# Preservice Mathematics Teachers' Attitudes and Developing Practices in the Urban Classroom: Are they "Winging" it?

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**Abstract**

*This study examines the attitudes and developing practices of a cohort of preservice secondary school mathematics (PSSM) teachers preparing to teach in urban contexts. Data sources included a survey taken by these PSSM students in fall semester and again after student teaching in the spring semester. Interviews and observations were conducted, and fieldnotes taken, at the beginning and after their student teaching internship, to determine the extent of attitude changes and development practices in regard to teaching mathematics. Findings indicated that the PSSM teachers' attitudes changed positively except for one student. Further positive changes were reflected in alignment to willingness and commitment in teaching mathematics in urban contexts.*

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## Background

One of the dilemmas that teacher education programs face today is the mindset that almost anyone, with a knowledge of mathematics and who can recall how they were taught is qualified enough to teach reasonably well (Darling-Hammond 2006, p. 301). This author also suggests that "this false or lame ideology" should be something of the past, explaining that teacher educators should be cognizant that preservice teachers do bring with them knowledge, beliefs, and attitudes relevant to their own subject matter. For example, Ernest (1989) stated that the "official pressure for reforms in the teaching of mathematics overlooks a key factor: the psychological foundations of the practice of teaching mathematics, including the teacher's knowledge, beliefs, and attitudes" (p. 13). In this view of teaching, teacher beliefs and attitudes play an important role in shaping classroom practice (Bolhuis & Voeten, 2004; Eaton & Kidd, n.d, p. 1, Shulman, 1986).

Attitudes and beliefs held by an individual are intricately related. Specifically, Arp (1999) expressed that distinguishing between the two is difficult because attitudes have both cognitive and affective components as opposed to beliefs that have only a cognitive component. Due to this complexity, we do not make a distinction between attitudes and beliefs in this study although we are cognizant that these are sub-constructs interplaying throughout teachers' education and practices. Rather, we use the term "attitude" throughout this text. For the purpose of this study and the teacher education program, attitudes are defined as the various levels of the PSSM's penchant, enjoyment, and enthusiasm for teaching mathematics as well as their confidence in their ability to teach mathematics (Eaton & Kidd, n.d.; Ernest, 1988, 1989; Nicolidau & Philippou, 2004; Van der Sandt, 2007). We agree with Arp (1999) that preservice teachers have negative attitudes when they themselves are students which can result in negative cycles in their own classrooms. We suggest that teacher educators have a plan of action to monitor and/or develop more positive attitudes and practices conducive to teaching math in all classrooms, but specifically in an urban school. Educators must take into account that among prospective teachers it is more common to encounter the attitude of "All students can learn if they want to" than "Let me try some things to bring about desired changes for students' learning."

## Attitude Regarding Teaching Mathematics

Inquiry-oriented mathematics teaching of a new curriculum is mandated and as such, preservice mathematics teachers have the challenge of promoting practices in which teachers are encouraged to give up a degree of their control over mathematical activity allowing students to initiate their own strategies to solve problems and grapple with contradictions (National Council of Teachers of Mathematics, 2000; Stipek, Givvin, Salmon, & MacGyvers, 2001). Knowing appropriate facts, algorithms, and procedures is not sufficient to guarantee success of mathematics students (Mapolelo, 1998). Answering to mathematics reform, some scholars have suggested that:

> . . . teachers have to engage students in rich, meaningful tasks as part of a coherent curriculum; students' thinking shared orally and in writing, must be used by teachers to guide the classroom community's exploration of important mathematical ideas; and teachers have to gather information from many sources as they assess their students' understanding of these ideas. (Peressini, Borko, Romagnano, Knuth & Willis, 2004, p. 67)

However, there are other factors such as the decisions teachers make, the strategies they use, and the attitudes displayed, that are relevant to performance on mathematical tasks and which influence the direction and outcome of student performance (Mapolelo, 1998; McLeod, 1988; Schoenfeld, 1985). It is often declared that the attitude of a teacher could influence their actions in the classroom, which becomes critical to student learning. In other words, a teacher's attitude regarding mathematics and students is relative to attitudes towards the teaching of mathematics, which in turn, has a powerful impact on the atmosphere within the mathematics classroom (Ernest, 1989; van der Sandt, 2007).

## Practices of Teaching Mathematics

According to Ernest (1994), there should be a shift to a problem solving approach that requires deeper changes, which depends on the teacher's system of beliefs, particularly, as it relates to the teacher's conception concerning the nature of mathematics and mental models use to teach and learn mathematics. He further expressed that the practice of teaching mathematics depends on key elements, which include (1) "the teacher's mental contents or schemas, particularly the system of beliefs concerning mathematics and its teaching and learning"; (2) "the social context

of the teaching situation, particularly the constraints and opportunities it provides"; and (3) "the teacher's level of thought processes and reflection."

Again, attitudes and practices of teaching mathematics are complexly affected by beliefs, emotions, social context, and content knowledge. The focus of this study was not to determine the preservice secondary school mathematics (PSSM) teachers' beliefs, or emotions, though we acknowledge they are underlying constructs. Instead, it was to gain an understanding *of this cohort's* attitudes and developing practices in teaching mathematics in urban schools. According to Mewborn and Stinson (2007):

> Although preservice teachers bring well-established views of teaching to their teacher education programs, Tabachnick and Zeichner (1984) claimed that it is possible to amend preservice teachers' views. They portrayed the learning of teachers as a negotiated and interactive process rather than as one that is predetermined by teachers' prior experiences (p. 1458).

Therefore, this presumes that there is possibility for change to take place with prospective teachers' attitudes and practices.

Going into the classroom, prospective teachers have to stop viewing their students as *not doers* and begin to see themselves as the agents of positive desired change for student learning. It becomes crucial that teacher educators guide and empower the prospective teachers encouraging them to rethink what they can do to bring about desired outcomes for their students, specifically in urban settings (Gibson, Brewer, Magnier, McDonald & Van Strat, 1999). Their knowledge, beliefs, and attitudes are intertwined and demonstrated through their practice, that is, the pedagogical and curricular knowledge. Teacher educators have to be more than just willing; they have to be purposeful in preparing prospective teachers. In this way, we are constantly reminded to encourage a culture of thinking and rethinking, and constructing and reconstructing the processes and ways of thinking during the preparation. In the spirit of such recognition, and functioning as teacher educators, we asked the following question: *What are preservice secondary school mathematics teachers' attitudes and developing practices during their preparation for teaching in urban contexts?*

**Context of the Study: Teacher Education Program**

This study was conducted in a teacher education program at an urban university in the southeastern region of the United States of America. The program has a non-traditional approach to certification in secondary mathematics and has been in existence for the past 14 years. Applicants to the program must hold at least an undergraduate degree in an area that includes a background in mathematics, Graduate Record Examination (GRE) scores of at least 800, and a Grade Point Average (GPA) of at least 2.5. Usually, student teachers entering this program hold a bachelor's degree in applied mathematics, science, engineering or an equivalent field. The program of study is 45 semester hours with 15 hours in graduate mathematics, 12 hours in Mathematics Education and 18 hours across Instructional Technology, Educational Psychology, Research and Measurement, and Social Foundations.

This program is built upon the ten principles of the Interstate New Teacher Assessment and Support Consortium (1992), standards of the National Council of Teachers of Mathematics (2000), and the National Educational Technology Standards (International Society for Technology in Education, 2008). The design of the program is based on constructivism (von Glaserfeld, 1995) and the work of Shulman (1986) on the Stanford Knowledge Growth in Teaching Project. The environment is interactive, reflective, and based on inquiry. Shulman suggested that the transformation of subject matter for teaching occurs as the teacher *critically reflects* on and *interprets* the subject matter; finds multiple ways to *represent* the ideas; *adapts* the material to students' abilities, gender, and prior knowledge; and *tailors* the material so that students can be successful. Participating in collaborative groups and reflective activities, student teachers experience mathematics pedagogy and instructional planning through microteaching experiences under the guidance of university professors.

For the PSSM teachers, their experiences are developed in using the reflective teaching model (RTM) and the conception of teaching as problem solving (Artzt, 1999; Hart, Najee-ullah, & Schultz, 2004). The RTM is grounded in *constructivism* and *metacognition.* Constructivism is learning in an active situation through which new knowledge is acquired by building on prior knowledge. Metacognition is the ability to analyze how people think about thinking. Also, the values of *modeling, sharing authority, reflecting,* and *heuristic teaching* are the assumptions on

which the RTM is based. These assumptions guide the development of all activities and experiences in the RTM (Hart et al., 2004). The PSSM teachers have the opportunity to experience the Plan-Teach-Debrief sequence while they observe how others think about and teach from a reform perspective (modeling). This cycle is continuous throughout their practicum and student teaching. In particular, the study is situated in the mathematics methods courses where the PSSM teachers explored the RTM and other teaching and learning strategies.

## Theoretical Framework

During preparation, the PSSM teachers are engaged with a curriculum guided by the NCTM principles and standards, and the Interstate New Teacher Assessment and Support Consortium (INTASC) standards ( INTASC, 1992). They have to demonstrate evidence of meeting the standards within their course and field (clinical) work. This evidence is showcased in their exit portfolio, which is a program requirement. To describe and understand the PSSM teachers' change in attitudes and practices toward the teaching of mathematics as they complete the initial teacher preparation (ITP) program, the program designers chose the Attitude and Practices towards Teaching Mathematics (APTM2004) Survey (McDougall, 2004, p.87) as an advisement tool. The survey instrument is based on the 10 dimensions of mathematics education consortium (10-DMEC) (McDougall, 2004, p.72-76), which was derived from the NCTM principles and process and content strands. "These [ten] dimensions can be used to simplify the complex task of assessing a mathematics program to identify specific goals for improvement" (McDougall, 2004, p. 16). In particular, the 10-DMEC has specified criteria for teacher improvement. For this reason, the 10-DMEC has been employed as the theoretical frame for this study.

## Methodology

To examine the PSSM teachers' attitudes and developing practices towards teaching mathematics, we took a qualitative case study approach with the bounded group, as suggested by Stake (1995). The APTM2004 survey, advisement sessions, observations, fieldnotes, and interviews were instruments in collecting data and are considered the data set (see Appendix A for the timeline). In the next section, we provide a description of the participants followed by instruments and data collection procedures.

**Participants**

The cohort that was taught consisted of eight female PSSM teachers. Seven of them volunteered to participate in the study. Six of the seven were scholars of the Urban Mathematics Educator-Researcher Program (UMEP), a Robert Noyce - National Science Foundation grant. The UMEP scholars are willing and committed to teach in the urban context after completing the program that occurs simultaneously with the teacher preparation program. Their ages ranged from late twenties to late thirties of which two were White and five were Black. Three of them were career changers and the remaining four had recently completed a Bachelor's Degree. Their pseudonyms are *Angeli, Danielle, Evelyn, Jackie, Laura, Simone, and Zephyr.* These PSSM teachers have evidence of high scores on the GRE over 1000 and GPA of 3.0. The ITP program, in which they were enrolled, required them to take other education, content, and technology courses along with a series of three methods and three practicum courses. The Practicum I course, called Practicum, is completed in fall semester and Practicum II and Practicum III courses, called student teaching, are completed in spring semester. The PSSM teachers took a survey that served as an advisement tool in fall semester before the practicum and in spring semester after student teaching. During the practicum, the PSSM teachers attended an advisement session individually. They were interviewed before and after they conducted student teaching to determine the extent of change in their attitudes and developing practices toward teaching mathematics.

**The Instruments and Data Collection Procedures**

*The APTM2004 Survey*

The APTM2004 survey (McDougall, 2004; p. 87), which served as the advisement tool, was administered in the fall semester and at the end of student teaching and given to our graduate research assistant (Internal Review Bureau (IRB) approved) for processing. The survey contained 20 statements to which the PSSM teachers responded on a Likert scale that ranged from A (*strongly disagree*) to F (*strongly agree*) for some statements and A (*strongly agree*) to F (*strongly disagree*) for the others. The GRA submitted the responses online (http://k12.nelson.com/prime/survey.aspx) and an analysis was retrieved for each participating PSSM teacher.

*Advisement Sessions*

After the analysis of the first survey, we determined the guiding questions for each PSSM teacher according to their scores and the "Guide to Using the Ten Dimensions Continuum" (McDougall, 2004, p. 77). At the end of the fall semester, after practicum, each PSSM teacher was scheduled to meet with the program coordinator for advisement. In each session, we discussed their development as classroom teachers. They were allowed to speak first by telling the interviewer about effective student activities they used in their practicum classes, next about less effective ones. Also discussed were, several facets of classroom management including their attitudes toward the diversity of students in the classroom, teaching strategies utilized, and parental involvement. Further, the interviewer delved into what actions the PSSM intended to take to change any adverse effects. Notes were made regarding the differences in their views based on surveys while they were speaking. When the interviewees have exhausted their views, the results of the survey were presented for discussion. A sample question was as follows: "How do you know, or decide when to guide rather than deliberately focus on students' approaches?" The PSSM teacher responded, and then a discussion was conducted concerning their observations. Such a discussion included their use of content and process standards, resources, and their pedagogical actions throughout the observations. As a matter of design, the next step in the process was to outline areas of consistent behavior that was observed and how cooperative efforts might produce desirable changes in their student teaching. At the end of the sessions, each PSSM teacher had a plan of action.

*Observations and Fieldnotes*

Classroom observations and fieldnotes gathered throughout student teaching experiences served to triangulate unspoken actions and interactions. The interview protocol had 10 questions, which the GRA conducted before and after student teaching internships in the spring semester. The interviews provided in depth responses, and served as another opportunity to verify a portion of the data provided in the surveys (Bogdan & Bliken, 1998) and allowed the PSSM teachers to articulate other views on their development.

**Data Analysis**

As stated earlier, the responses on the APTM2004 surveys were analyzed electronically. The analyses of the PSSM teachers' responses provided us with a reflection of their behaviors in their attitudes and practices from their own lens. The analyzed scores allowed us to determine guiding questions for the advisement sessions. Based on observations, the supervisor of student teaching provided observable attitudes and the impact of their teaching and learning in their classrooms. This data is integrated into the interview analyses in order to culminate the analyses.

The interview conducted at the beginning of student teaching was used as a baseline to determine their attitudes and practices after their practicum in the fall semester. What were their thoughts at that time? Then, the GRA conducted a final interview after their student teaching experiences and the data was transcribed and analyzed using Microsoft Word. We looked for themes according to the 10-DMEC for each PSSM teacher and then for each of the 10-DMEC we further analyzed how the cohort met each specific dimension.

## Results and Analyses

The scores from APTM2004 survey was analyzed and interpreted based on its rubric. Data from the interviews, observations, and field-notes were coded, analyzed, and synthesized throughout each respective dimension of the theoretical framework, 10-DMEC, to answer the research question: *What are preservice secondary school mathematics teachers' attitudes and developing practices during their preparation for teaching in urban contexts?*

**Interpreting the Scores of the Survey**

*The Rubric*

According to McDougall, scores of the survey range from 1 through 6 for each dimension and the overall score of the dimensions (2004, p. 88). For each dimension, the higher the average score means the more consistent the teacher's attitude and teaching practices are with current mathematics education thinking. A low score would indicate that a teacher needs to focus on that specific dimension for personal growth and professional development.

For the overall score of the ten dimensions for a teacher, it means the higher the overall score means the more consistent the teacher's attitude and teaching practices are with current mathematics education thinking and the more receptive that teacher might be to further changes in his or her practice.

*Actual scores*

On the first survey, every student scored 4s and/ 5s on each dimension except Laura who scored 3s on *Manipulatives and Technology* and *Students' Mathematical Communication.* Each student scored 4 on their overall score which gives a score of 4 overall for the cohort. On the second survey, four out of the seven PSSM teachers scored 4s and/ 5s on each dimension. Each of two PSSM teachers got one score of 3 on *Communicating with Parent*" and *Constructing Knowledge* respectively. However, one PSSM teacher got a score of 3 on *Meeting Individual Needs; Student Tasks;* and *Constructing Knowledge.* Five of the seven PSSM teachers maintained an overall score of 4, while one teacher score increased to 5 and the other teacher score decreased to 3. The overall score for the cohort remained 4. Comparing their initial and final scores, two PSSM teachers had a decrease in only one dimension, another had decreases in scores in eight dimensions, and the other four had increased scores in all ten dimensions.

*Analyzing the scores based on the Rubric*

Based on the scores and the rubric for the survey, the cohort of PSSM teachers scored 4 which indicates that on a scale of 1 through 6, we would interpret that score as "above average," which means that the cohort of PSSM teachers are *above average* in being consistent with their attitude and teaching practices with reference to current mathematics education thinking and they are receptive to making changes in their practices. However, on an individual basis, there was one PSSM teacher who had decreasing scores for eight of the ten dimensions.

**Observations - Plan of Actions**

Each PSSM teacher conducted student teaching with a plan of action. The plan of action was shared with her supervisor who observed her for the changes and appropriateness of her actions. The supervisor observed the seven PSSM teachers at three schools. There were three teachers at each of two schools and one at another school. The supervisor spent a whole day at the two

schools with three PSSM teachers and a few hours at the other school each time she visited them. All PSSM teachers formed professional relationships with their cooperating teachers and at each of the two schools they worked on the reflective teaching model with their peers and cooperating teachers while the other PSSM teacher spent more time with her cooperating teacher as her RTM partner. The PSSM teachers' actions, relationships formed, and overall receptiveness to the guidance of their mentors during student teaching were observed, summarized, and reported.

**Analyses of the Data Set**

*Program Scope and Planning*

In their interviews, except for Simone, the data showed that the PSSM teachers' attitudes on planning remained positive and were demonstrated in their practices. In the final interviews, the PSSM teachers described in more detail their lesson planning experiences with their cooperating teachers and their peers:

> My lesson planning experiences have been wonderful. I do a lot of co-operative planning with my co-operative teachers and also with some of my other class mates. I make sure that I address the concepts and the goals and objectives that we are trying to meet. [Danielle]

This is also a reflection of the pedagogical tool we employed in the program that encourages a plan, teach and debrief model. Planning with peers and cooperating teachers was encouraged within the program. However, to hear from their own voice that they are taking ownership of their actions, and acting appropriatly was impressive. It was a bit comical, but honest to hear a PSSM teacher saying that she and her cooperating teacher "wing it" (the choice of words make it seemed an inappropriate act):

> No, we actually *wing it* we talk about what we are doing we look at the book and we find . . . the one thing we do is we find power points. And there is a county in Virginia called Enrich County [it] had fabulous PowerPoint's that align almost exactly with the geometry and algebra text books that we use. And so we pull down all of their PowerPoints and save them for the chapter and we look at them ahead of time and decide if they are useful and they almost always are and we modify them as necessary and we use them as a basis of the lecture. [Laura]

However, as she went on to explain further, one can understand what was going on. The cooperating teacher was demonstrating an act of using prior resources, something we call "do not

reinvent the wheel." The next PSSM teacher gave the emphasis her cooperating teacher places on formative and summative assessment as she stated:

> I have learned that I should give an assessment well the teacher I am working with likes to give in class assessments after . . . during every lecture. So, after we lecture then maybe a 5 or 10 minute brief assessment. [Zephyr]

Again, they followed a plan, teach, and debrief model in their preparation, and they used the model in their student teaching practices. However, here they talk much about planning with their cooperating teachers which is what they are encouraged to do in developing their practices to be collaborative with other teachers. Although, earlier in the preparation a few of them tended to attach power relations and did not feel as though they were colleagues with the cooperating teachers. However, over time we noticed that they seemed to be heading in a positive direction because we have observed some of their behaviors of having lunch and consistent dialogues with their mathematics teaching team which consisted of their peers, cooperating teachers, and other veteran teachers.

*Meeting Individual Needs*

Among the PSSM teachers, there was a general consensus that their students needed much guidance and more direct instruction and they were willing to provide for them. These PSSM teachers were interactive with their cooperating teachers, resource teachers, and other teachers in the schools to get support with the issues of addressing students' needs. Evelyn explained:

> For me a lot of the ways that I try to figure out the needs of an individual student or a small group of students is [through] a lot of observations, going around the classroom, asking them [students] questions and also looking at their work.

Angeli expressed deep concerns for the way she identifies students' needs. As far as special needs students, she viewed their individual education plan (IEP) in order to make modifications with her strategies and instruction. In general, PSSM teachers used the resources available at the school sites to facilitate their instruction and even spoke with their students regularly as another approach to understand, assess and address the individual needs of their students.

*Learning Environment*

The PSSM teachers had mixed feelings on the learning environment for their students. They expressed that it was primarily because of their experiences as students. Simone explained her proactive approach was based on her high school experience of reluctance about group work:

> Going through high school I really didn't like groups myself because I was there stuck in a group where I was doing all the work. So it depends on if the group members are really motivated to actually do what they are supposed to do. It's how and when I am trying to form the groups myself that's what I look at, I look at their ability, and if they are really motivated to actually do the work, or you know, the other kids . . . the group members decide [how to form] the group instead of trying to form the groups myself.

Jackie initially promoted working on her own but found and appreciated the benefits of working in groups:

> I used to feel that working in a group you had some that won't help at all and just like to sit back and let you do all the work. And there are others that take over the tasks. So my preference is to work individually. But I found that [with] some things in the classroom, the students after some instructions will be able to work on their own. [While] there are other tasks that are more, I guess, detailed than others . . . I found that they [students] work better in groups where they can feed off one another.

Jackie sets parameters to assist in the management of her class and accountability for each student. She stressed to students that if they are going to let someone copy off of their paper, they are to ensure that their peer understands their thinking and why he or she is working out the problems in that particular way. Like the other PSSM teachers, she felt that individual knowledge was important whether students get it individually or through small or whole class groupings. However, there was general consensus that small group work maximizes student knowledge.

*Student Tasks*

Many PSSM teachers try to incorporate activities, such as drill and practice, performance based, standards based and skills based activities. Some of them liked to incorporate "discovery activities," "experiments," "games," and "real world examples." Engaging students with activities that are more hands-on using manipulatives and/or calculators was common among

them, except for Zephyr who did not like to use computer technology. Jackie explained that relevance of her tasks to her students' lives was important:

> …You know, the Superbowl is coming up and one of my classes is heavily dominated by young males so my goal was to look at their past knowledge of both quarterbacks. On both of the teams, graph that so you could see the positive and negative, so we can see the y-intercept, so we can do some graph analysis, and they can take everything we have been covering and have a kind of light bulb moment of [that] sort and do some activities that will really allow them to see that #1 what they have been doing has not been in vain. We actually do use this in the real world and #2 to help overcome those deficiencies they have been having in making the connections between the abstract and the concrete.

*Constructing Knowledge*

Most of these PSSM teachers believed that students improve their knowledge by "practicing" mathematics in authentic ways. One of their preferred approaches was to have their students working at the blackboard and explaining their solutions to the whole class. Using real world examples to help students understand concepts better and providing space for their students to explore on their own were integral in these PSSM teachers' practices. To build on students' knowledge, Evelyn insisted that connections had to be made by leaving space open so students can explore within boundaries. However, she still understands there are more traditional methods but that there are tons of options for students to practice critical thinking. She further stated that one has to also keep in mind that students need to go through some struggles to develop problem solving skills and the cognitive abilities to grapple with the works (National Council of Teachers of Mathematics, 2000; Stipek, Givvin, Salmon, & MacGyvers, 2001).

Simone, who taught Algebra 3, found her students lacking in the basic algebra skills. Having a high aptitude in mathematics, she could not understand why students were this way when they only learned these skills a semester or as much as two years prior to this class (REFs). During her student teaching practices, Simone was mildly frustrated with the students' lack of basic skills though she gave them opportunities to reflect and use previous knowledge.

*Communicating with Parents*

Some of the PSSM teachers had communicated with parents during their practicum and student teaching practices. Their encounters when they occurred were positive. Evelyn's experience with

communicating with a parent was positive in that the parent was thankful for the update on his child's disposition in class. What Evelyn got out of this communication was the father telling her the real problem with his child. The PSSM teachers had varying experiences and when asked in what order they would communicate grades, behavior, strengths, weaknesses to a parent, Danielle responded, "I think grades and with grades you have to enforce the strengths and their weaknesses so the parents can thoroughly understand why that student may have that particular grade and of course then behavior." However, Jackie stated, "I think I will do strengths as #1, weaknesses as #2, grades, and then behavior last."

*Manipulatives and Technology*

Many of the PSSM teachers were comfortable using manipulatives in their teaching and found that students enjoyed using manipulatives in their activities. However, all PSSM teachers had taken a course in Instructional Technology (IT) as a part of their program of study. During the IT course, they were exposed to several different technologies and software. Opportunities to incorporate technology into their teaching practices were sparing and so they have not developed high confidence. While six of the PSSM teachers were disappointed because of the limited resources they had at their schools during their practices, Zephyr was very adamant about using technology. She was not confident or comfortable in the use of technology and as she further explained,

> You can teach me fine but I don't care but if it is difficult to use, difficult to teach, I ain't probably . . . I am not going to use it. And that's the bottom line, I have to be able to pick it up quickly and it has to be easy because I'm under the business of teaching not learning something that really don't got a lot for me to do with teaching.

*Students' Mathematical Communication*

Evident with the PSSM teachers' practices were the following: encouraging group work; students solving problems on the blackboard and explaining to the whole class; students using mathematical language; creating activities; and journaling their reflections on mathematics and mathematical thinking. These strands cross cut the 10 dimensions. Danielle further explained how she encourages her students to communicate mathematically:

> I like to incorporate different creative activities for example in geometry they may be able to do a poem that requires them to use the different geometric terms. In algebra they may have to complete a project that requires them to show their algebraic skills in reference to real world applications. So, those are just a few examples of how I can do that to allow students to express their mathematical skills differently.

*Assessment*

A mixture of different assessment strategies has been the driving mode for these PSSM teachers. They continue to use traditional methods but also tying in other methods such as projects, portfolios, master assessment, and the "YES/NO cards." Some PSSM teachers recognized that their students are not good test-takers and that it is necessary for them to use alternative assessment strategies to capture the evidence of student learning. In Angeli's rationale for the portfolio assessment, she stated,

> With the portfolio I would have them . . . I guess more like what we did have [in our program] their best collection of work. Have a portion of the portfolio where there is a project or assignment they must do to show off a comprehensive knowledge I guess it will be like a culminating project that would go through the entire semester or entire year in which they submit different types of work maybe they want to put their quizzes in there or whatever but they get to choose but there may be certain criteria that they have to meet so they have like a best collection of work. . . .

*Teacher Attitude and Comfort with Mathematics*

Most of these PSSM teachers are comfortable with the mathematics content. They continue to do well in their mathematics courses throughout their program of study and have maintained their love for mathematics. However, Laura stated,

> I know the material but I don't know the best way to teach it. And that's why I really . . . really enjoy being in the classroom right now. . . . I am taking notes and really paying attention because my mentor teacher does a very good job of explaining the things [concepts] and playing [them] out . . . Some of the ways she lays things out is really nice they are not in the book, . . . she has been teaching for 20 or 30 years and . . . she knows the stuff so well . . .

**Summary of the Themes**

Overall, the scores for the APTM2004 survey indicated that the PSSM teachers initially were "above average" with regard to positive attitudes in mathematics teaching and the perceived ideas of their practices. For the most part, they maintained or increased their attitudes, but in one

instance there was a decrease in attitudes. The PSSM teacher who was originally motivated to try many strategies was disappointed when she was introduced to the classroom settings. She realized it was a different classroom culture from the ones she experienced as a child. However, her disappointment in the classroom culture was a result of her intolerance in meeting individual needs, student tasks, and constructing knowledge. Interestingly, Zephyr's scores for eight dimensions decreased while the dimensions for *program scope and planning* and *teacher comfort and attitude with mathematics* remained constant. It was evident that Zephyr had an attitude of "students must be submissive to learning." She claimed that there was no way around this and she was not putting up with "students' laziness." Zephyr consistently compared her students' working habits with her traditional upbringing (Arp, 1999). She specifically critiqued the school's social culture saying that "it's more of a social atmosphere in the classroom so much so, that again unless you are testing there is really no true individual work, even doing the sponges…., students are working together with whoever is next to them."

Zephyr failed to realize that she could use those behaviors with a positive attitude in getting her students to work cooperatively. Interviews were supportive in giving other important views that could not be mentioned in the surveys or advisement session and in gaining deeper understanding for the findings in the surveys which was extremely useful in this study. In particular, Zephyr's responses in her interview fully explained why her scores had decreased. According to the supervisor's observation of Zephyr during her student teaching internship, it is noteworthy that she was "cooperative, agreeable, and professional". In particular, she worked "well with her mentor teacher, peers, students, and college supervisor." Zephyr did not complain to her supervisor or program coordinator in her advisement session, but it was evident that she had disagreements and was able to voice it to the GRA who interviewed her. Further inquiry and support is required for the PSSM teachers. Why? For those who felt positive about their experiences we need to follow-up to determine if there were others like Zephyr with hidden challenges but "winged it" through the whole process and to support them in continuing to improve and or to address the concerns/challenges. As a mathematics teacher educator, we must continue to be proactive in finding ways to unearth the deeper concerns of PSSM teachers so they could be addressed during preparation and caution can be taken in their induction years.

## Discussion

### Benefits of the APTM2004 Survey

The benefits of the APTM2004 survey had three indicators: *lesson for a small sample size; Self-Identification; and High/low scores*, and a section on *Cautions in Using the Survey.*

*Indicator –Lesson for even a small sample size*

Though the sample of PSSM teachers was small, the survey provided some useful insights for further interventions in the teacher preparation program. Four out of seven PSSM teachers showing positive change in their attitude and developing practices is not statistically significant to determine the effectiveness of our program, but it indicates that if PSSM teachers are open-minded and do not allow the baggage of traditional behaviors to get in the way, there is the tendency to make positive changes in their practices over time.

*Indicator – Self-Identification*

Initially coming into the program, these teachers showed evidence of competency in mathematics, were willing and committed but soon they realized that their knowledge of mathematics [for teaching] was not enough to be as effective as they would like to be in the mathematics classrooms (Darling-Hammond, 2006). As the data from the survey indicated, they were all comfortable with the mathematics and were developing their practices, taking on the new standards- and performance-based tasks as ways to facilitate their students' understanding of mathematics. The learning community that was built through the reflective teaching model–a pedagogical tool for developing their practice was instrumental in keeping them motivated and committed.

Another highlight of the survey was the ability to have PSSM teachers self-identified themselves with the not-so-positive attitudes towards the reform strategies and current student and parents behaviors. What seemed to bear fruit for some PSSM teachers was their reflective thinking, which was a product of the reflective teaching model. They were taught to reflect on their actions that promote and/or inhibit student learning. The plan of action that they received based on the APTM 2004 survey also guided them through their student teaching, hence being the evidence

for their "above average" attitude and receptiveness toward making changes in their teaching practices.

*Indicator – high/low scores*

Laura expressed her low level of confidence in teaching mathematics, Zephyr was pessimistic about teaching with the use of technology and attending to students' variance in classroom social culture, and Simone was taken back with the students' low level of basic skills. Their experiences in this program have led them from a realization of their own competencies in learning mathematics to observing, teaching, and trying to affect the competencies of their students. Although, these were real challenges that they needed to continually work on they were not deterred from continuing their path to teaching mathematics in urban schools. Therefore, this would imply that these teachers need support and resources in the induction years that would assist them to continue making the changes that are necessary in their pedagogical and content knowledge. A partnership between school and the university to support teachers within the induction years in building their mathematics knowledge for teaching and classroom action research methods would be viable. Further, motivating these teachers to go thus far into education, we do not want to lose them through the development of frustration within their induction years (Glenn Commission on Mathematics and Science Teaching for the 21st Century, 2000). However, these initiatives need much support to sustain them. We do agree that while advocating for support, teachers must continue to find creative ways to enhance their capabilities for teaching mathematics in secondary schools, and teacher educators must continue to nurture prospective teachers in developing effective pedagogy for the teaching and learning of mathematics.

*Cautions in Using the Survey*

The survey becomes a powerful tool if you are able to follow-up with the advisement and nurturing of the PSSM teachers. We will explore in future semesters to draw on the benefits of this tool. We believe that using the survey as an advisement tool is beneficial, in particular, using the guiding questions and possible evidence throughout the program to determine and encourage plans of actions for the PSSM teachers. We plan to conduct the survey in the first week of the

program before they practice micro-teaching, before practicum, before and after student teaching. Consistency would be one of the key factors.

## Further Implications

Based on the findings, there is implication that future PSSM teachers should be engaged in deeper reflections on their teaching strategies and for them to realize that the ultimate goal is for student learning to occur. As a mathematics teacher educator, this study has been an eye-opener in many ways and below is what we suggest going forward.

### Program Revisions

There are moderate revisions that we would make in our program to accommodate the use of this tool. Inclusion of the responses from the survey would add value to the existing advisement sessions we had. We would explore with this for the next cohort as a full cycle. Collecting the opinions of the PSSM teachers would be an additional but important criterion for having their voice on its usefulness and effectiveness.

Another revision is a focus on preparing the PSSM teachers with mathematics knowledge for teaching. It is necessary as indicated in the data where the PSSM teachers are having struggles to construct knowledge. As an alternative four-semester program, we would have to prioritize some activities to maintain the quality and rigor of the program but allowing teachers to have a full and fun experience in a learning community.

### Recommendations for Mathematics Teacher Educators

The APTM 2004 survey is useful in not only identifying weaknesses and strengths of the prospective teachers but is accompanied with a "Guide to Using the Ten Dimensions Continuum" (McDougall, 2004, p. 77) that provides you with guiding questions for discussion on each dimension. We found it appropriate to assist in facilitating conversation in the advisement session of a program. The tool is also helping teachers to first self-identify the things they need to change and has a built-in mechanism "Possible Evidence" to guide them through initiating and continuing the pathway for change.

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