

# A Model for Increasing Pre-Service Mathematics HBCU Teacher Effectiveness through National Board for Professional Teaching Standards (NBPTS)

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## Abstract

This paper will present a model to increase pre-service mathematics teacher effectiveness with Differentiated Instruction and National Board for Professional Teaching Standards (NBPTS) resources. This model can potentially advance knowledge in the field of Educator professional development by providing a model to create, train and support pre-service STEM teachers, content specialists and educational leaders. In addition to potentially impacting college/university teacher preparation, school districts and state/federal entities. This model can be replicated for other content areas.

## Keywords

National Board for Professional Teaching Standards (NBPTS), ATLAS, Historically Black Colleges and Universities (HBCU), Professional Development, Pre-Service Teachers, Mathematics, Teacher Effectiveness, Differentiated Instruction

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## 1. Overview of the Proposed Model

The Self-efficacy of Pre-service teachers at a Historically Black College or University (HBCU) is a concern because of the following: 1) the national critical shortage of STEM teachers, 2) the lack of African American teachers teaching all children, including children of color, and 3) The need for Elementary Mathematics Content Specialists. The proponents of this model are to:

- a) Improve STEM education and educator development (NBPTS related training);

- b) Develop a diverse, globally competitive STEM workforce (Increased Self-Efficacy and NBPTS related training);
- c) Increase partnerships between academia, industry, and others (NBPTS Collaboration);
- d) Increase economic competitiveness of the U.S. (Student Mathematics Preparation);
- e) Use STEM Educator best practices to inform public policy (NBPTS related training);
- f) Increase opportunities for African-Americans to participate in STEM leadership roles (Elementary Math Content Specialist Preparation/Training);
- g) Aid in the success of African-American students in STEM related programs.

## 2. Literature Review

For the 2022-2023 school year, districts across the United States experienced a critical shortage of STEM teachers. This has been an ongoing issue in STEM fields. In 2006, [National Council of Teachers of Mathematics \(2006\)](#), President of the National Council of Teachers of Mathematics (NCTM) published an article entitled “We Need Elementary School Mathematics Specialists NOW”. Dr. Fennell described a “specialized teacher model” that assigns the primary responsibility for teaching mathematics to one teacher. The specialized teacher typically has responsibility for a single grade—often at the upper grade levels (e.g., grades 4 or 5). By, 2010, [NCTM \(2010\)](#) President J. Michael Shaughnessy echoed the same sentiment (NCTM Summing Up, June 2010).

Contrary to NCTM’s recommendation, many states still do not offer an elementary mathematics teacher certification and only 22 states currently provide certification for Elementary Content Specialists (ECS). However, districts are using teachers in Elementary Content Specialist roles.

In 1977, Psychologist [Albert Bandura \(1977\)](#) developed the concept of Self Efficacy. It is defined as an individual’s belief in their capability to exercise control over their own functioning and over events that affect their lives. It is a person’s belief in their ability to succeed in a situation. Self-efficacy is developed from four sources:

Self-efficacy is developed from four sources:

- 1) Mastery Experiences—how well you have “Mastered” a task in the past. Past experiences aid in providing a perceived reinforced perception of future success or failure. Hence, if a person has experienced repeated success on a task (Mathematics), they tend to believe that they will continue to experience success in that arena.
- 2) Vicarious Experiences—seeing others “like you” succeed at a task. Hence, if your mother was a successful teacher then you might believe that you could be a successful teacher. This component could be especially daunting for students from homes/backgrounds where they have not “seen” anyone like them pursuing their desired career choice (ex. STEM).

3) Social Persuasion—receiving positive verbal feedback that instills within an individual that they can accomplish a task. For example, consistently telling a child that they think and process information like an engineer. The student then might be “persuaded” to pursue a career in the engineering field. Social persuasion is also encouraged when educators and influencers operate with a Growth Mindset (Dweck, 2006).

4) Emotional States—“the emotional, physical, and psychological well-being of a person can influence how they feel about their personal abilities in a particular situation”. Hence, if an individual generally has low self-esteem, they may believe that they cannot accomplish/achieve any task. For these individuals, interventions must be put in place to address the students’ needs and to move them to a Growth mindset.

According to Bandura, teacher self-efficacy can be developed through “Vicarious Experiences”. Vicarious-experienced or realized through imaginative or sympathetic participation in the experience of another (Merriam Webster). Vicarious experiences (shadowing, internships and clinical experiences) are especially useful for pre-service teachers who have not had the opportunity to create mastery experiences. Within college/university education preparation programs, practicum experiences like student teaching allows pre-service teachers to have a “vicarious” teaching experience. Throughout the experience the pre-service teacher will watch, model, question and adjust their teaching practice based upon the shadowing of their “mentor/master/cooperating teacher”. There is limited research on the impact that vicarious experiences have on self-efficacy. According to (Lazarides, Watt, & Richardson, 2020), research needs to examine whether observing expert teachers in classroom situations versus observing their (the teachers) own behavior in classroom situations yields different effects on teacher students’ self-efficacy (Gold, Hellermann, & Holodinsky, 2017). Vicarious experiences are seen as an important source of self-efficacy not only for the individual teacher but also for schools as organizations that may learn by replicating other institutions’ successful educational programs (Goddard et al., 2004; Morris et al., 2017).

Teacher self-efficacy is based upon the teacher’s personal judgement or belief that they can bring about desired outcomes of student engagement and learning (Tschannen-Moran & Woolfolk Hoy, 2001). According to Tschannen, Teachers with high self-efficacy are more open to new ideas and new teaching methods; they exhibit a greater level of planning and organization, are more constructive in dealing with the mistakes of their students, and are more persistent when facing difficulty.

### 3. Mentors

Research on mentor characteristics and skills is limited, but some studies suggest that knowledge of student assessment (both formative and summative) and standards (both learning and teaching) are critical elements for successful mentoring

(Achinstein & Athanases, 2006). Mentor selection varies by school/district. Per Conway (2006) mentors should have a minimum of 5 years of teaching experience; understand classroom management; be skilled, effective, and reflective. A master of effective instructional practice; be respected as competent by peers; and, committed to their own professional development (Conway & Hodgman, 2006; Moir, 2009; Zaffini, 2015).

As stated by Weimer (2021), potential mentors must also be knowledgeable about subject matter, curriculum, instruction, resources, and assessment (Moir, 2009). They must possess knowledge of students, policies and procedures, and school and community climate and culture (Conway & Hodgman, 2006; Zaffini, 2015). Mentors also provide emotional support, encouragement, and foster a relationship of trust (Conway & Hodgman, 2006; Smith et al., 2005). Therefore, they should possess strong interpersonal skills (Moir, 2009); be organized, confident, collaborative, positive, honest, open-minded, flexible, patient, energetic, enthusiastic, and able to listen, communicate, and interact with a variety of people with different perspectives and viewpoints (Conway & Hodgman, 2006; Smith et al., 2005; Zaffini, 2015).

In the absence of a mentor teacher that possess these qualities, the National Board for Professional Teaching Standards provides a repository of over 1700 ATLAS videos of Nationally Board certified accomplished teachers. ATLAS is a unique, searchable online library of authentic videos showing National Board Certified Teachers at work in the classroom. The essence of the National Board's vision of accomplished teaching is their Five Core Propositions:

- 1) Teachers are committed to students and their learning.
- 2) Teachers know the subjects they teach and how to teach those subjects to students.
- 3) Teachers are responsible for managing and monitoring student learning.
- 4) Teachers think systematically about their practice and learn from experience.
- 5) Teachers are members of learning communities

<https://www.nbpts.org/certification/five-core-propositions/>.

The five core propositions reflect accomplished/master teaching and help to form a strong foundation for potential mentor teachers. More than 125,000 teachers across the United States are Board certified.

#### **4. Effectiveness of Nationally Board Certified Teachers**

More than two decades of research from across the country confirms that students taught by National Board Certified Teachers (NBCTs) learn more than students taught by other teachers.

Previously, teachers needed 3 years of successful teaching experience before beginning the National Board certification process. Effective September 2022, National Board announced a policy change. The policy outlines the following:

Educators can now begin the National Board certification process before completing the 3 years of successful teaching experience.

Even though the teacher can begin the National Board Certification process early, certification will not be awarded until they complete 3 successful years of teaching.

*Currently, research is needed on the impact of beginning the National Board certification process on student achievement and teacher effectiveness for pre-service, first and second year teachers.*

For Nationally Board certified teachers, estimates of the increase in learning are about an additional one to two months of instruction and the positive impact is even greater for high-need students. (Cowan & Goldhaber, 2015; Cavalluzzo et al., 2015; Cavalluzzo, n.d.). Per Peggy Brookins, President of NBPTS, “teachers who have gone through the Board certification process say that it is the most valuable and transformative professional development they have ever received”.

In a seven (7) year study, (Cowan & Goldhaber, 2015), utilized statewide assessment data to study the effectiveness of Board certified teachers in the state of Washington. The empirical results determined that Board-certified teachers produce nearly six weeks of additional learning gains in middle school math classrooms and one to two weeks of additional learning gains in elementary classrooms and middle school reading classrooms. Cowan and Goldhaber also found that teachers who achieve Board certification on their first attempt produce four and a half weeks of additional learning gains compared to those teachers who pursue but never achieve Board certification. The results of the study indicate that the scale score a teacher receives on the assessment is predictive of gains in student achievement. Scores vary based upon the teacher’s certification, with greater effects for middle school math certificates.

Cavalluzzo et al. (2015) studied the effects of Board-certified teachers in Chicago and Kentucky. They examined ACT (American College Testing) and ACT PLAN student tests. The researchers found empirically that National Board Certification is an effective “signal” of teacher quality across locales, test types, and subject areas, while effect sizes varied. They also found that National Board Certification effectively “screens” applicants; in other words, that teachers who achieve Board certification produce larger student gains when compared to teachers who pursue but do not achieve board certification. The proposed model is outlined in detail below. It will be implemented in the pre-service mathematics teacher education program through the undergraduate Mathematics Methods course. This course is required for all education majors that are seeking initial licensure.

The Pre-Service Teacher Model—Each Participant will:

1) PreTest—Be administered the *Teachers’ Sense of Efficacy Scale* (n.d.) (also known as the Ohio State Teacher Efficacy Scale (OSTES)) Tschannen-Moran and Hoy (2007). This scale is a self-assessment designed to gain an understanding of the entities that create difficulties for teachers in an instructional environment <https://stellar.edc.org/instruments/teacher-efficacy-capturing-elusive-construct#>:

[~:text=The%20Teachers.](#)

Teacher efficacy has proved to be powerfully related to many meaningful educational outcomes such as teachers' persistence, enthusiasm, commitment and instructional behavior, as well as student outcomes such as achievement, motivation, and self-efficacy beliefs. However, persistent measurement problems have plagued those who have sought to study teacher efficacy (Tschannen-Moran & Woolfolk Hoy, 2021).

2) Receive a NBPTS account with access National Boards 1700+ Atlas videos. Receive information regarding National Board from a National Board representative.

3) Be assigned to a "think-pair-share" group of 3 members.

4) Be assigned a standard from the Tennessee (or applicable) state standards for elementary mathematics (K-5). Within a group, each group member will have a different standard.

5) Journal Article—review the theoretical basis for Differentiated Instruction. Students will read and review, "Teachers and their implementation of differentiated instruction in the classroom" (Muhamad, Martin, & Raymond, 2017).

Within each group, students will discuss and submit the following questions:

a) What is the overall aim of the research being presented? Is this clearly stated?

b) Have the authors clearly stated what they have identified in their research?

c) Are the aims of the manuscript and the results of the data clearly and concisely stated in the abstract?

d) Have the authors discussed the implications of their research in the discussion? Have they presented a balanced survey of the literature and information so their data is put into context?

e) Identify at least three points the author makes to explain or further expand the main idea. In which paragraphs are these points made?

f) What are some other significant ideas presented in addition to the main idea?

g) Give an overall impression of this article. Is it effective, useful, confusing, informative, etc.? Explain why you are characterizing the article as you are. Point to specific features or details to validate your impression.

6) Video Commentary—review a NBPTS Atlas video, whose content, grade level and instructional strategy align with the students' assigned standard. Read/review the commentary of the instructional content for the self-selected Atlas video. Students will review/reflect and submit a reflection on how the accomplished teacher met each component within the Madeline Hunter rubric and reflect on the practices exemplified in the video.

7) Sample Component 2—review and submit NBPTS Component 2: Differentiation in Instruction—this classroom-based portfolio entry is primarily comprised of samples of student work and an accompanying written commentary. Candidates will submit selected work samples (4) that demonstrate the students' growth over time and a written commentary that analyzes the candidate's instructional

choices. See rubrics on page 25

[https://www.nbpts.org/wp-content/uploads/2021/05/NBPTS\\_Scoring\\_Guide.pdf](https://www.nbpts.org/wp-content/uploads/2021/05/NBPTS_Scoring_Guide.pdf).

8) Lesson Plan—submit a lesson plan aligned to your TDOE (or applicable state) standard that emphasizes Differentiated Instruction. Students will be using the Madeline Hunter Lesson Plan template

<http://coe.indstate.edu/ncate/TOTAL/Student/Lesson%20Plan%20Format%20-%20Madeline%20Hunter.pdf>.

9) Posttest—students will again take the Teachers' Sense of Efficacy Scale (also known as the Ohio State Teacher Efficacy Scale (OSTES)) *Tschannen-Moran and Hoy (2007)*. This scale is a self-assessment designed to gain an understanding of the entities that create difficulties for teachers in an instructional environment.

10) Data—collect data on the impact that beginning the National Board certification process had on student achievement and teacher effectiveness for preservice, first and second year teachers.

## 5. Challenges and Limitations

The challenges and limitations are connected to the Five Core Propositions for the National Board for Professional Teaching Standards. The issues with mitigation strategies are listed below:

Proposition 1—Teachers are committed to students and their learning.

While pre-service teachers are committed to their learning, some are not in full-time dedicated classrooms. To mitigate this, students will reflect on work related and practicum experiences.

Proposition 2—Teachers know the subjects they teach and how to teach those subjects to students.

Proposition 3—Teachers are responsible for managing and monitoring student learning.

Pre-service teachers are still acquiring content and pedagogical knowledge. This model will allow them to see accomplished teacher at work and utilizes NBPTS best practices when designing lessons.

## 6. NBPTS at State and National Levels

Nearly every state in America provides compensation for NBPTS Board Certification, connection to state licensure and/or support for board certification fees. This support varies across the nation. For example, “California provides a \$25,000 incentive award for NBCTs who teach in high priority schools—schools with 55% or more of pupils classified as an English learner or foster youth, or eligible for free or reduced priced meals. The incentive is paid in \$5000 installments for five years”. Whereas, in Hawaii, a “\$5000 annual stipend and an additional \$5000 for NBCTs employed in high-need schools” (*In Your State, 2023*).

## 7. Expected Outcomes

The expected outcomes of this model include increased self-efficacy of Afri-



can-American Pre-Service teachers. This will be measured by the Teachers' Sense of Efficacy Scale (also known as the Ohio State Teacher Efficacy Scale (OSTES)) Tschannen-Moran and Hoy (2007). This scale is a self-assessment designed to gain an understanding of the entities that create difficulties for teachers in an instructional environment. The model also provides increased opportunities for African-Americans to pursue Math leadership positions such as Elementary Mathematics Specialists; aid in retention, and progress of African-American students in Education (Mathematics) K-12 and undergraduate programs. Nationwide research from across the country confirms that students taught by National Board Certified Teachers (NBCTs) learn more than students taught by other teachers.

Overall, the potential of the model to benefit society and contribute to the achievement of specific desired societal outcomes include:

- Increased participation of African-Americans in STEM fields;
- Improved STEM education and educator development (NBPTS related training);
- Development of a diverse, globally competitive STEM workforce (NBPTS related training);
- Increased partnerships between academia, industry, and others (NBPTS);
- Increased economic competitiveness of the U.S.;
- Use of STEM Educator best practices to inform public policy (NBPTS related training);
- Increased opportunities for African-Americans to participate in STEM leadership roles;
- Aid in the success of African-American students in STEM related courses and programs;
- Increase the diversity of African American Elementary Math Specialists in the STEM workforce.

This model can potentially advance knowledge in the field of Educator professional development by providing a model to create, train and support pre-service STEM teachers, content specialists and educational leaders. In addition to potentially impacting college/university teacher preparation, school districts and state/federal entities. This model can be replicated for other content areas.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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