation. This means teachers are self-aware of their progress or lack of knowledge by monitoring results, performance, personal knowledge states, and adequacy of new knowledge for solving the case at hand. These epistemic dispositions and cognitive and metacognitive stances characterize an *adaptive* orientation.

In conclusion, routine experts draw conclusions based on limited exploration of the situation and apply current knowledge to a case. Although using previous knowledge is important, these teachers rarely build on new knowledge or learn from the problem. Unfortunately, being a routine expert is not sufficient for the ever-changing schools, especially within urban systems. Adaptive experts, on the other hand, systematically explore and review data to effectively form hypotheses to draw conclusions about a particular case. These teachers are willing to acknowledge the limits of their knowledge and seek out possible solutions to learn from the experience. Therefore, adaptive experts are highly needed in the constantly evolving K-12 school systems within the United States.

Study Purpose

In light of the data showcasing the inadequacies of preparing teachers for urban schools, it is necessary to understand how urban and diverse field placements, in conjunction with multicultural coursework, puts prospective teachers on a trajectory to be successful. By exploring these field placements, researchers can better understand how teachers can adapt and become successful at teaching in environments dissimilar to their own experiences. Therefore, this pilot study used the adaptive expertise lens to explore underlying mechanisms - the skills, dispositions, and abilities - that are necessary for teachers to push past inadequacies and excel in

urban environments. To guide this exploratory study, the following research question was generated:

1. In what ways does our program cultivate adaptive practices in our mathematics and science pre-service teachers?

Methods

To gain knowledge regarding the development of adaptive practices for pre-service teachers in high need schools, data was examined retrospectively using a subset of data generated from a larger longitudinal research study. The purpose of this design was to pilot data analysis procedures on a smaller scale in preparation for a later study, which will incorporate a larger sample of participants (Polit, Beck, & Hungler, 2001). By piloting the analytical methods involved with this study, the rendered findings regarding the development of adaptive expertise practices will be further validated with future research.

This study adopted a qualitative methodology to address the research question. Specifically, this study used a case study approach (Creswell, 2013). The case study design was selected to provide an in-depth understanding of how four pre-service teachers harness adaptive practices while student teaching in urban high need schools. Further, the selection of four cases allowed for a comparison of varying experiences and across multiple urban school contexts (Creswell, 2014). In this study, each case was individually explored and then a comparison of all cases' similarities and differences regarding the development of adaptive expertise practices were generated for discussion (Gerring, 2007).

Program Description

Preparing teacher candidates with a strong foundation in both content and pedagogical knowledge is a mission of this Mid-Atlantic, urban university. More specifically, the Masters of

Teaching (M.T.) secondary mathematics and science programs (grades 6-12) are designed to harness this conceptual framework through coursework and field experiences. The program is opened to undergraduate students seeking a bachelor's degree in mathematics or a science (biology, physics, chemistry, etc.) and master's degree in teaching. Post-baccalaureate candidates with degrees in mathematics or science are also accepted into the program for obtainment of a master's degree in teaching. The M.T. program takes approximately 15 months to complete all required coursework, practicum, and student teaching experiences. At present, the vast majority of participants in the M.T. secondary science and mathematics programs are funded with the National Science Foundation's (NSF) Noyce scholarship.

The Robert Noyce scholarship program was developed to provide secondary science and mathematics teaching candidates with a rich conceptual understanding of the research, theory, and practice behind effective teaching in high need schools. According to NSF (2014), a high need school is defined as any school meeting at least one of the following criteria: "a high percentage of individuals from families with incomes below the poverty line; a high percentage of secondary school teachers not teaching in the content area in which they were trained to teach; or a high teacher turnover rate" (p.5). This particular Noyce scholarship program required multicultural coursework as well as practicum and student teaching placements in urban, high need schools. The purpose of this design was to provide teacher candidates with foundational knowledge for working in diverse and urban settings. For all field placements, teachers were placed with a specially trained teacher of high-poverty and high-minority students for one complete academic year.

Participants

The teachers sampled for this study were enrolled in a secondary science or mathematics Masters of Teaching (M.T.) program during the 2014-2015 academic school year. During this time, all participants received Noyce scholarship funding and were assigned to a yearlong practicum and student teaching placement at a local, urban high need school. Pseudonyms were used for the three female participants (i.e., Sahara, Denae, and Mamba) and one male participant (i.e., Dexter). Sahara was the only African-American participant, whereas, Denae, Mamba, and Dexter were Caucasian. The participants' ages at the beginning of enrollment were 27, 27, 23, and 25, respectively. Two math teachers and two science teachers were purposefully sampled for this study. The two math teachers (i.e., Mamba and Dexter) were selected because they were the only two M.T. program completers receiving Noyce funding during the 2014-2015 academic year. Since there were more science completers, the two science teachers (i.e., Sahara and Denae) were used to represent variations in personal histories, race, and previous teaching experience. Similarly to the math teachers in this study, the science teachers also completed the M.T. program and received Noyce scholarship funding during the 2014-2015 academic year.

Data Collection

In addition to the responsibilities associated with the teacher preparation program (e.g., coursework, practicum, and student teaching), teachers were asked to participate in semi-structured interviews over the 2014-2015 academic year. To gain an understanding of any changes in their teaching practices over time, the first (pre; August 2014) and final (post; May 2015) interviews were used for this pilot case study, totaling eight interviews. The interviews were conducted by the same graduate research assistant and in the same location. The interviews lasted approximately 30 minutes and covered various topics regarding teaching practices and

perceptions of high need schools. To elicit responses, open-ended questions were used.

Examples of questions include: what is your ideal approach to teaching a topic in their content area; what have you included or what would you include to meet the needs of high need students; and describe challenges you think you may face in a high need school?

Data Analysis

Interview transcripts were gathered and organized using the software program Atlas.ti. Content analysis was guided using key concepts from prior literature (i.e., Crawford et. al, 2005). First, one researcher examined potential variables within the existing theory of adaptive expertise and identified initial coding categories (Potter & Levine-Donnerstein, 1999). A detailed codebook was developed including two categories (i.e., Epistemic/Dispositional Aspects of Adaptiveness and Adaptive Cognitive/Metacognitive Processes), operationalized definitions, and five sub codes (i.e., epistemic distance, case sensitivity, metacognitive skills, cognitive processes, and metacognitive processes) with their dispositions/skills/processes and clarifications.

The next step of analysis included three researchers reading through the four participants' post-interviews. Later, each researcher independently coded the post-data using the deductive codes. Any codes that could not be categorized in the initial coding scheme were given an open code (Hsieh & Shannon, 2005). After each post-interview was separately coded, all three researchers met to discuss any coding discrepancies and came to convergence on the data. Based on mutual coding of the post-interviews, the first researcher coded the pre-interviews and analyzed the results against the post-interview findings for consistency. Once the first researcher wrote the four cases' results, the findings were given to the other two researchers for feedback. This peer debriefing process was used to increase study credibility (Creswell & Miller, 2000;

Shenton, 2004). After individual cases were examined and reported, all data was organized and presented in the discussion section.

Results

Findings from each pre-service teacher will be presented separately to illustrate the unique development of adaptive expertise practices in high need schools. The four cases will be pulled together for a more comprehensive discussion.

Sahara: *It's been a learning process for me, but I think now that I understand where the differences lie for me I will be okay.*

Sahara is an African-American physics teacher who has no prior experience teaching. Although she shares the same race as many of her students, she grew up in a very different school environment. Throughout the yearlong placement in a high need school, Sahara verbalized how her personal experiences were unlike her current educational experiences:

They've got a billion things, which most high schoolers do, but this is a different kind of billion things. They are real life problems that they are dealing with, not necessarily sports and clubs, you know school activities, [they have] things outside of school that makes them have to grow up really fast.

Sahara learned quickly that students in high need schools feel “grown up” and she found it challenging to have them follow classroom rules. She mentioned, “the way they [students] talk to teachers is different, which a lot of that stuff just wouldn't be tolerated in a non-high need school.” By the end of the year, Sahara accepted these differences and learned how to interact with students from different backgrounds. When asked about why she still wanted to become a teacher in a high need school, she replied:

I've had students with that I would consider really bad attitudes, but mostly because that's not how I grew up...For me just being able to still accept that and to still feel like I teach them and reach them in some kind of way, that's one thing that solidified it.

Sahara attributes some of this understanding to conversations with and observations of her cooperating teacher (CT). Early in the school year, she reflected on an interaction between her CT and the students:

Her mannerisms around them and pet names for them I feel like are reminiscent of their home life...I think someone raised their hand to ask a question and she's like, 'yes babe.' Like, 'babe' was something I never heard in school and I know if I heard it, it would have been weird to hear from a teacher, but that's what you hear at home and that's what you would hear from your loved ones.

Further, Sahara's CT "opened her eyes" to how student learning, especially in high need settings, can be very different than her personal learning processes.

I am more of a traditional learner. So if you just put something in front of me, I'll just read it and be independent and good to go. My students need more time. They need more visual demonstration. Yeah it's in front of them and they can read it, but they won't understand exactly what the procedure is for the lab. So I've added a lot more modeling, a lot more diagrams, just things where they won't have to – where they can see it in a different way.

These conversations with her supervisor caused Sahara to adjust her instruction to better fit the needs of her students. By her final interview, she was willing to try new teaching practices, but understands that teaching is a process. She stated, "I've learned where, like what, my

strengths are and what my weaknesses are. I feel like it's okay to not be a completely perfect teacher at this point in my career.”

Summarizing these extracts from Sahara, we can see that she was very aware of how her personal experiences do not apply to the context of a high need school. Through the guidance of others in the school, she improved upon her knowledge of that setting and learned how to teach within that environment.

Denae: I had to write them [surprising realizations] down through the year where it's like I wouldn't have thought this was a big deal, but it is a big deal.

Placement in a high need district during her field placement is Denae's first experience in a public school. She is a science teacher with a biology concentration. Before enrolling in this program, Denae worked for five years at a private school as a science teacher. At the beginning of the school year, she was aware that her current students would be different than the students at her private, rural school. Mainly, she imagined that she would have to change instruction to incorporate different student interests. It was not until the end of the year that she expressed understandings of how interacting with students in an urban, high need school is different:

In other backgrounds I've been in, the teacher got respect. It might not be respect inside of the person, but at least outwardly the teacher was respected...whereas these guys [urban high need students] need to know that you care before, with many of them, you get any work or results.

Denae was able to use this knowledge to get her students more academically involved in the classroom. Once she developed a rapport with her students, she was able to start building respect:

Respect is very important for them and their respect sometimes looks a little funny. If they know that you are respecting them as a person and respecting what they think, their time, and their space...they return it. That's a huge part of getting them to vocalize in the classroom, to open in the classroom.

According to Denaë, respect was not the only difference she noticed between the students in private, rural schools and those attending public, urban, and high need schools. After a year in of student teaching, she began to realize that students in high need schools are missing critical content knowledge needed to teach higher-level science concepts. In her final interview she stated:

Understanding the breath, the incredible breath of knowledge they do not have, which you would just assume that they have, like pretty common knowledge, things somewhere else you usually pick up and know...sometimes being very surprised, but trying to find out where they are with those things...because you can't teach them the content you are trying to teach them.

To help keep track of the pieces lacking in her students' foundational knowledge, she mentioned keeping an ongoing journal. She writes down every time a student says something that she thought everyone knew and she "notes that for coming years because if they don't know that then the rest of it doesn't make any sense." For her, this is important for coming years as she anticipates continuing to teach in a high need school:

They don't have some foundational piece of knowledge that you think they did, like knowing where the Atlantic Ocean is, for instance. So that is definitely a challenge...that's a challenge in designing the curriculum, designing how you are putting

things together...making sure that you are incorporating space and time for those realizations, so you can correct them along the way as much as possible.

Denae was also sensitive to the individual differences within her high need setting. She varied her teaching approach by class period to incorporate the unique learning styles of each class. Although her second and eighth periods were both general biology courses, she managed and structured each class differently. In her final interview, she described her teaching method for her second period:

I gave the kids the opportunity to give the feedback on what they would like to learn and they said I would like to do real labs... I said, okay if these are the things that we want to do, these are the things that need to happen in the classroom to have the time and so I know that we will be safe and all of these different things and they responded really well to that.

If the students in her second period class begin to lose focus, Denae responds by saying, "Hey we are not getting through this and we really need to get through this right now so I need your attention, you need to focus." Consequences for disruptions are built into her classroom structure. She said, "we have classroom breaks and they know that, so if they are not cooperating, like we are just not getting anywhere...our break goes away and they know that."

Unlike her second period, Denae's eighth period is considered "reluctant learners." This inclusion class, which occurs after lunch, is full of students who will "cuss the teacher out, periodically, or a friend or shout it across the classroom for no apparent reason." To maintain engagement in this class and avoid the students "shutting down", Denae describes her eighth period lesson structure:

I have a collab teacher in there and when it is possible, we split the class into smaller groups to help us be able to help the kids with their varying reading needs, small group needs, focus needs, and attention needs. We need to take more breaks, so we try to do a lot of, instead of one 5 minute break, we do like two 2-minute breaks, just every time that we complete something we celebrate by taking a break.

Regardless of class period, Denae shared her enthusiasm about teaching these students. In her opinion, urban students in high need schools are more fun to teach than others. She said the excitement to teach these students is different because, “There is a different kind of excitement about being successful, that’s really what it is, it seems like they haven’t had that opportunity so much and providing it is great.” Although she may have to take different avenues to make those successes possible, she is willing to take the necessary steps to get to that point.

The above extracts illustrate the path Denae took to understand students in an urban high need school. At the beginning of the program, she was cognizant of how student interests vary by geographical location and school contexts. Through placement in a high need environment, she learned more about those differences and built upon those in her teaching practices.

Mamba: They [students] have a lot of diverse ways of looking at things and a lot of different sights and backgrounds to bring to the table that you can work with in your content area.

Mamba is a mathematics teacher who has no previous K-12 teaching experience. Throughout three years of her undergraduate education, she taught freshman level mathematics as a teaching assistant. During the first interview, she was aware that teaching at the university level would be different from teaching high need populations, but she was only able to express more idealistic teaching approaches in the beginning:

I don't have much experience with classroom management because I haven't been in the classroom, so it would really depend on my class once I'm in it...with small groups you really have to focus on keeping them on track and making sure that they're not getting off on little tangents and roaming around from group to group, not participating. So I am not sure how I would manage it, but I know I would have to.

By the end of the year, Mamba demonstrated her willingness to try new methods and classroom arrangements. According to her final interview:

The students always come into the classroom and are like, oh my gosh you are always changing it around because one day they will be in groups and the next day it will be back in rows...I actually have this new system instead of having them in straight rows towards the board, I've had them diagonals facing each other so that the board is almost like a stage and everybody has access to it and I easily have access to all of them also.

That's been my favorite set up actually, where they can still get that independent practice, but they are close enough to the people around them where they can get some help.

At the beginning of the program, Mamba believed students in high need schools are often "given up on" and the teacher's relationship with these students really affects how you teach them. She did not provide a detailed description of those relationships, she merely stated:

High need schools, a lot of times, you end up with teachers that maybe don't want to be there or are only there temporarily and are going to leave as soon as they can...I think that the students will be kind of hesitant to trust me.

She went on to say:

How you relate to the students really affects how they are going to learn and those relationships with your students is really what is going to make them care about your class or not care about your class.

At the conclusion of the year, Mamba likes to use multiple representations of an activity so that she has “lots of different ways of seeing the same kind of information.” At this point in the program, she also had a greater understanding of how to develop relationships with her students and how she can incorporate their unique characteristics into her instructional practices. When envisioning her first year as an in-service teacher, Mamba stated:

I’ve been thinking... ‘how am I going to structure my syllabus?’ I really want to find a way to get a conversation going with my class, like what have you found that works and what do you think about that...so trying to get students to be more reflective about their education and how they learn best.

In her final interview, Mamba is mindful of individual student interests and how to incorporate those into her lessons. While walking through the halls, she believes a teacher should, “figure out what is funny to them [students] and what they like to play around with or what are the jokes around the school.” She found that including this information into her lessons made them more engaging for students:

Maybe I will dap them up. They love that because it’s hilarious or just use the slang that they use in my lesson...just joking with them, just using the interactions with them that they would use with their friends in a learning environment. I think just joking with them gets them motivated to participate in whatever I am teaching.

As shown in the above extracts, Mamba is aware that her prior experiences in teaching will likely not be appropriate for a high need, K-12 classroom. Throughout the year, she began trying

different teaching methods and classroom structures in an attempt to find an approach that worked for both her and her students. Moving forward, she realized that student involvement and their unique characteristics are a vital part of instructional practice.

Dexter: *Math evolves, we evolve, the students evolve, and education has to keep evolving. You can't stay the same because then they move forward and you don't.*

Dexter is a mathematics teacher. Like many of the teachers in this program, he has no experience teaching in a high need school. In fact, prior to this experience, Dexter has never taught outside of tutoring friends and family members. At the beginning of student teaching, Dexter anticipated barriers, such as poverty or family issues, that will inevitably impact student learning in a high need school. Although, he stated, he had yet to witness any of these problems firsthand:

I've kind of seen it, but I think I would see it more if I were in a non-IB [International Baccalaureate] class...So I haven't really seen it take form...these types of issues that stop them from being able to succeed in the classroom. So, not that IB doesn't have any of that, but I think I would see it more otherwise.

Although Dexter did not see issues often endemic to high need schools at the beginning of the year, he understands that his case may be a unique circumstance. By the conclusion of the program, however, Dexter explains what it is like to teach students in high need and how there are struggles, even for those enrolled in IB courses:

Sometimes you can do that [a lesson] with students and they can grow in their educational endeavors and also in their personal endeavors as they understand who and what they are in this world, but with a high need school you have to be okay with it not growing as fast and you have to be okay with consistent growth and you have to be okay

if the next day that slate gets shaken and you have to start building again. The struggle is real and the struggles do that and you just have to stay at it and not get discouraged. So obviously that, I could have known from the beginning, but seeing it is a different story.

With a yearlong student teaching experience in a high need school, Dexter poses a question regarding the problems present in high need schools: “Why can’t I use the tools that I have to do something about them?” Dexter believes student achievement is possible through both consistency and fluidity. First, he found consistency was not always what students in high need environments received at home. Therefore, he believes, “If you say this, you do it, and you do it every time...the more consistent you can be the more confident and comforted the students can feel because no surprises.” For him to avoid “being a stick in the mud,” he also has to know when to “go with the flow.” This reflection displays his willingness to evolve with every situation and with every student. Dexter stated in his final interview:

There are just so many different learning styles and so many different paths to comprehensions, kind of trying it out, again you don’t want every year to be trial and error, but at the same time you want to...always stay on top of the best way to help conceptualize [math].

To help plan for these learning differences in his lessons, he tries to do as much pre-assessing as possible. He tries “to understand to meet them where they are. Too low, you don’t get progress, too high you can’t get them too.” When asked about his ideal approach to teaching quadratic functions at the end of the year, he said:

One of the things that I feel like I’ve gotten through this whole experience is...try many things and take the pros and cons from all of them. So I don’t think I have a way in my handbook, which I will always teach quadratic functions...If it’s ideal I will continue to

experiment what gets certain learning styles and what gets certain emotional levels. So I don't, looking back the way I did teach it, I don't think it was ideal by any means. There were certain aspects of it that may have worked, but I will just go back and do it again...and try to make it better.

Through this experience, Dexter believes that teachers should not spend too much time struggling with that they don't know. Although high need schools are different from non-high need schools in various aspects, there are "other people who have done it and failed and succeeded." Dexter wants to learn from others and use his resources to be successful in this environment.

As this extract suggests, Dexter had some expectations of a high need school going into this experience, but he was unsure how those beliefs would impact his teaching and student learning. His placement in a high need school exposed him to some challenges of teaching students from these schools and how he plans on approaching their learning styles throughout his teaching career. Finally, his ability to change instruction based on reflections of his practice, student learning, and willingness to seek the support from others will benefit him in the years to come.

Discussion

Mediated by their personal and field placement experiences, findings from this study begin to illustrate the unique processes prospective teachers take to develop adaptive practices in urban and high need schools. In this section, a comprehensive examination of the four teachers' experiences and how those are associated with their developmental trajectories are reported. This section concludes with study limitations and implications for future research.

The central element connecting many of these teachers at the beginning of the program is the knowledge that their field placement experience would be different from previous educational experiences. In most cases, this concept was merely an assumption as the teachers were only able to relate these expectations to the knowledge they acquired from multicultural coursework and their previous personal experiences. The awareness that their current educational experiences were different than their own refers to the characteristics of the teacher as knower (Crawford et al., 2005). Since these teachers expressed this realization early in the program, these teacher candidates may have come into the program with some basic epistemic and dispositional aspects of adaptiveness (i.e., epistemic distance and case sensitivity). More specifically, these teachers possessed the skills and frame of mind necessary to recognize when their prior experiences were not appropriate within the current situation. Further, these prospective teachers were also sensitive to the uniqueness and complexity associated with urban contexts (Crawford et. al. 2005). Yet, these results reveal that all four teachers were unsure how personal differences would impact interactions with students and their teaching practice at the beginning of the program.

The teachers' thought processes became more complex as the academic year progressed. During the post interviews, the teachers continued to demonstrate instances of epistemic distance and case sensitivity. However, the four teachers also started to express ways in which they were willing to build from those deficiencies. This disposition also highlights the notion of the teacher as knower, but the teacher now views the issue as an opportunity to learn and grow (Crawford et al., 2005). By the end of the program, the prospective teachers stated how they were able to use this field placement experience as a way to test new methodologies, try novel classroom physical arrangements, and learn ways to interact with students. For many of them, the field experience

was the first time they were able to adjust their theory-based teaching practices away from the ideal classroom and towards a more realistic setting. Therefore, it not only showed the teachers where gaps in their knowledge existed, but it allotted for the opportunity to learn from their experiences.

Throughout the urban field placement experiences, the four teachers also began shifting their thinking towards higher-level cognitive and metacognitive adaptive processes. Specifically, the teachers started developing the ability to seek, monitor, and assess feedback about their teaching practices and the environment (Crawford et al., 2005). In some cases, this was acquired through the guidance and observance of veteran teachers within the urban environment. In other instances, the teachers improved their ability through “trial and error” of multiple practices until they were able to better diagnose the problem and build from this practice. Regardless of the origin of acquisition, all four teachers in this program formulated new teaching strategies in light of the information generated from their current experiences. By monitoring and reflecting on their own knowledge, performance, and learning, these teachers realized that they may never become perfect at their jobs, but they can take certain aspects of every experience and grow to become better teachers.

An important factor to note is that these are the beginning processes associated with the obtainment of adaptive expertise. Even though these teachers began exhibiting practices associated with this theory, a field placement will not guarantee their success in other urban environments. Sahara, one of the four teachers, had this realization while enrolled in the program. She was cognizant that her field placement was considered an urban and high need school; yet, she was also aware that her actual teaching placement might be different and more challenging. Although teacher preparation programs aim to set teachers up for success through

coursework and field experiences, many will continue to fall short given the uniqueness of every classroom situation. This pilot study was designed to shed light on the adaptive expertise processes for pre-service mathematics and science teachers in an urban field placement experience, but there are many limitations with this study.

First, this study used retrospective interview transcripts, which did not ask specific questions regarding adaptive expertise. Instead, the researchers constructed a priori codes based on the literature and applied those codes to the transcripts. Although this provided the researchers with a structured approach to data analysis, it also introduced possible bias to the study. For instance, the researchers may have been blinded to evidence that was non-supportive of the theory. This study utilized multiple coders in an attempt to reduce this bias and increase trustworthiness of this study. Lastly, self-reported data was used, which limits the study. Teachers may have given responses that were more socially desirable rather than their actual feelings or beliefs. A graduate student who was removed from execution of the teacher preparatory program was used as the interviewer to help reduce this risk.

Several factors will continue to influence how teachers successfully teach in urban environments. Therefore, teacher preparation programs will have to continuously evolve with the changes occurring within our nation's schools. Perhaps through further exploration of the acquisition of adaptive expertise practices during urban field placements, teacher preparation programs can begin to understand how pre-service teachers learn during this experience. Continued research is needed to determine whether these processes would yield similar findings in other urban environments.

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References

- Bell, E., Horton, G., Blashki, G., & Seidel, B. M. (2012). Climate change: Could it help develop “adaptive expertise?” *Advances in Health Science Education*, 17, 211-224.
- Bransford, J. (2004). Thoughts on adaptive expertise. Unpublished manuscript.
- Bransford, J., Derry, S., Berliner, D., & Hammerness, K. (2005). Theories of learning and their roles in teaching. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world: What teachers should learn and be able to do* (pp. 40-87). San Francisco, CA: Jossey-Bass.
- Chizhik, E. W. (2003). Reflecting on the challenges of preparing suburban teachers for urban schools. *Education and Urban Society*, 35(4), 443-461.
- Crawford, V. M., & Brophy, S. (2006, September). Adaptive expertise: Theory, methods, findings, and emerging issues. In V. Crawford, & S. Brophy (Chairs), *The Adaptive Expertise Symposium*. Symposium conducted at the meeting of SRI International, Menlo Park, CA.
- Crawford, V. M., Schlager, M., Toyama, Y., Riel, M., & Vahey, P. (2005, April). *Characterizing adaptive expertise in science teaching*. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Quebec, Canada.
- Creswell, J. W. (2013). *Qualitative Inquiry and Research Design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: SAGE.
- Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice*, 39(3), 124-130.

- Colby, S. L., & Ortman, J. M. (2014). *Projections of the size and composition of the US population: 2014 to 2060. Current Population Reports*. Washington, DC: U.S. Census Bureau. Retrieved from <http://www.census.gov/content/dam/Census/library/publications/2015/demo/p25-1143.pdf>
- De Arment, S. T., Reed, E. & Wetzel, A. P. (2013). Promoting adaptive expertise: A conceptual framework for special educator preparation. *The Journal of the Teacher Education Division of the Council for Exception Children*, 1-14.
- Dewey, J. (1938). *Experience and education*. New York: Macmillan.
- Dill, V., & Stafford-Johnson, D. (2003). Can teachers be found and certified to teach students at risk?. Available from the Haberman Educational Foundation Web site. <http://www.habermanfoundation.org>.
- Fisher, F. T., & Peterson, P. L. (2001, June). A tool to measure adaptive expertise in biomedical engineering students. Paper presented at the annual meeting of the American Society for Engineering Education, Albuquerque, New Mexico.
- Gerring, J. (2007). *Case study research: Principles and practices*. Cambridge, MA: Cambridge University Press.
- Goodnow, J. J., Peterson, C., & Lawrence, J. A. (2007). Culture and cognitive development: Giyoo Hatano's insights and the questions they open. *Human Development*, 50, 16-22.
- Haberman, M. (1996). *Selecting and preparing culturally competent teachers for urban schools*. In J. Sikula (Ed.), *Handbook of research on teacher education* (pp. 747-760). New York: Macmillan.
- Hammerness, K., Darling-Hammond, & Bransford, J. (2005). How teachers learn and develop. In L. Darling-Hammond & J. Bransford (Eds.), *Preparing teachers for a changing world:*

- What teachers should learn and be able to do* (pp. 358-389). San Francisco, CA: Jossey-Bass.
- Hatano, G., & Inagaki, K. (1986). Two courses of expertise. In H. Stevenson, H. Azuma, & K. Hakuta (Eds.), *Child development and education in Japan* (pp. 262-272). New York: Freeman.
- Hatano, G., & Oura, Y. (2003). Commentary: Reconceptualizing school learning using insight from expertise research. *Educational Researcher*, 32(8), 26-29.
- Hatton, T. J. (2015). United States Immigration Policy: The 1965 Act and its Consequences. *The Scandinavian Journal of Economics*, 117(2), 347–368.
- Hollins, E. R., & Guzman, M. T. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on Research and Teacher Education* (pp. 477-548). Mahwah, NJ: Lawrence Erlbaum.
- Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, 15(9), 1277-1288.
- Humes, K. R., Jones, N. A., & Ramirez, R. R. (2011). Overview of race and hispanic origin: 2010. *U.S. Census Bureau*, 1–23. Retrieved from <http://www.census.gov/population/race/>
- Inagaki, K., & Miyake, N. (2007). Perspectives on the research history of Giyoo Hatano. *Human Development*, 50, 7-15.
- Knoblauch, D., & Woolfolk Hoy, A. (2008). “Maybe I can teach those kids.” The influence of contextual factors on student teachers’ efficacy beliefs. *Teaching and Teacher Education*, 24(1), 166e179.

- Ladson-Billings, G. (2000). Fighting for our lives: preparing teachers to teach African American students. *Journal of Teacher Education, 51*(3), 206-214.
- Liaw, E. (2009). Teacher efficacy of pre-service teachers in Taiwan: the influence of classroom teaching and group discussions. *Teaching and Teacher Education, 25*, 176-180.
- Maistre, C. L., & Paré, A. (2010). Whatever it takes: How beginning teachers learn to survive. *Teaching and Teacher Education, 26*(3), 559-564.
- Lin, X., Schwartz, D. L., & Hatano, G. (2005). Toward teachers' adaptive metacognition. *Educational Psychologist, 40*, 245-255.
- Lin, X., & VanderPutten, E. (2007). The ideal science student: Helping teachers adapt to diversity in the science classroom. *Teachers College, Columbia University, Math, Science and Technology*. New York, NY.
- McKinney, S. E., Haberman, M., Stafford-Johnson, D., & Robinson, J. (2008). Developing teachers for high-poverty schools. *Urban Education, 43*, 68-82.
- National Research Council. (2000). *How people learn: Brain, mind, experience, and school* (Expanded ed.). Washington, DC: National Academies Press.
- National Center for Education Statistics. (2013). Number and percentage distribution of teachers in public and private elementary and secondary schools, by selected teacher characteristics: Selected years, 1987-88 through 2011-12. Retrieved from https://nces.ed.gov/programs/digest/d13/tables/dt13_209.10.asp
- National Center for Education Statistics (2013). *Digest of Education Statistics*. Retrieved March 13, 2016, from http://nces.ed.gov/programs/digest/d13/tables/dt13_209.50.asp

- National Center for Education Statistics (2012). Public elementary and secondary school student enrollment and staff counts from the common core of data: School year 2010-11. Retrieved from <http://nces.ed.gov/pubs2012/2012327.pdf>
- National Science Foundation. Robert Noyce Teacher Scholarship Program (2014). Retrieved from <http://www.nsf.gov/pubs/2015/nsf15530/nsf15530.pdf>
- Orfield, G., Frankenberg, E., Ee, J., & Kuscera, J. (2014). Brown at 60: Great progress, a long retreat, and an uncertain future. *The Civil Rights Project*, 1–42.
- Polit, D. F., Beck, C. T., & Hungler, B. P. (2001). *Essentials of nursing research: Methods, appraisal, and utilization* (5th ed.). Philadelphia, PA: Lippincott.
- Potter, J., & Wetherell, M. (1994). *Analyzing discourse*. In A. Bryman & R. Burgess (Eds.), *Analyzing qualitative data* (pp. 47-68). London: Routledge.
- Schwartz, D. L., Bransford, J. D., & Sears, D. (2005). Efficiency and innovation in transfer. In J. Mestre (Ed.), *Transfer of learning* (pp. 1-51). Greenwich, CT: Information Age Publishing.
- Shenton, A. K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, 22, 63-75.
- Sleeter, C. E. (2001). Preparing teachers for culturally diverse schools: research and the overwhelming presence of whiteness. *Journal of Teacher Education*, 52(2), 94-106.
- Sleeter, C. E. (2008). Preparing White teachers for diverse students. In M. Cochran-Smith, S. Feiman-Nemser, D. J. McIntyre, & K. E. Demers (Eds.), *Handbook of Research on Teacher Education: Enduring Questions in Changing Contexts* (3rd ed.) (pp. 559-582). New York, NY: Routledge.

Siwatu, K. O. (2007). Preservice teachers' culturally responsive teaching self-efficacy and outcome expectancy beliefs. *Teaching and Teacher Education, 23*, 1086-1101.

Siwatu, K. O. (2011). Preservice teachers' sense of preparedness and self-efficacy to teach in America's urban and suburban schools: Does context matter? *Teacher and Teaching Education, 27*, 357-365.

Wang, W. (2012). The rise of intermarriage: Rates, characteristics vary by race and gender. *Pew Research Center, Social & Demographic Trends*, (202). Retrieved from <http://www.pewsocialtrends.org/>

Whipp, J. & Geronime, L. (2015). Experiences that predict early career teacher commitment to and retention in high-poverty urban schools. *Urban Education, 1-30*.