Using Culturally Ambitious Teaching Practices to Support Urban Mathematics Teaching and Learning

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Urban middle and high schools, though challenging places to work, can also be gardens of innovation and creativity for the students and teachers who work in them. How urban school districts support and enhance the educational preparation of their teachers is of paramount importance to the learning of the students who attend these schools. Culturally relevant pedagogy (CRP) is a set of principles that has been shown to support teaching in urban and high poverty settings (Howard, 2001; Lipman, 1995; Morrison, Robbins, Rose, 2008). Its basic tenets – academic achievement, cultural competence, and critical consciousness – address many of the issues urban teachers face in developing a positive and productive classroom environment (Ladson-Billings, 1994). However, as a pedagogy, CRP has not become a staple in many classrooms and schools across the country as research on CRP has not provided specific practices for teachers to employ (Ladson-Billings, 2006) nor has research on CRP clearly delineated how student achievement - broadly or narrowly defined - correlates to a CRP ideological stance.

The field of mathematics education would be a good test case for operationalizing CRP. Math has long been a gatekeeper for course taking, college acceptance and success, and college-major choices (Moses & Cobb, 2001; Schoenfeld, 2002). With the societal view that anyone good at math is intellectually superior, those good at math tend to be White males or Asian, and that mathematics is culture free, it is imperative to provide a counter-narrative about what math is and how it can be taught so all students can succeed (Anderson, 1990; Burton, 1994; Rosa & Orey, 2010). This work will advance a set of teaching practices in mathematics for urban teachers, called Culturally Ambitious Teaching Practices in mathematics (CATP), that considers the possibilities of developing academically challenging yet welcoming classrooms for all students. Specifically, this work will address the following questions:

1. In what ways can the theory of culturally relevant pedagogy be operationalized into teachable and observable ambitious mathematics teaching practices?
2. What areas of CATP are readily observable? Which areas were difficult to observe consistently?
3. How will ratings from the CATP instrument define successful and non-successful implementation of CATP?

Defining urban

Before I begin, it is important to define what urban is in the context of this work. In the New Oxford American Dictionary (2009), urban has two distinct

definitions: 1) relating to the characteristics of a city or town (high population density, economic and cultural diversity) and 2) denoting popular black culture. This connection of urban with African American culture denotes a vibrant, creative, and rich history of a cultural group connected to city living. We know, however, that urban spaces also include economic and cultural diversity that goes beyond just the African American cultural or ethnic group. For this work, I define urban students as students of multiple ethnic backgrounds who dwell in cities and bring their cultural, ethnic, socio-economic, and familial diversity to the city schools they attend. As such, the idea of what it means to attend to issues in urban schools requires a thoughtful consideration of all the cultures that come together in a school and how schools work toward infusing and embracing this diversity.

Review of Literature

Understanding Culturally Relevant Pedagogy

Culturally relevant pedagogy was originally described by Gloria Ladson Billings (1994) in her study of eight African American teachers who were considered to be excellent teachers of students of color. Drawing on critical race theory, she defined CRP as "a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (p. 18). CRP rests on three main ideals: *academic achievement* - teachers demand, reinforce, and produce academic excellence in their students; *cultural competence* - students maintain cultural integrity in their academic excellence; and *critical consciousness* - students are expected to engage the world and others critically (Ladson-Billings, 1995). These areas are three crucial interconnected spaces in a pedagogy of opposition and collective empowerment (Ladson-Billings, 2006). However, culturally relevant pedagogy continues to stay in the margins of educational research and with limited enactment in classrooms. Sleeter (2010), in her work on issues confronting the implementation and marginalization of culturally relevant pedagogy in research and practices, posited that because of the current trend in educational reforms, CRP has not been taken seriously and its power not fully researched or harnessed. Moreover, she argued that other factors have added to CRP's marginalization: a persistence of simplistic conceptions of what CRP is, such as cultural celebration, trivialization, and essentializing; little CRP research on a large scale that connects CRP practices to student achievement; CRP research that only speaks to specific contexts (ethnicities); and the fear of politicizing the classroom through CRP tenets. She suggested clearly defining what CPR is and what it looks like in classrooms while cutting through the political turmoil to highlight how CRP challenges "unjust social relations" (pg. 23).

In research on culturally relevant teaching practices, the three prongs of CRP – academic achievement, cultural competence, and critical consciousness – were rarely found together. Most research on CRP focused on cultural competence; looking closely at students' cultural habits, behaviors, and choices in order to infuse them into teaching practices and curriculum materials (Benson, 2003; Enyedy & Mukhopadhyay, 2007; Hastie, Martin, & Buchanan, 2006; Hefflin, 2002; Young, 2010). Less attention was placed on academic achievement, and least of all, critical consciousness. Young (2010) in her study on supporting school administrators and teachers in implementing CRP practices, found teachers were less likely to address issues of social justice with curriculum materials or events. In their literature review of 45 studies describing culturally relevant pedagogy, Morrison, Robbins, and Rose (2008) also found fewest examples of critical consciousness being enacted in CRP classrooms. Young (2010) provided an explanation for this lack of consideration of critical consciousness; teachers can have "an unintended cultural bias or an unpreparedness to confront issues that are racially and socially charged" (p. 256).

Culturally relevant pedagogy and mathematics teaching

Understanding and navigating the pathways that lead to academic success are crucial in mathematics. Studies have shown that mathematics school achievement is affected more by the school environment (i.e. curriculum, teacher qualifications and expectations, materials) than by the home environment (Lee, 1998; Roscigno, 1998); that mathematics is critical in advancing to higher education due to its filtering effect (Schoenfeld, 2002); and that mathematics is a civil rights issue in that if children are not math literate they will be doomed to second-class economic status (Moses & Cobb, 2001). As many urban students of color perform poorly in math on classroom achievement and standardized tests, it is imperative to look beyond students' backgrounds as the sole reason for their difficulties and consider how mathematics is taught in schools.

Ethnomathematics – the study of the relationship between culture and mathematics – considers how different cultures use mathematics to solve problems (D'Ambrosio, 2001; Rosa & Orey, 2010). An ideological framework behind ethnomathematics is that "mathematics is a cultural product and that every culture has developed its own form of mathematics"(Rosa & Orey, 2010, p. 21). As defined, ethnomathematics shares a vision of teaching and learning with culturally relevant pedagogy in that "the teacher builds from the students' knowledge (*ethno*) or informal mathematics and orients the lesson toward their culture and experiences (*mathema*), while developing the students' critical thinking skills" (p. 24). If we are serious about creating equitable classrooms where all students have opportunities to learn math at high levels, considering the

influence culture has on the math knowledge being shared *with* students as well as the impact culture has on how math knowledge is learned *by* students leads us to focus on the cultural influences teachers draw on to understand and impart math knowledge in their classrooms.

In the studies that focused on culturally relevant teaching in mathematics classrooms, a consistent finding is the use of student prior knowledge, both cultural as well as mathematical, in classroom practice (Brenner, 1998; Bonner, 2009; Gutstein, Lipman, Hernandez, & de los Reyes, 1997; Matthews, 2003; Nasir, 2002; Osisioma, kiluva-ndunda, & Van Sickle, 2008; Tate, 1995). Matthews (2003) suggested teachers should work to form a dialectical relationship among themselves, their students, and the community such that informal/cultural knowledge and critical thinking be used to build bridges to culturally accepted mathematics knowledge and the culture of school. Gutierrez (2009) also contended that to move toward equitable mathematics teaching, teachers must know their students through a variety of avenues – academically, socially, personally – without essentializing who they are. Creating equitable classrooms where all students have opportunities to learn math at high levels, we must consider the influence culture has on the math knowledge being shared *with* students as well as the impact culture has on how math knowledge is learned *by* students.

Other findings in the research on culturally relevant mathematics teaching demonstrated how teachers made connections to students' lives and communities with real world applications of mathematics (Ensign, 2003; Enyedy & Mukhopadhyay, 2007; Gutstein, Lipman, Hernandez, de los Reyes, 1997; Rosa & Orey, 2010; Tate, 1995). It is crucial for students to grapple with the messiness and unpredictability of the real world through applications with direct connections to students' lives. However, because students bring different experiences, habits, and values with them to a classroom, trying to account for those myriad experiences can be an impossible and overwhelming task for teachers. It then becomes important to develop a critical and problematic stance about teaching and learning school mathematics as a way to bring the messiness found in real life applications to the abstract work of school mathematics.

Ambitious and High Leverage Mathematics Teaching Practices

Ambitious and high leverage mathematics teaching practices have been studied in mathematics teacher education; its focus has mainly been on how novice teachers learn high level and critical mathematical practices (Ball & Forzani, 2009; Grossman, Hammerness & McDonald, 2009; Lampert, Boerst, & Graziani, 2011). However, ambitious math practices are just as important for in-service teachers. Lampert, Boerst, Graziani (2011) defined ambitious teaching as "teaching that

aims to teach all kinds of students to not only *know* academic subjects, but also to be able to *use* what they know in working on authentic problems in academic domains" (p. 1, emphasis added). High leverage teaching practices are "teaching practices in which the proficient enactment by the teacher is likely to lead to comparatively large advances in student learning" (Ball, Sleep, Boerst, & Bass, 2009, p. 460). High leverage and ambitious teaching practices (see figure 1) in math focus on what learning is co-produced by teachers and students in specific contexts, what practices are central to daily math teaching, and considers student differences and issues of equity (Ball, 2011).

Figure 1

High leverage teaching practices adapted from Ball (2011), "Supporting High-Quality Mathematics Instruction"

Ten high leverage practices for ambitious math learning
• choosing math tasks that are complex and build skills
• choosing examples
• academic language
• productive whole-class discussions
• reflecting on and using student errors
• using homework equitably
• specific math focused positive reinforcement
• public recordings
• diagnosing patterns of student thinking
• assessing and adapting to students' math proficiencies

However, since most of the research has been on supporting the development of novice teachers, less focus has been paid to in-service teachers and the kinds of classroom environments that support ambitious math practices. This work considers how ambitious mathematics teaching practices can embrace ideals of culturally relevant pedagogy in order to develop such a classroom environment: addressing cultural competence through building on and to students' prior knowledge, encouraging academic achievement through the development of inquiry skills, and infusing critical consciousness by adopting a problematic stance about mathematical ideas and content.

Culturally Ambitious Teaching Practices in Mathematics

I define Culturally Ambitious Teaching Practices in Mathematics (CATP) as mathematics teaching practices that support the development of a culturally relevant classroom environment and is a space for learning ambitious mathematics through a community of teachers and schools leaders who critically reflect on teaching. Appendix A provides the list of practices in rubric form, defined and organized by CRP tenets. CATP is a framework that meshes the

ideals of cultural relevance with the ideals of ambitious mathematics into a set of teaching practices that are used to develop a *classroom environment* in which all students, but particularly urban students, can achieve and learn mathematics at a high level. Why classroom environment? I posit that the starting point for implementing CRP is the classroom environment; students need to consider how they fit into the classroom community and how they can have an impact on the learning environment. Teachers also have to consider how they themselves fit into the classroom environment they are crafting – thinking about their own beliefs, culture, and learning habits and how these beliefs and habits interact with their teaching practices. As such, the demands on teachers is to understand not only the mathematical knowledge in the work they do, but also to include the multiple perspectives of students and their habits of interaction. It is the teacher's work to build a classroom environment that supports the mathematical knowledge to be taught, the cultures students bring, and the practices that acknowledge, examine, and support student growth as math learners. Doing high-level mathematics through critical analysis with your peers, taking risks and making mistakes, or engaging in discussions that draw on different, and sometimes uncomfortable, worldviews requires students to be in a space where they feel safe and cared for. Developing that environment then becomes structure upon which culturally relevant pedagogy and ambitious math can find a foothold.
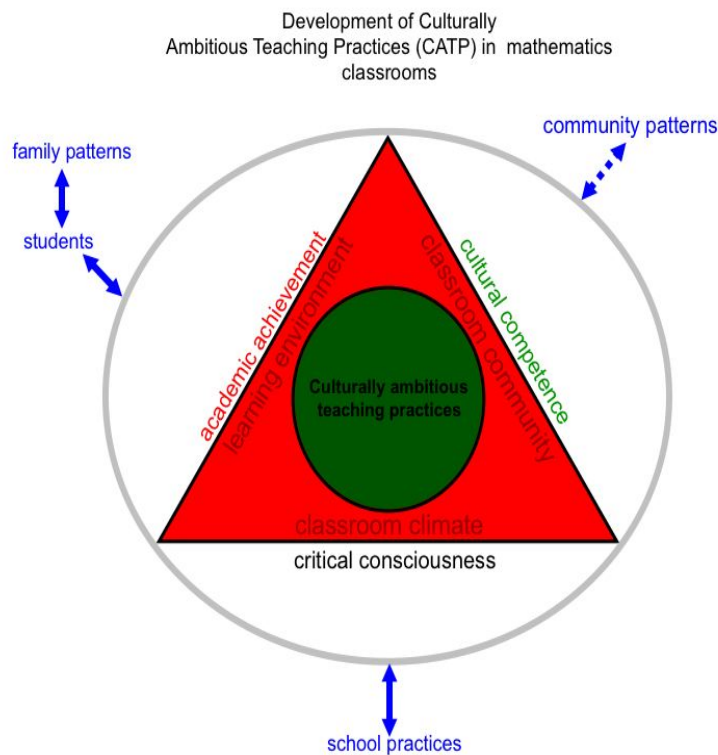
Drawing on the work of Tompkins (2009) on the development of a classroom community in language arts classrooms and Matsumura, Slater, and Crosson's (2008) work on classroom climate and rigorous instruction in urban schools, I define a classroom environment as having three parts. First is the *learning environment*, which encompasses the structures and procedures that support student learning and the academic attitudes developed in the classroom. Another aspect of the environment is the *classroom community* that considers the interactions between community members and the supportive relationship for learning that can be developed among those members. Finally, the *classroom climate* is the degree to which students feel safe and supported in the classroom and how that safety allows students to critically consider their world (see figure 2).

Learning environment

The learning environment has as its focus the CRP tenet of *academic achievement*. Teachers demand, reinforce, and produce academic excellence in their students; students' skills and abilities are valued and channeled in academically important ways (Ladson-Billings, 1995). Providing structures, templates and academic protocols for students allows them to have a base upon which to build their learning and in turn, will scaffold students to tackle higher-level problems and tasks. Teachers also know that in order for students to be successful in the work

that is expected of them, additional work may be needed on a regular basis – in and out of the classroom. Students need multiple opportunities to learn new materials, review areas of academic weakness, and grapple with challenging ideas while developing perseverance and dedication for their academic endeavors.

Figure 2
The development of culturally ambitious teaching practices in mathematics

Development of Culturally
Ambitious Teaching Practices (CATP) in mathematics
classrooms

family patterns

community patterns

students

academic achievement

cultural competence

learning environment

classroom community

Culturally ambitious
teaching practices

classroom climate

critical consciousness

school practices

Classroom community

By paying close attention to the classroom community, teachers utilize students' *cultural competence* as a vehicle for learning; students maintain their cultural integrity as they strive for academic excellence. Classroom communities are designed to enhance cultural competence encourage students to be self-reflective about their multiple identities and how those identities can be used to create a positive life path. However, many middle and high school students are aware of the expected school behaviors, rules, and protocols but may enact behaviors that are deemed "unacceptable" in a school setting. In particular, many urban students

come to school with ideals and habits that do not match "mainstream" ways of interacting in school. Though some behaviors may be detrimental to students' academic learning, other behaviors that are deemed unacceptable could be parts of the cultural habits and histories of the students' lives. Teachers can support students' cultural competence by critiquing their responses to behaviors and determining the detriment and/or benefit to learning each behavior represents and then responding accordingly (Davis and Martin, 2008). Knowing each student academically, socially, and personally supports a teacher's ability to further understand student behaviors.

Classroom climate

To engage in a *critical consciousness* stance about learning, the classroom climate must allow students to feel safe. Developing a safe classroom means teachers readily address issues and events that can potentially make students fearful and hesitant in their interactions with others. Through a safe classroom climate, teachers and students can examine inequities in society and how these inequities play out in their lives. In order to consider and understand the ways in which societal biases impact policies, rules, and structures, students will need to develop a critical or problematic stance for trying to uncover such biases. A problematic stance means you consider things from a critical or questioning point of view (Hiebert et al., 1997). This problematic stance, however, does not only have to be used when thinking of issues in society and community. This also includes ideas such as basic algorithms in math as well as reasons for war in social studies. Asking why we learn certain algorithms or whose viewpoints the reasons for war are supported and whose viewpoints are rejected denote viewing school learning in a problematic way. Developing a problematic stance in relation to everyday school learning is important, as it develops the skill of critical inquiry in students that includes querying issues and ideas both in and out of school.

Outside Factors

Although teachers hold a great degree of autonomy and responsibility in developing their classroom environments, there are other factors that influence the classroom and the practices teachers put into place. Families and students have a large impact on the structures and procedures that support learning in the classroom. As discussed previously, the habits and practices students learn from their families can interact in a classroom in multiple ways; teachers need to be aware and open to any conflicts or differences. School policies and practices can also have an impact on the teaching practices implemented in a classroom. Being flexible, staying involved in policy and committee decisions at the school and/or

district level, and maintaining open lines of communication with school leadership will allow teachers to become an advocate for culturally relevant and ambitious teaching as an important staple in their school. Finally, the community in which the school is situated, too, can have an impact on how teachers develop their classroom environment. Knowing and drawing on available community services can bring a variety of opportunities to a school and classroom. The development of a classroom designed to support students in critical inquiry about their academic and social lives is grounded in the teacher's awareness of the different forces coming to bear on their classroom practices.

Methods

Participants

Six middle school mathematics teachers were used in this work to analyze the CATP instrument. The teachers ranged from 1 to 4 years of teaching experience. This group of teachers was a convenience sample from schools in which the researchers work as coaches for mathematics and literacy. All teachers were students in a special master's program designed for urban middle school teachers that included content and urban focused course work, weekly coaching by a faculty member, and a cohort system that placed teachers in schools with others in the program. The schools where the teachers work were three urban middle schools, grades 5-8, in a southeastern mid-size city (see Table 1).

Table 1
School Demographics

	Washington	Buchanan	Adams
% Asian	6.2%	2.0%	4.4%
% Black	26.2%	73.9%	38.1%
% Hispanic	42.0%	8.1%	38.3%
% American Indian	-	-	-
% White	25.5%	16.0%	19.2%
% Free/Reduced Lunch	90.4%	96.4%	89.7%
% English as a Second Language Program Eligibility	19.8%	10.1%	19.8%
% Limited English Proficiency	25.2%	10.5%	23.0%

Developing CATP

The development of CATP involved a number of iterations of considering mathematical practices through multiple lenses. I first drew on previous work where I defined reform-oriented teaching practices (Waddell, 2010). Those practices were then compared with the current research on high leverage and ambitious practices and revised (Ball & Forzani, 2009; Grossman, Hammerness & McDonald, 2009; Lampert, Boerst, & Graziani, 2011). I then amplified Ladson-Billings (1994) definition of culturally relevant pedagogy with other studies on CRP in classrooms to consider how the tenets of CRP could be operationalized in mathematics classrooms. Then the revised mathematical practices were organized through the CRP lens by asking a series of questions – Which practices exemplify the ideas of supporting and developing the academic prowess of students? Which practice support opportunities for students to draw on their cultural knowledge and backgrounds as an avenue for academic success? Which practices provided opportunities to critically engage with the math content through multiple perspectives? Appendix A provides the list of practices in rubric form, defined and organized by CRP tenets.

Data collection and analysis

Each teacher was observed twice over a two-month period; each observed lesson was video recorded. The recorded lessons were chosen at the convenience of the observer and teacher from the same class period. A total of 12 videos were coded, with four videos used for training of raters. Three raters were used for this project: the principal investigator, who was also the math coach for the participants, an experienced middle school teacher who was interning with the PI in classroom coaching, and a fellow faculty member who was also a literacy coach working in urban classrooms. All raters had seven or more years of middle school teaching experience, with the PI and teacher rater having mathematics teaching experience. The raters watched four videos together to learn to use the CATP rubric; they rated the teachers' enactment of practices using a rating scale: fluent, consistent, inconsistent, or not evident (see Table 2). The raters then discussed areas of discrepancies in their ratings and what may have caused those discrepancies. After the group ratings, each rater individually rated the remaining teacher videos and those ratings were compiled and analyzed.

After the data was compiled, ratings for each teacher were tabulated, resulting in three ratings per teacher per practice. Inter-rater reliability was calculated using a linear weighted kappa between each pair of raters to determine the measure of agreement between raters; the linear weighted kappa was used

because the ratings were related and consecutive, i.e., a rating disagreement between fluent and consistent is less troubling than the difference between fluent and inconsistent, etc. (Lowry, 2012). Additionally, the ratings for each practice were tabulated and counted to consider the levels at which the teachers enacted each practice.

Table 2
Rating descriptions for CATP

Fluent	Teacher enacts practice in a natural and fluid manner; the practice is noted throughout the lesson in different areas; students respond to the practice in positive and expected ways
Consistent	Teacher enacts practice in multiple ways through the lesson; students sometimes respond to the practice in expected ways
Inconsistent	Teacher enacts practice minimally and/or narrowly; student response is limited and/or negligible
Not Evident	The teacher does not enact the practice

Findings

To determine the agreement between raters, pair-wise ratings were counted between each pair of raters. There were 480 possible pair-wise ratings over 20 practices and 8 observed lessons. A linear-weighted kappa was calculated for each pair of raters, resulting in 3 kappa statistics: 0.3617 with standard error of 0.053 between the two faculty members, 0.2906 with standard error of 0.0675 between the PI faculty member and the teacher rater, 0.1808 with standard error of 0.07 between the second faculty member and the teacher rater. The highest value was between the two faculty members and the lowest between the teacher coder and second faculty member. Though the level of agreement as noted by the kappa statistic is low, a closer look at the actual meaning of the agreements and disagreements is warranted.

Looking at the actual ratings, 42% of all the pair-wise ratings were full agreement (F-F, C-C, etc.), and 84% were either full agreement (both raters agreed) or one-off agreement - rater agreement is off by one category: fluent-consistent, consistent-inconsistent, inconsistent-not evident. The practices with the highest agreement by raters are noted in Table 3. Of the 20 practices, twelve had full or one-off rater agreement of 85% or better. The highest level of full agreement was 75% or 15 pair-wise ratings, with three other practices having full rater agreements of 60% and above.

Table 3
Practices with the highest rater agreement

Practice	Full rater agreement	Full and One-off rater agreement
Encouraging all students in their academic success; providing	75%	100%

space for accolades of academic achievement		
Facilitating student independent work	65%	100%
Demonstrating and leading students in developing respectful and caring classroom norms, individual work behaviors, habits, and attitudes through explicit critique and discussion	65%	100%
Using activities and tasks to encourage risk taking, perseverance, and collaborative thinking with/among students	60%	95%
Encouraging active listening among classroom community members by promoting and modeling student to student, student to teacher interactions	55%	100%

Practices with lower rater agreement are shown in Table 4. Though having one-off rater agreement of about 50%, the level of full agreement was much lower for these practices, ranging from 20 to 30 percent. Of the lowest eight practices in rater agreement, the level of full rater agreement ranged from 20% to 45%, but with a one-off agreement rate ranged from 55% to 80%.

Table 4
Practices with low rater agreement

Practice	Full rater agreement	Full and One-off rater agreement
Providing work and interaction templates, structures, routines, and organizers for students in assignments, communication and behaviors	25%	55%
Creating opportunities for small group/partner/collaborative work	20%	60%
Using multiple forms of assessment to support the learning growth of all students	30%	60%
Developing and using varied tools and representations including student work	25%	75%
Modeling, comparing, and analyzing problems and solution strategies with students by thinking, reasoning, and justifying	25%	75%

When considering how the raters agreed within and across CRP categories, practices that were considered cultural competence related had the highest rates of agreement (7 out of 7 practices had agreement of 85% or greater), while academic achievement practices had the lowest rates of agreement (only 4 out of 10 practices had agreement of 85% or greater). Critical consciousness only had three practices considered for this study, but with a rater agreement of 85% (see Table 5).

Table 5
Rater agreement of practices by culturally relevant pedagogy tenets

CRP tenet	Full agreement	Full and one-off agreement
Cultural Competence	42%	91%
Critical Consciousness	50%	85%
Academic Achievement	38%	78%

Discussion/Implications

Observing CATP

The findings confirm previous research on the difficulty of operationalizing CRP. Raters had difficulty agreeing on how the practices were enacted and to what degree. It became evident during the training of CATP that the raters needed to fully develop their understanding of cultural relevance. As an example, the teacher rater had difficulty seeing practices that focused on academic achievement as being culturally relevant. Her view was that only practices that focused on issues of student culture or critical analysis of world events should be culturally relevant. Before classroom observers can work with teachers on examining and critiquing their own culturally relevant practices, the observers must also have the opportunity to do the same. When considering the importance and challenge associated with the perspective-changing elements of culturally relevant pedagogy, classroom observers need opportunities for deep learning of cultural relevance. Just as they will take their teachers through a slow, but critical shift in thinking about math learning, they too will have to look deep in themselves to consider the impact of their viewpoints and backgrounds on the work they do with teachers.

Practices with higher rater agreement correlated with practices the teachers enacted fluently or consistently. Because there was less ambiguity, it was easier for raters to discern whether the practice was enacted and to what extent. Six of the eight practices with the highest rater agreement were also the practices enacted most fluently by teachers. On the other hand, practices with low rater agreements may have occurred because a deeper understanding was needed to distinguish the degree to which a practice was enacted: What is the degree to which a practice moves from consistent to fluent? Inconsistent to consistent? This could be an issue for all ratings, but based on the data, the number of one-off ratings between fluent and consistent were the highest as compared to consistent and inconsistent, or inconsistent and not evident (see Table 6). We noted that it was more difficult to determine whether a practice was consistent or fluent due to both ratings being examples of enacting a practice well.

Table 6
Number of one-off ratings between rating categories

Ratings	Number of one off ratings
Fluent and Consistent	127
Consistent and Inconsistent	37
Inconsistent and Not Evident	23

One explanation on the difficulty to agree on the degree to which a practice was enacted is related to the idea of what a specific mathematical practice looks like in a classroom. High level and ambitious mathematics practices move away from what many people envision a math classroom to look like - teaching topics in abstraction and context free, using deductive reasoning over intuitive (personal or invented) and empirical methods, and memorizing traditional solution methods that follow from static mathematics principles (Anderson, 1990; D' Ambrosio, 2001). Having a deep and workable vision of ambitious math practices, such as actively engaging prior content knowledge and student background knowledge or encouraging student sharing and explaining of their ideas for both correct and incorrect work/responses, is more difficult to consider without having experiences with those practices, leading to inconsistency in classroom observer ratings.

Enacting CATP

To be considered a successful implementer of CATP, a teacher had to have an overall fluent and consistent average of 80% or higher. The 80% threshold reflects having no more than 2 practices per CRP category below 80%. Additionally, when ratings were categorized by CRP tenet, no tenet total should average below 80%. The teacher ratings ranged from a high of 87% fluent and consistent to a low of 42%. Four of the teachers would be considered successful implementers with over 80% fluent and consistent ratings. Looking at the data through percentages, we were not putting a value on a teacher's worth in the classroom. Rather, the data allowed us to recognize which areas of CRP teachers are most adept in enacting, and which areas they continue to need support.

Overall, the teachers in the study enacted the 20 CATP's fluently or consistently 74% of the time. The practices rated highest in fluency were practices around classroom community and cultural competence. For example, the teachers used math tasks that encouraged students to think together and take risks, and allowed students more opportunities to listen and communicate with each other mathematically. These practices allowed students to bring themselves into the classroom, and use their ways of communicating with supportive mediation by the teacher. Teacher leveraged student talk and representations as a bridge from informal math representations toward more formal ones. This builds a strong class community through cultural competence, by accepting and valuing shared ideas and strategies.

Practices the teachers were less successful in enacting did not fit into one CRP area. As an example, one of the lowest rated practices – analyzing and critiquing differences in world views/student life views through and with content objectives– demonstrated the teachers' continued hesitancy in delving into issues

of social justice and questioning societal norms. Only two teachers in the study took up issues that uncovered differences or questions about the way things occurred in the world or in the classroom. It is clear that the work needed to encourage teachers to feel comfortable and confident in tackling social justice and inequality issues continues to be challenging. However, the teachers in this study were provided with opportunities to reflect on ways to engage students in these deep and important conversations. Other low rated practices reflected conflicts between expected CATP's and school norms and expectations, such as traditional classroom management protocols.

The question arises, so what does that mean? Should those teachers who are rated fluent in CATP also have higher levels of test achievement? Though student achievement levels as reflected in standardized testing are paramount to the teachers in this study, as it is for most teachers in the US, we want to measure achievement in different ways. In this study, we did not collect test data from the teachers or any other type of data that may represent the impact of successful implementation of CATP on student achievement. However, looking ahead, collecting student data on attendance, homework completion, other academic pursuits, future goal setting, and surveys on attitudes toward math and school in addition to test scores as measures of success would help more fully understanding the impact of enacting CATP.

Looking Forward

The goal for developing CATP is to allow teachers, mentors, and administrators to have a baseline of practices that reflect the ideals of developing cultural relevance in math classrooms. Having well-crafted practices that reflect the deep and critical aspects of CRP and ambitious mathematics provides starting points for conversations about classroom practices. Using such practices can help maintain and grow opportunities for critical reflection by teachers on their practices, beliefs, and cultural vision. It is the teacher's work to build a classroom environment that supports the high-level mathematical knowledge to be taught, the cultures students bring, and the practices that acknowledge, examine, and support student growth as math learners. Using a tool like CATP to consider culturally relevant pedagogy in the development of math classrooms becomes the backdrop for the rigorous work of teaching mathematics with understanding.

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Appendix A.   Culturally Ambitious Teaching Practices in Mathematics

CATP practice					
Academic Achievement. The learning environment has as its focus the CRP tenet of academic achievement. Teachers demand, reinforce, and produce academic excellence in their students; students' skills and abilities are valued and channeled in academically important ways (Ladson-Billings, 1995). Providing structures, templates and academic protocols for students allows them to have a base upon which to build their learning and in turn, will scaffold students to tackle higher-level problems and tasks. Teachers also know that in order for students to be successful in the work that is expected of them, additional work may be needed on a regular basis – in and out of the classroom. Students need multiple opportunities to learn new materials and grapple with challenging ideas while developing perseverance and dedication for their academic endeavors. This additional and focused time can allow teachers to attend to students' academic identities and explore the ways those identities are tied together with their personal and cultural identities (Martin, 2000; Nasir, 2002; Nasir & Saxe, 2003).					
sub category	**Academic achievement**		**The teacher:**		
classroom interactions	Encouraging all students in their academic success; providing space for accolades of academic achievement		develops a system to provide all students with academic success on their academic levels; offers students consistent, focused and specific feedback on their academic work; provides rigorous and meaningful goals for students to reach and supports all students attempts to reach those goals; describes the outcomes of classroom work habits and behaviors on future outcomes		
content inquiry and tasks	Questioning and probing students on multiple levels (Bloom's taxonomy) and using thinking time to encourage academic engagement		Uses multiple levels of questioning (Bloom's taxonomy as an example) to solicit student ideas or information and probe student thinking; uses multiple levels of questioning and discussion with students to support learning through modeling		
content inquiry and tasks	Providing activities and tasks of a varying cognitive demand that challenge all levels of students in classroom - memorization, procedures without connections, procedures with connections, doing math.		considers cognitive demand of work provided to students; uses differentiated instruction methods to allow all students to engage with learning activities that encourage higher level thinking		
content inquiry and tasks	Using multiple forms of assessment to support the learning growth of all students		continually gathers information/data about students through assignments, questions, interviews, writing tasks, and other means; makes appropriate decisions about such matters as reviewing material, reteaching a difficult concept, or providing something more or different for students who are struggling or need enrichment; provides students with clear and timely feedback on their learning with opportunities for corrections and growth		
content inquiry and tasks	Modeling, comparing, and analyzing problems and solution strategies with students by thinking, reasoning, and justifying		interactively models problem solutions, games, and tasks to emphasize strategies and thinking; models and compares different strategies when discussing student work; conjectures, reasoning, error analysis, and alternative solutions are discussed; models how to make sense of content ideas, construct arguments, analyze situations, provide evidence and support for conclusions and claims		
family, school. community integration	Creating a two way communication pathway about academic progress between school/classroom and families using multiple forms of communication		develops consistent forms of family communications, beyond normal school measures, that informs them of upcoming classroom assignments, student grades, conferences, and other classroom needs		
learning structure	Providing work and interaction templates, structures, routines and organizers for students in assignments, communication and behaviors		develops specific tools, routines, formats, and forms to support organized learning for students; provides consistent examples and reminders for these structures		

Cultural Competence. By paying close attention to the classroom community, teachers utilize students' cultural competence as a vehicle for learning; students maintain their cultural integrity as they strive for academic excellence. Teachers can support students' cultural competence by critiquing their own responses to behaviors and determining the detriment and/or benefit to learning each behavior represents and then respond accordingly (Davis and Martin, 2008). Knowing each student academically, socially, and personally supports a teacher's ability to further understand student behaviors and how to address them. Another action to support students' desire to examine their behavior is the development of a classroom community grounded in collaboration, risk-taking, personal and group responsibility, perseverance, and communication.

	Cultural Competence		
content inquiry and tasks	**Actively engaging prior content knowledge, as well as student background knowledge, in preparation for learning**	draws out and uses students' mathematical prior knowledge as a mathematical tool; considers what students may know about the topic or context of the lesson and actively engages students in thinking about and sharing their ideas on the context; uses this information to support learning of the topic; helps students critique how their understandings and cultural knowledge can be useful in learning	
communication	**Encouraging student sharing and explaining of their ideas for both correct and incorrect work/responses**	llows opportunities for sharing and explaining ideas and solutions as part of classroom protocols; uses student errors as teaching and learning experiences; works to connect student ideas to one another	
classroom interactions	**Creating opportunities for small group/partner/collaborative work**	provides small group work and opportunities to actively engage with task or activity; encourages interdependence, accountability, and participation.	
communication	**Leading whole group discussions to build "taken-as-shared" understandings**	develops whole group discussions about math topic of the day, providing students with opportunities to engage with math ideas and interact with others while doing so, uses discussions to develop academic language, representations, and ways of knowing that can become common in the classroom	
learning structure	**Facilitating student independent work**	engages with students as a support during independent or small group mathematical tasks; actively monitors the classroom for appropriate behavior and academics focus	
communication	**Encouraging active listening among classroom community members by promoting and modeling student to student, student to teacher interactions**	encourages students to listen, focus and interact with the topic at hand and who is speaking during discussion/lessons; provides interaction structures for students in discussions of tasks and concepts that include student to student interactions	
communication	**Modeling and supporting multiple means of mathematical communication using academic language, everyday language, symbols and representations**	encourages students to use a variety of means and media to communicate and solve problems in the classroom (models, drawings, symbols, physical materials, verbal models, kinesthetic movements); provide examples of correct usage of academic language and the relationship to everyday language	
family, school. community integration	**Engaging in school extracurricular activities**	participates/leads extra curricular activities in the school community that match personal interests and skills; encourages students to join activities that interest them	
family, school. community integration	**Spending time attending student social activities and community projects**	attends student events that occur outside of school - sporting events, recitals, church services, community fairs and events - as a way to understand and appreciate the community and its impact on the students	

Critical Consciousness. The idea behind critical consciousness is for students to engage the world and others critically (Ladson-Billings, 1994). However, to engage in a critical stance about learning, students need to feel safe in the classroom climate. Developing a safe classroom means teachers readily address issues and events that can potentially make students fearful and hesitant in their interactions with others. From openly sharing and analyzing mathematical mistakes to discussing the pros and cons of life pathways students' families have taken, teachers and students interrogate and dialogue school and life through a critical lens. Critical consciousness considers the inequities in society and how these inequities play out in the lives of students. For marginalized students, being able to view the world from multiple perspectives and consider how those perspectives correlate to outcomes is an important skill in the effort to mitigate the detrimental effects of having low societal status. In order to consider and understand the ways in which societal biases impact policies, rules, and structures, students will need to develop a critical or problematic stance for trying to uncover such biases. A problematic stance means you consider things from a critical or questioning point of view (Hiebert et al., 1997). This problematic stance, however, does not only have to be used when thinking of issues in society and community. This also includes ideas such as basic algorithms in math as well as reasons for war in social studies. Asking why we learn certain algorithms or whose viewpoints the reasons for war are supported and whose viewpoints are rejected denote viewing school learning in a problematic way. Developing a problematic stance in relation to everyday school learning is important, as it develops the skill of critical inquiry in students that includes querying issues and ideas both in and out of school.

	Critical Consciousness					
content inquiry and tasks	**Adopting a problematic stance in teaching by developing, analyzing, and critiquing content ideas**	considers and draws on the important mathematical ideas behind activities and assignments; encourages students to consider math problems from different perspectives and methods; presents assignments and tasks as something to be thought about and considered, rather than as prescriptions to be followed, models critiquing of problems and ideas, uses questions to problematize ideas, solution strategies, and claims				
content inquiry and tasks	**Analyzing and critiquing differences in world views/student life views through and with content objectives**	researches and analyzes school content from multiple perspectives; provides avenues for students to engage in a critical analysis and evaluation of content; makes connections to the world and student communities through mathematical discussions and activities; interacts with school community outside of classroom as a way to gain access to relevant connections				
family, school. community integration	**Supporting families' understanding of connection among school requirements, student needs/future goals, family habits**	develops and maintains regular interactions with families to inform them of upcoming events, avenues for academic support, how up coming events impact students' academic lives; pathways toward family / student desired academic goals				
classroom interactions	**Demonstrating and leading students in developing respectful and caring classroom norms, individual work behaviors, habits, and attitudes through explicit critique and discussion**	requires students to demonstrate respectful, caring, and supportive behavior to one another while demonstrating that same behavior to all classroom members; consistently and quickly addresses issues of disrespect as a model for classroom behavior; builds a classroom community that works to establish participation norms through critique and discussion; considers differences between school and home behaviors and openly discusses them				