


2014

Culturally relevant pedagogy: secondary mathematics in an urban classroom

Julia Glissmann North
University of Northern Iowa

Copyright © 2014 Julia Glissmann North

Follow this and additional works at: <https://scholarworks.uni.edu/hpt>

 Part of the [Algebra Commons](#), [Bilingual, Multilingual, and Multicultural Education Commons](#), [Curriculum and Instruction Commons](#), [Science and Mathematics Education Commons](#), and the [Secondary Education and Teaching Commons](#)

Let us know how access to this document benefits you

Recommended Citation

North, Julia Glissmann, "Culturally relevant pedagogy: secondary mathematics in an urban classroom" (2014). *Honors Program Theses*. 97.

<https://scholarworks.uni.edu/hpt/97>

This Open Access Honors Program Thesis is brought to you for free and open access by the University Honors Program at UNI ScholarWorks. It has been accepted for inclusion in Honors Program Theses by an authorized administrator of UNI ScholarWorks. For more information, please contact scholarworks@uni.edu.

CULTURALLY RELEVANT PEDAGOGY:
SECONDARY MATHEMATICS IN AN URBAN CLASSROOM

A Thesis Submitted
In Partial Fulfillment
Of the Requirements for the Designation
University Honors

Julia Glissmann North
University of Northern Iowa

December 2014

Research and test scores have shown that African-American, Latino, Native American, and other minority students are underachieving in secondary mathematics. This is concerning not only to school personnel – who are under pressure to have students perform well on standardized tests – but also to the future of the country. When teachers adopt a culturally relevant pedagogy, diverse students will have a better opportunity to learn and retain mathematical content. When academic content is taught in a culturally relevant way, students are able to retain the information, improve their performance in school, and become more informed participants in society. Through literary analysis, I have determined how culturally relevant teaching can be applied in an urban, Algebra I classroom. I have also provided examples of how mathematical tasks can better reflect the cultures and environment of urban students.

Literature Review

Research and test scores suggest that there is a lack of equity in mathematics education. When considering the different factors that influence students' achievement in mathematics, the teachers' chosen pedagogy appears to be a leading factor. This suggests that teachers must choose a pedagogy that fully meets the needs of their students – specifically, a culturally relevant pedagogy. Although culturally relevant teaching can be applied in any classroom, my focus will be on research regarding how this pedagogy is being applied in mathematics classrooms.

Current Student Performance

African-American, Latino, Native American, and other minority students have consistently underperformed in mathematics compared to white students. “The consequences of this underachievement for [minority] students includes the creation of

future citizens who will not be productive and contributing members of their families, communities, nation, and world,” said Ukpokodu (2011, p. 47). Our communities and country are not the only parties being impacted by the underachievement of students; schools and teachers are being impacted as well. The United States puts heavy emphasis on standardized test scores, which in turn puts a great deal of pressure on school personnel to have their students perform well. Unfortunately, despite this pressure, minority students continue to underperform on these tests.

The underachievement of culturally diverse students becomes very evident when looking at results from the National Assessment of Educational Progress (NAEP) mathematics assessment (2013). This is an ongoing assessment given to students all across the nation during fourth, eighth, and twelfth grade. Not only does the assessment allow us to see how students as a whole are performing in mathematics, but the authors also disaggregate the data based on different factors (socioeconomic status, level of parental education, race and ethnicity, etc.).

Although overall NAEP (2013) scores have changed compared to the first assessment year, the gap in scores between students of different races and ethnicities has continued to stay about the same. For instance, the difference between white students and black students on the 2005 twelfth grade assessment was 31 points. While both groups' scores showed improvement in 2013, the gap decreased by only 1 point. Similar results are seen when comparing the white versus Hispanic score and the white versus Native American score. As for overall proficiency levels in mathematics, 33 percent of white twelfth graders were at or above the proficient level in mathematics in 2013. Only 12

percent of Native American, 12 percent of Hispanic, and 7 percent of black students achieved this same level of proficiency.

Equity in Mathematics Education

These alarming results have led to much discussion within the mathematics education community about what has come to be called “the achievement gap.” Despite this discourse, little progress has been made to close the gap. In order to make progress, we must investigate the issue of equity – specifically looking for the source of the *lack* of equity in secondary mathematics classrooms.

Equity can be viewed as the opportunities provided to students to learn mathematics (Rubel & Chu, 2011). When the achievement of minority students is discussed, the location of the schools where many of these students attend is often indicated as a problem. The demographics of urban schools often contain large numbers of minority students. Rubel and Chu (2011) described these schools in the following way:

By virtue of being in densely populated areas and therefore large school districts, urban schools are typically characterized by high teacher turnover rates, uneven mixtures of certification and mentoring programs, a heavy emphasis on standardized testing and bureaucratic district structures. (p. 40)

Although many minority students attend schools that fit this description, there are also minority students who attend well-performing schools. Yet these students are still underachieving compared to their white peers. Thus, location cannot be the only source of this lack of equity in secondary mathematics classrooms. We must dig deeper.

The next reasoning used to explain the achievement gap is since is not the school’s fault, then it must be the students themselves. This conclusion does not align with studies that have shown that the home environments of students makes less of an impact on mathematics achievement in school compared to the school environment (i.e. curriculum,

teacher qualifications and expectations, materials). Thus, instead of blaming students' backgrounds for their difficulties in mathematics, we must look at how mathematics is taught in schools (Waddell, 2014).

As stated by Rubel and Chu (2011), "[Urban school] teachers oftentimes adopt a 'pedagogy of poverty,' rife with low expectations and emphasis on rote learning... Students are consistently denied equitable opportunities to learn and therefore remain significantly underprepared" (p. 50). Teachers practicing this pedagogy tend to perform the following tasks: give information, ask questions, give directions, make assignments, monitor seatwork, review assignments, give tests, review tests, assign homework, review homework, settle disputes, punish noncompliance, mark papers, and give grades (Ladson-Billings, 1995). No other tasks are included to make the mathematics more meaningful to students. Many teachers in urban schools do not take advantage of the rich cultural diversity their students bring to the classroom in order to make learning mathematics successful and relevant for all students (Ukpokodu, 2011). In fact, many teachers view these differences in culture as shortfalls, rather than as assets.

According to Tate (1995), typical mathematics pedagogy in secondary classrooms is teacher-directed and focused on students producing correct answers to narrowly defined problems. There is an emphasis on memorizing rules and algorithms, repetitive practice, learning skills out of context, and relying on a textbook. This type of pedagogy has historically been a part of the European (white) culture for a very long time, and it is not meeting the needs of students from many other cultures. In fact, based on standardized test scores, it may not be meeting the needs of the students from the white culture either.

Many educators and researchers have found that this typical secondary mathematics pedagogy is far from best practice, which has led to calls for mathematics to be taught differently. The National Council of Teachers of Mathematics (NCTM, 2014) identified eight teaching practices that mathematics teachers should strive to implement to improve student learning:

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

These research-based practices are being implemented in certain, isolated parts of the United States. Although these new practices can be expected to improve students' learning in secondary mathematics classes, there is still one important aspect missing: students' cultures being intertwined within mathematical content.

This leads one to question, what is culture? Leonard, Brooks, Barnes-Johnson, and Berry (2010) defined culture as "a group's individual and collective ways of thinking, believing, and knowing, which includes their shared experiences, consciousness, skills, values, forms of expression, social institutions, and behaviors" (p. 261-262). In more concise terms, culture is the shared beliefs, values, norms, and traditions shared by a group of people. It is important that we recognize culture for its complete worth – not just the

surface-level expressions that we are able to see. It influences how we think and learn mathematics as well.

Many people argue that mathematics is culture free. These individuals must be reminded that mathematics is used differently, interpreted differently, communicated differently, and has developed differently in every culture. Mathematics is not a “universal language,” for there are many variations in the vocabulary, symbols, and expressions of mathematics. Just comparing the formalities of mathematics (monetary systems, notation, arithmetic, etc.) from culture to culture, we can see all the diversity that exists. Just like other subjects, mathematics has a rich and exciting history, involving a diverse group of individuals from all over the world. For these reasons, mathematics is far from culture free. Therefore, teachers must not dismiss this fact in their classroom. Ladson-Billings (1997) stated, “[Culture] informs all human thought and activity and cannot be suspended as human beings interact with particular subject matters or domains of learning” (p. 700).

With this in mind, we must examine how European-based pedagogical practices differ from the cultural learning practices of many minority students. To start with, white culture tends to stress the individual; where as other cultures tend to emphasize community. Gay (2002) described this difference in the following way:

Many students of color grow up in cultural environments where the welfare of the group takes precedence over the individual and where individuals are taught to pool their resources to solve problems... All members are responsible for helping each other perform and ensuring that everyone contributes to the collective task... These ethics and styles of working are quite different from the typical ones used in schools, which give priority to the individual and working independently. (p. 110)

In addition to this collaborative approach to learning, it has been suggested that minority students tend to have a “global orientation to learning,” meaning that these students may

respond well to learning that is relational (i.e. learning about relationships among concepts) and has a thematic approach. Learning could be optimized even more when visuals and other tangible methods are used (Wiest, 2001).

An additional aspect of the classroom is communication, which is another area minority students tend to approach differently. According to Gay (2002), communication in white cultures is often very direct, avoids elaboration, has a linear and logical flow, and many times lacks passion. This differs from many minority styles of communication where communication tends to be much less direct, a lot of time is spent “setting the stage,” many topics are intertwined in a single conversation, and communication is very passionate. In contrast to white cultures, people from other ethnic groups often actively participate in conversations. Listeners are expected to provide prompts, feedback, and commentary to the speaker. If a teacher is not aware of these cultural differences, he or she may believe that a student is being rude or disruptive. If this interpretation results in a student being denied the use of his or her natural style of communicating, this student would be getting “intellectually silenced” (Gay, 2002, p. 111).

Not only are many mathematics teachers unaware of these cultural differences, but they are also not aware they bring their own cultures into their classroom. “This cultural discontinuity creates a mismatch between the cultures of the home and school and may result in poor academic performance because teachers and students approach learning from different perspectives,” said Leonard and Guha (2002, p. 114). Differences in cultures can cause teachers to incorrectly assess the abilities of their students. Underestimating a student often leads to lower expectations for that student, therefore negatively impacting student achievement. This chain of events could lead one to believe that pedagogy plays a

key role in students' achievement in school. If we are serious about creating equitable mathematics classrooms and closing the achievement gaps, we cannot ignore students' cultures. In order to get rid of the discontinuity of cultures in the classroom, teachers can adopt a culturally relevant pedagogy.

Culturally Relevant Pedagogy

Gloria Ladson-Billings first coined the term culturally relevant teaching in 1994. She defined the term as, "a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (2009, p. 20). This pedagogy is based on the belief that by intertwining students' experiences and cultures with academic content, students will retain the information. This success is found because the material becomes meaningful and appealing to the students (Gay, 2002). Culturally relevant teaching can be thought of as having three elements: (1) academic excellence for all students, (2) students developing cultural competence, and (3) students developing a critical consciousness.

To start with, this pedagogy allows students to be themselves and to be successful academically. Gay (2002) gave us insight as to why this is so crucial:

Students have been expected to divorce themselves from their cultures and learn according to European American cultural norms. This places them in double jeopardy – having to master the academic tasks while functioning under cultural conditions unnatural (and often unfamiliar) to them. Removing this second burden is a significant contribution to improving their academic achievement. (p. 114)

In contrast, culturally relevant pedagogy acknowledges, celebrates, and connects with students' cultures. The second part of this pedagogy – cultural competence – involves helping students develop an appreciation and respect for different cultures. Teachers and students are required to become aware of the cultures within their community, which

benefits both parties. Students must also come to the realization that they too – as individuals – have their own culture. Critical consciousness – the final component – involves students recognizing, analyzing, and critiquing social inequalities. “This consciousness brings a sense of empowerment and agency because the possibility of change becomes visible,” said Scherff and Spector (2010, p. 68). Culturally relevant pedagogy raises issues like privilege, race, oppression, and other topics that are often silenced. When critical consciousness is part of classroom practices, many lessons will be issue driven rather than content driven. The school subject is found within an issue seen in the community or world, then brought to students’ attention. Tate (1995) compared teachers who use this teaching style to school bus drivers – “picking up students where they live, and following their directions to a destination of their ‘choice’” (p. 172). These three elements of culturally relevant teaching align well with the purpose of education: give students the tools they need to be contributing members of society.

Hubert (2013) conducted a case study where she examined students’ perspectives of culturally relevant teaching and its effects on students’ attitudes towards mathematics. She found the following:

All the students interviewed stated that they preferred being taught mathematics using [culturally relevant pedagogy] versus the traditional method of instruction. One student even described traditional instruction as “grandma fashion” teaching, while another student stated that using [culturally relevant pedagogy] “made class feel so alive.” All of the students interviewed also stated that participating in culturally relevant mathematics instruction helped to increase their interests in mathematics. (p. 329)

One student in this study stated that “because the instruction used life situations that she saw on the daily basis at home, she paid attention to what was going on in class, and therefore she learned more and understood mathematics better” (p. 331). Students in this

study were exposed to at most 16 hours of this type of instruction. One can only imagine the kind of impact that a full academic year of culturally relevant teaching could have had on this same group or other groups of students.

Implementing Culturally Relevant Pedagogy

Before culturally relevant teaching can be implemented, a teacher must develop skills and knowledge needed for this pedagogy. This is not a “one size fits all” process. The key aspect of culturally relevant teaching is that it must be individualized to fit the needs of particular group of students. A teacher must first gain an understanding of the cultures in the community where he or she teaches. It is imperative a teacher knows the ethnic make-up, current issues, norms, values, businesses, and any other important insight needed to understand the students’ larger environment. This process will also help the teacher become better prepared to use the community’s culture as a context in the classroom.

Knowledge base. Once an understanding of the community has been established, the teacher can then start to develop a knowledge base of cultural diversity – specifically of the cultures present in the community. This knowledge base must go beyond acknowledging and respecting ethnic groups. According to Gay (2002), “Teachers must learn about ethnic groups’ cultural values, traditions, communication, learning styles, contributions, and relational patterns” (p. 107). In other words, factual information must be sought out in order to fully understand the norms of the community. This may require teachers to do research on their own, including finding and reading multiple books addressing the community’s cultures or taking a course about a particular ethnic group’s culture. The focus of this learning is threefold: to discover the learning styles,

communication styles, and cultural contributions to the subject (mathematics, science, art, etc.) of the cultures evident in that community.

Park (2001) described learning styles as “cognitive, affective, and physiological traits that are relatively stable indicators of how learners perceive, interact with, and respond to the learning environment.” She goes on to say that these are qualities that “persist though content may change” (p. 180). As we saw earlier, there appears to be a disconnect between how most minority groups tend to learn compared to the white, European-based schooling they receive. To implement culturally relevant pedagogy, a teacher must know the specifics of these differences. Similar to learning styles, we also see that communication styles of cultures tend to differ. Gay (2002) stated:

Understanding [communication styles] is necessary to avoid violating the cultural values of ethnically diverse students in instructional communications; to better decipher their intellectual abilities, needs, and competencies; and to teach them style or code-shifting skills so that they can communicate in different ways with different people in different settings for different purposes. (p. 112)

Communication is a key part of any classroom, so it is imperative that teachers wishing to adopt this pedagogy develop a solid knowledge base of how cultural norms influence their students’ communication.

The final key focus of the research should be on how the cultures in question have contributed to the subject matter. In the case of mathematics, minority students have at least two aspects of society working against their attitudes towards the subject. According to Hubert (2013), “One particular stereotype that oftentimes clouds the mathematics classroom is the ‘White male myth’ which states that White boys are naturally skilled at mathematics” (p. 324). Not only does this stereotype negatively affect females in the classroom, but minority students are also impacted. The second aspect working against

minority students is that in typical mathematics classrooms, only famous, European (white) decent mathematicians are talked about and recognized. Consequently, minority students do not believe that members of their culture have contributed to mathematics or are as capable of doing mathematics. By researching mathematicians from these cultures, teachers can prepare themselves to empower culturally diverse students about mathematics and help these students gain a positive mathematical identity.

Leonard, Brooks, Barnes-Johnson, and Berry (2010) defined mathematical identity to be one's belief about his or her ability to do mathematics. Part of this includes how a person views their opportunities and barriers to enter a mathematics related field and the motivation a person is willing to put in to obtain the content's knowledge. Seeing that mathematics can be a very gendered and racialized subject, "students can be conditioned to believe they are not the appropriate type of math student" (p. 262). It is important for mathematics teachers to recognize if any of their students have these misconceptions and to take steps in countering these misguided beliefs.

After gaining this deeper understanding of multicultural mathematics and knowledge of the community, the teacher must analyze how people from these ethnic groups and their experiences are presented in mass media and popular culture. The media often portrays individuals from ethnic groups in prejudiced and inaccurate ways. By taking the time to recognize this, teachers can start to identify their own prejudices and see possible sources of the misinformation. One of the aspects of culturally relevant teaching is helping students develop a critical consciousness. Before teachers can help students develop this consciousness, they must develop their own.

Analyzing media portrayals of ethnic groups naturally leads teachers to reflect on their own beliefs. As stated by Waddell (2014), “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” (p. 6). Scherff and Spector (2010) suggested some possible questions for teachers to ask themselves:

- How and for whom does the environment of my classroom facilitate or hinder development?
- What characterizes my interactions with students, and how do those interactions vary by student or student group?
- Which structures within the classroom and school act as obstacles to students realizing academic excellence?
- How does the curriculum I teach align with the experiences of students who excel and those who do not? (p. 18-19)

When a teacher understands her or his own culture and its impact on the classroom, this teacher will be much more aware of and reflective on her or his actions.

In addition to making sure a teacher is in touch with his or her own culture and the culture of the students, the teacher must also make sure he or she knows their content area very well. As it was once stated, “We can’t teach what we don’t know.” This applies to both knowledge of material to be taught and knowledge of the student population (Gay, 2002). Students often approach content from different directions, therefore a teacher must know their content backwards and forwards in order to differentiate and respond appropriately.

Classroom. Up to this point, preparing to adopt culturally relevant teaching has been generally an internal process. The question then becomes, how do teachers transfer what they learned to their teaching? Culturally relevant pedagogy can be seen in various ways within a classroom. Pedagogy encompasses not only the strategies for teaching

material, but also the physical features of the classroom, the way the teacher interacts with students, the types of tasks presented to students, and much more. Anything that the teacher does that impacts the students in his or her classroom (to any degree), can be viewed as that teacher's pedagogy.

Ukpokodu (2011) explained that "the notion of culturally responsive teaching does not resonate with urban teachers and when it does, they do not know how to teach their specific subjects from that pedagogical stance" (p. 47). For the simple reason that this pedagogy must be individualized to fit specific students' needs, no research thus far has laid out step-by-step instructions for this pedagogy that will fit any given classroom. Some generalizations from research have been made about features that are likely to be present if a teacher is using this type of instruction. For the purposes of this paper, research relating to culturally relevant *mathematics* pedagogy in secondary schools has been examined.

Before students enter a mathematics classroom, teachers have the opportunity to decorate and set-up their classrooms. Culturally relevant teaching can clearly be seen in how a teacher chooses to go about this task. Wiest (2001) stated, "Materials should present both past and present mathematicians, as well as famous and little known individuals... Cultural diversity in classroom materials is important regardless of the racial make-up of the student body" (p. 18). When students look around a room, the materials they see influence their attitude. "Classroom and school walls are valuable 'advertising' space, and students learn important lessons from what is displayed there. Over time, they come to expect certain images, value what is present, and devalue what is absent," according to Gay (2002, p. 108). This implies that students should be exposed to and see a wide variety of

cultures, genders, places, and social classes on their classroom walls and in any instructional materials. These displays should not reinforce any negative stereotypes of groups presented.

Along with images put on display, teachers must also look at the curriculum used in their classrooms. Gay (2001) stated how traditional curriculum differs from culturally relevant curriculum:

Among [the ways formal school curricula deal with diversity] are avoiding controversial issues such as racism, historical atrocities, powerlessness, and hegemony; focusing on the accomplishments of the same few high-profile individuals; ... giving proportionally more attention to African Americans than other groups of color; decontextualizing women... from their race and ethnicity; ignoring poverty; and emphasizing factual information while minimizing other kinds of knowledge (such as values, attitudes, feelings, experiences, and ethics). Culturally responsive teaching reverses these trends by dealing directly with controversy; studying a wide range of ethnic individuals and groups; contextualizing issues within race, class, ethnicity, and gender; and including multiple kinds of knowledge and perspectives. (p. 108)

Although it may not always be possible to buy a completely new curriculum, teachers can take the time to improve their current curriculum. This may mean modifying tasks, making sure negative stereotypes are not being reinforced, or adding materials to balance the curriculum.

Instruction. When a teacher implementing culturally relevant pedagogy wants to have students work on a task, he or she must consider using cooperative learning strategies. As stated earlier, many cultures learn best in communal environments. If a particular student is not as comfortable working in small groups, a teacher could ease this student into group work by having the student start by working in a pair. Group work promotes discussion, which is needed in a room where culturally relevant teaching is being practiced.

The tasks teachers use should be embedded in a context relevant to the students' communities. Since a teacher deciding to use this pedagogy will have taken time to get to know the community, this will help him or her create appropriate mathematical tasks. The teacher must find where mathematics is present in the community and in students' experiences, then translate this into mathematical tasks that will challenge students (intellectually and socially). In other words, real situations are mined for mathematical content.

Teachers can start with building knowledge from culturally specific problems, and then transfer that knowledge to more general types of problems (Leonard, Brooks, Barnes-Johnson, & Berry, 2010). If content is un-related to students' cultures and experiences, then the teacher should start with a common experience that he or she creates for the students. Wiest (2001) warned teachers to be careful on how she or he uses culture and mathematics together within tasks. The following is a summarization of a few of her suggestions:

- Do not treat mathematical content superficially. Instead, fully explore the content in great depth.
- Do not use irrelevant content and contexts. Instead, make sure the content is relevant to the class and the context applies to the mathematics.
- Do not recreate stereotypes by consistently using foreign-sounding names for minority students or never including traditional, low status roles in the material. Instead, go beyond surface-level aspects of culture.

Berry (2003) also told us that "not all cultural expressions have to be mathematized, but it is important to help students see the connections between mathematics and their

contextual and cultural ways of knowing” (p. 247). Students should have to think critically about reasons people of a culture are engaging in mathematical and cultural practices.

Teachers must be careful not to insert mathematics into contexts in artificial ways.

Rubel and Chu (2011) showcased the following example to demonstrate this:

One [teacher] listed a set of jersey numbers for all of the members of a basketball team and a second set of jersey numbers for members of the team who could not play in that game. The teacher used this setup as a way to model the notion of a set and its complement; the prompt for the students was to find the members of the team who could play in the game. Set notation, however, does not illuminate aspects of the game of basketball, and conversely, the basketball context illuminates neither the concept of set nor its notation. (p. 49)

This teacher was using basketball in a way that did not authentically connect with the mathematics. Basketball can create a great context for a culturally relevant task. For instance, it may be an appropriate context if the concept is parabolas (shooting a ball), angle measures (positioning of the arm), measurement (where player is from hoop), or many other aspects of geometry. Tasks must illuminate the mathematics that is all around us.

In mathematics, it is important for teachers to classify tasks in terms of cognitive demand: high-level tasks and low-level tasks. These types of tasks differ in the opportunities they provide students to struggle with important mathematics. Lower-level tasks could include memorization tasks (reproducing learned information) and tasks that call for procedures without connections (focus on producing the correct answer). Higher-level tasks could include tasks that call for procedures with connections (underlying concepts must be understood) and tasks where students are ‘doing mathematics’ (complex and nonalgorithmic thinking) (National Council of Teachers of Mathematics, 2014). Too often, low-level tasks are the most frequently used when compared to the number of high-

level tasks. This should not be the case in classrooms where culturally relevant pedagogy is practiced.

Low-level tasks lend themselves to listening and practicing, whereas higher-level tasks offer varied opportunities for students to actively engage in mathematics (Rubel & Chu, 2011). Although both types of tasks are necessary in a mathematics classroom, culturally relevant teaching calls teachers to use more high-level tasks. Since the goal of culturally relevant teaching is to get students thinking critically about cultures and society in addition to content, higher-level tasks are naturally more appropriate. Students' ideas of this world will not be challenged when their time is solely spent memorizing algorithms and practicing procedures.

Besides calling for a high-level of cognitive demand, culturally relevant tasks should be open. This means that there are multiple ways for students to approach the task. These tasks should then be followed by meaningful conversations where students discuss their strategies and the deeper meaning of the problem. These kinds of tasks encourage students to think together and take risks. By allowing students to have more opportunities to communicate and listen to their peers in mathematical ways, students will begin to accept and value shared ideas and strategies (Waddell, 2014). Wiest (2001) also pointed out that looking at different ways of doing mathematics can help students see that "different" does not equate with "deficient".

Although no collection of culturally relevant mathematics tasks has been published, there are numerous examples of tasks that align with this form of instruction. The following are illustrations of how mathematics can be used in culturally relevant ways:

- Students photographed statues and other interesting artifacts around their city. The students then used their photographs to develop and solve mathematical problems. (Leonard & Guha, 2002)
- In a lesson about triangle points of concurrency, students were prompted to plot their own address and that of two friends on a neighborhood map. The students were then asked to devise a strategy to calculate a fair meeting location, where “fair” was defined in mathematical terms as each person traveling the same distance. (Rubel & Chu, 2011)
- Students were asked to identify problems within their community. One problem was posed about the amount of liquor stores. Students embarked on an effort to close and/or relocate 13 liquor stores within 1,000 feet of their school. Throughout these efforts, they developed a deeper understanding of decimals, fractions, percent, calculation of distance, measurement, data, variables, data, and statistics. (Tate, 1995)
- Students were given statistics about the percent of Americans between the ages of 2 and 19 that are either overweight or on the brink of becoming so. They were asked to determine how many kids would be overweight in 2050 if the trend continued at a constant rate, as well as various other questions. (Leonard & Martin, 2013)
- Students used mathematics to confront overcrowding in their school. Students learned critical mathematics as they measured spaces, calculated areas, generated data, and questioned the inequities of society. (Ukpokodu, 2011)

The conversation that proceeds, intertwines with, or follows a task is essential to students developing their critical consciousness and cultural competence, in addition to their mathematical understanding. Rubel and Chu (2011) emphasized that teachers need to help students develop their critical consciousness with or about mathematics. They stated, “Developing [this consciousness] *with* mathematics implies investigating societal issues of power using mathematical analysis...The development of [this consciousness] *about* mathematics involves surfacing issues of power between people and mathematics” (p. 41). One way teachers can do this is by discussing with students why one approach to solving the task may be valued more by people than another. Teachers can also discuss who creates mathematics, why mathematics is created, and what impact this mathematics has on society. Even if a topic is “touchy,” teachers must not be afraid to engage students in conversations about the issue. Letting students think critically about the messy issues of this world and helping them form their own opinions is one the main goals of culturally relevant pedagogy.

When teachers are discussing these things, they can refer back to their content knowledge about how the cultures represented in their classrooms (and other cultures not present) have contributed to mathematics. Mathematics is created and practiced by people across all cultures, and students should know this. Teachers can easily talk about the mathematical concept at hand from a historical perspective. Having students examine historical and current ways to perform a concept can help the students appreciate the sophistication, creativity, and meaningfulness of different mathematical thinking (Wiest, 2001). At this point, teachers should also educate students on the formal differences in mathematics among cultures. For instance, cultures differ in whether they use commas or

decimal points. There are also different ways of computing across cultures and differences in monetary systems. Once again, these types of conversations help students to become more culturally competent and recognize that mathematics is within every culture.

Having students do tasks and facilitating discussions are not all that a teacher should do in the classroom. Depending on what ethnicities are present in a classroom, a teacher must adjust his or her instruction accordingly. This may mean incorporating more motion and movement, using a story-telling teaching style, or having more dramatic elements in their teaching. No matter the ethnicity, using techniques such as peer-tutoring and having frequent variability in tasks has shown to be helpful to all students.

One crucial realization is all of this meaningful discourse and empowerment of students is not going to happen unless a teacher has developed a meaningful, trusting relationship with the students of his or her classroom. Teachers must demonstrate to students how much they care about the students and their successes in the class. This does not mean that teachers have to be overly affectionate towards students, but this does mean that teachers must set high-expectations for all students. Landon-Billings (1997) stated, "Students treated as competent are likely to demonstrate competence" (p. 703). By getting to know students academically, socially, and personally, teachers will be able to understand student behaviors better. This will also allow the teacher to know which student experiences should be drawn on to use in the classroom.

A great deal of effort and time must also be spent developing the community among the diverse learners within a classroom. By creating home-like classrooms, conversations will be more meaningful and students will be more likely to achieve. Ukpokodu (2011)

suggests the following ways for fostering effective cooperative learning in a culturally responsive mathematics classroom:

- Build trust and relationship among students by having them work frequently in partnerships and small groups.
- Use heterogeneous grouping structure based on race, gender, ability, language, etc.
- Teach democratic values and behaviors, rules, and participation roles.
- Create learning tasks that are complex with multiple parts that allow each group member to have a part that contributes to the overall activity goal. (p. 53)

By creating a safe and supporting climate in a classroom, teachers will make it easier for students to critically consider the world.

Conclusion

Tate (1995) summed up culturally relevant pedagogy in the following way:

Central to [this] approach to teaching are the following: (a) communication between students, teacher, and outside entities; (b) cooperative groupwork; (c) investigative research throughout the learning process; (d) questioning content, people, and institutions; (e) open-end problem solving connected to student realities; and (f) social action. (p. 172)

After a student has experienced culturally relevant mathematics pedagogy, he or she should be able to view mathematics as a tool. By educating and preparing students to solve real problems in their own lives, students can start to see mathematics as a way to change their out-of-school realities. Their mathematics class should empower them to make needed changes in their world. Teachers must view their responsibilities of helping students succeed as giving back not only to the society at large, but also to the students' communities (Scherff & Spector, 2010).

No matter which classroom culturally relevant teaching is being implemented, students are learning not only how to be confident problem solvers, but they are also learning how to be good problem posers and communicators (Tate, 1995). When teachers

adopt this method of teaching their students, significant growth and content retention is seen in students – both white and minority students. It is crucial that teachers start questioning their instructional practices and take this pedagogy into consideration. Not only will adopting culturally relevant teaching benefit our schools and students, but it will also benefit the future of this country.

Research Questions to Be Addressed

Although culturally relevant teaching can be applied in any mathematics class, the remaining portion of this paper will focus on how to apply this pedagogy in an urban, Algebra I classroom. There are two research questions that will be addressed:

1. What are the components of a culturally relevant pedagogy in an urban, Algebra I classroom?
2. What criteria should an Algebra I task meet in order to align with a culturally relevant pedagogy?

Methodology

A meta-analysis of research has been created to apply to the research questions. By analyzing many articles and studies, then finding their commonalities, a clear picture of culturally relevant teaching and culturally relevant tasks has been revealed. When deciding how to apply culturally relevant teaching, one must know the cultural make-up of his or her students. In order to keep the research focused, the ethnic demographics of the Des Moines Public Schools were identified. The most prevalent ethnicities found in these schools have guided this research.

Algebra I content was focused on due to it being a gateway course for secondary students. Much of the mathematics studied later in high school and in post-secondary

classes depends on a strong foundation in algebra. Conclusions were drawn on how Algebra I teachers should prepare for culturally relevant teaching, how this pedagogy would appear in an Algebra I classroom, and what types of tasks Algebra I students should be engaging in. These conclusions can be seen through a hypothetical application of the pedagogy. An example of a task that aligns with both the Iowa Core and culturally relevant teaching for the identified students has been created.

Application: Algebra I in an Urban Classroom

Students

Culturally relevant pedagogy must be tailored to the students of a particular classroom. The students' communities, ethnicities, and experiences are all fundamental pieces of information. This fictional implementation of culturally relevant teaching will be based on the demographics and community of the Des Moines Public High Schools. Des Moines is an urban location in Iowa and is the largest city within the state's borders (by population). Des Moines has six public high schools, each rich with ethnic diversity. The ethnic demographics for these high schools can be seen in Table 1. One may find it useful to know, that out of the 8,668 total high school students enrolled about 60.49% are eligible for free and reduced lunch. The district as a whole has students from at least 88 nations, leading it to have the largest English Language Learner (ELL) program in all of Iowa, with students speaking nearly 100 languages and dialects (Des Moines Public Schools, 2014). African American, Hispanic, and Latino students constitute the largest minority populations in the Des Moines high schools so accommodating their learning and communication styles will be the central focus for this work. For simplicity, Hispanic and Latino will be referred

to simply as Hispanic. While these are two distinct cultures, there are many overlapping factors allowing them to be considered together.

<u>Ethnicity</u>	<u>Percentage of Total Enrollment</u>
African American (not Hispanic)	18.10%
American Indian or Alaskan Native	0.60%
Asian	7.80%
Hispanic (Latino)	21.00%
White (not of Hispanic origin)	46.00%
Pacific Islander	0.10%
Multi-Racial	6.30%

Table 1: Des Moines High Schools' 2013-2014 Ethnic Makeup

Berry (2003) described the African American cultural experience as having the following dimensions: emphasis on spiritualism, orientation toward expressive movement, emphasis on communalism, tendency to approximate time and space, preference towards oral communication, enthusiasm towards action that is energetic, and expressive individualism. This differs from the majority, white society where materialism, sameness, individualism, and other opposing dimensions are often valued.

Hispanic Americans have many similar cultural values as African Americans. Family commitment and emphasis on cooperation to attain goals tend to be very important within Hispanic cultures. This means that there is often strong loyalty to the family, duty to care for those who are unable, and that behaviors reflect the honor of the family. Other prominent values within this culture are spirituality, the dignity of each individual, and respect for authority figures. The Hispanic culture tends to support stereotyped sex roles, where the male is the provider and the female is the nurturer. It is not uncommon for Hispanic male adolescents to have more and earlier independence compared to male adolescents of the general United States population (Griggs & Dunn, 1996). It is important to note that although the people within each of these ethnic groups share common cultural,

historical, and social experiences, these values may not apply to all individuals within an ethnic group. Being aware of these values can help educators interpret students' thoughts, feelings, and actions.

These cultural values have a great impact on learning and communication styles of their student members. "Urban students, particularly African-American and Latino-American students, live in close-knit family and neighborhood contexts where they learn to work and play together," said Ukpokodu (2011, p. 53). This suggests that cooperative group learning arrangements and peer-tutoring would especially appeal to these communal cultural systems (Gay, 2001). Also supporting these preferred learning techniques are the way individuals in these cultures tend to communicate. According to Gay (2001), many Hispanic and African American students organize and transmit their ideas in highly contextual ways. Speakers often provide a lot of background information, are passionately and personally involved with the content being discussed, use a lot of symbolism and innuendo to convey ideas, weave many issues into a single story, and often sound as though they are storytelling. Listeners of these cultures tend to be very engaged with the speaker – providing commentary, prompts, and feedback.

Not only do these behaviors suggest communal learning, but they also suggest other instructional strategies that students of these cultures may prefer. If teachers were to engage in a story-telling teaching style, add dramatic elements to their teaching, and engage students in autobiographical case studies, these students may become highly engaged in the lesson. The highly contextual communication also suggests that these students might prefer highly contextual tasks that frequently vary. Berry (2003) stated, "African American learners use concrete imagery as a means of reckoning reality. They

draw on their daily experiences to facilitate learning [and] classify ideas, items, and experiences based on how things relate to each other” (p. 246).

Studies have shown that both Hispanics and African Americans students tend to be visual learners and kinesthetic learners, although African Americans tend to fit this description more than Hispanics (Griggs & Dunn, 1996). Involving movement, music, and interactive learning would likely benefit these students. The fact that both groups tend to be visual learners also implies that teachers should use visual aids or have students draw pictures and diagrams whenever possible.

When a group of African American students were asked what teaching practices they believed to be effective, their response included the following:

(a) Teachers who made their classrooms resemble home through family and community practices, beliefs, and values; (b) teachers that demonstrated culturally connected caring; and (c) teachers that used communication that contributed to an increased level of engagement and achievement in school. (Hubert, 2013, p. 325)

Another group of African Americans, when asked the same question, responded by saying that they preferred teachers who allowed them to actively participate in the learning process, work collaboratively in groups, and allowed opportunities for student discussion (Hubert, 2013). Based on the research that has been done on Hispanic learning and communication styles, one can assume that these students would respond in similar ways.

Many of these learning styles align with what is already considered to be good teaching. NCTM (2014) identified a number of student experiences that provide the foundation for effective mathematics teaching. Learners should have opportunities to:

- engage with challenging tasks
- connect new learning with prior knowledge and informal reasoning

- acquire conceptual knowledge as well as procedural knowledge
- construct knowledge socially, through discourse, activity, and interaction related to meaningful problems
- receive descriptive and timely feedback
- develop metacognitive awareness of themselves as learners, thinkers, and problem solvers

The teaching practices the teacher then uses build directly off of these experiences they want students to have. Thus, enacting these practices will not harm the learning of the students who are the majority – all students will have an equal opportunity for success.

Preparing to Teach Algebra I in Des Moines

Based on research about culturally relevant teaching, there are four activities that an Algebra I teacher should engage in before implementing this pedagogy:

1. Recognize that algebra is not “culturally neutral”
2. Develop a conceptual understanding of Algebra I content
3. Identify and research the students’ cultures and community
4. Self-evaluate

Knowledge of Algebra I. Algebra I teachers should specifically read about the history of algebra, focusing on the how the members of the cultures represented in their classrooms have contributed to the content. Once these teachers realize and learn that a large number of cultures have helped shaped the algebra we have today, they should be convinced that algebra is not culturally neutral. The following are facts that these teachers may come across:

- The word “algebra” comes from the Arabic word “al-jabar,” which was in the title of a book written by the Persian mathematician Al-Khwārizmī.
- Algebra has gone through three stages of expression: rhetorical algebra (only words), syncopated algebra (a mix of words and abbreviations), and symbolic algebra (our current way of expressing).
- Many groups of people have contributed to the algebra we now use today: Babylonians, Egyptians, Chinese, Greeks, Indians, Arabians, Europeans, and more. (Berlinghoff & Gouvêa, 2004)

Culturally relevant mathematics pedagogy not only calls for teachers to know the history of algebra, but the pedagogy also calls for teachers to provide opportunities for students to engage with mathematics. In order to do this, students must engage in tasks, discussions, and activities that require a high-level of cognitive demand. Algebra I teachers must have a deep level of knowledge about the Algebra I content in order to do all of these things effectively. He or she must have conceptual knowledge of the mathematics, not just procedural knowledge.

Des Moines Algebra I teachers should confirm that their algebraic content knowledge is aligned with the Iowa Core Mathematics Standards. Teachers should specifically focus on the standards that they address in their Algebra I class. As teachers go through these standards and look at the mathematical content, they should consider the following questions:

- Could I explain this concept in multiple ways?
- Do I know *why* this mathematical procedure works?

- How does this concept fit in with other concepts students have learned or will learn?

If a teacher does this and realizes he or she only has procedural knowledge of a concept, this teacher must take the necessary steps to gain a conceptual understanding. There are many ways a teacher could go about doing this: try proving why a concept works on their own, ask another teacher for help, use Internet resources, read a textbook on the topic, or take a course on the material.

Knowledge of students and their community. The “relevant” in culturally relevant pedagogy may look different based the demographics of a classroom. This method of teaching calls for Algebra I teachers to use material that is relatable to students – material that connects with students’ experiences, cultures, and communities. If not including aspects of these real-life experiences, the mathematics should be focused on relevant issues that will empower students to think critically about society and to develop cultural competence. Teachers must implement this material in ways that fits with the students’ learning style and communication style preferences. None of this can be done unless a teacher gets to know his or her students and researches the community surrounding the school. “Getting to know the community” includes the norms, values, businesses, current issues, and structure of the community. “Getting to know students” includes identifying the cultures that are present in a classroom and researching these cultures in great depth. A teacher must then draw conclusions on how these preferences and the community should impact his or her teaching.

In order to get to know the community, teachers could drive around neighborhoods, visit local business, read newspapers (*The Des Moines Register*), and take note of any

important events or issues that arise. Teachers should also take time to look up the demographics for the community, including data about socioeconomic status. All of this is even more important to do if a teacher does not live in the community surrounding the school.

Research on students' culturally-based learning and communication styles should be done using reliable resources such as academic journals and books. As seen earlier in this section, an Algebra I teacher could conclude that the following teaching techniques might be preferred among Des Moines Public High School students:

- Cooperative group work
- Peer-tutoring
- Highly contextual and relevant tasks
- Frequent variability in tasks
- Movement and music incorporation
- Frequent use of visuals
- Storytelling and biographical case studies
- Passionate discussions

In addition to these techniques, whenever possible, Des Moines Algebra I teachers should also be aware of how culture will impact these students' behavior. Classroom management should be handled carefully, with an understanding of relevant cultural norms.

The last piece of research that teachers would want to do to prepare for teaching in a culturally relevant way is to find out how ethnicities evident in their classroom and their experiences are being portrayed in the media. The research teachers have done up until this point will help them see any negative stereotypes and any biases that surround the

students outside of the classroom. The media has a large influence on students and their communities, so it is important that teachers look into this issue. The websites for *The Des Moines Register*, KCCI News, WHO TV, and Fox 17 (local television stations in Des Moines) would be good places to start for Algebra I teachers.

In addition to researching their future students, teachers must take time to reflect on their own culture since this, without doubt, influences their teaching. Once a teacher has reflected on who they are as a person, their biases, and their stereotypical beliefs, he or she should consider asking the following questions about their teaching of mathematics:

- Who is learning mathematics in my classroom and who is not, and why?
- What is my expectation for each of my students in mathematics learning?
- What social and community issues am I integrating into Algebra I curriculum and instruction?
- Am I open to divergent thinking and problem processing style?
- How caring and supportive is the learning environment I foster?

Asking these questions – some harder than others – a teacher can better know what kinds of adjustments he or she needs to make in order to implement a culturally relevant pedagogy. Ideally, this would be an ongoing practice.

Teaching Algebra I using Culturally Relevant Pedagogy

Based on conclusions from the meta-analysis of research, if an Algebra I teacher was using a culturally relevant pedagogy, there are seven elements that one would expect to see when observing this teacher's classroom:

1. Conducive learning environment for diverse students
2. Strong teacher-student relationships
3. Open-ended, relevant tasks which challenge students intellectually and socially
4. Students collaborating to solve problems
5. Regular discussion connecting mathematics to society
6. Instructional techniques to empower students and promote a positive mathematical identity
7. Classroom materials which reflect a wide range of diversity

Learning environment. At the beginning of the school year, a teacher must establish the classroom norms and set the tone for the classroom climate. The teacher should communicate to his or her students that they – the students – will be at the center of building their mathematical understanding. Students must understand that they will be discovering the mathematics for themselves by investigating the world around them, as opposed to the teacher just telling them. These expectations need to be consistently implemented throughout the school year.

Creating a safe environment filled with high expectations will be a main goal for the teacher. Students must be comfortable making mistakes without any fear that their peers or the teacher will ridicule them. In fact, the teacher must communicate that he or she is open to and encourages divergent thinking. Students should expect that they will be asked to justify their solution and reflect on how mathematics relates to their lives. Mathematics will be what their Algebra I class is about. By creating a safe classroom, a teacher will be able to help students develop their cultural competencies and critical consciousness.

Teachers must establish an environment that helps students in developing their own opinions about the issues of the world.

It should quickly become obvious to students that their Algebra I teacher genuinely cares for them – academically and personally. Academically, students will know that they are being held to high standards. The teacher-student relationship must be strong enough so that the teacher can challenge students to continuously improve. Moreover, culturally relevant pedagogy calls for teachers to relate mathematical concepts to the lives and interests of students. Teachers will be unable to do this if they do not take the time to get to know their students.

In order to build these relationships with students, Algebra I teachers may consider using one or more of the following strategies:

- Have students write an autobiography at the beginning of the year.
- Create an information sheet for students to complete.
- Use get-to-know-you icebreakers as warm-ups.
- Meet with students one-on-one throughout the year.
- Have students keep a journal where they reflect on topics talked about in class.
- Engage in conversation with students before and after class.
- Attend school-sponsored events.
- Build a relationship with the parents to better understand the student.

Instructional strategies. When examining Algebra I curriculum, teachers should take the time to improve the overall quality of the materials (if the materials do not align with culturally relevant teaching). In order to be deemed culturally relevant, an Algebra I task should meet the criteria specified in Table 2. A teacher must take note that although

most tasks should meet this criteria, this will not be possible for every Algebra I task. A concept should be introduced in a culturally relevant way to launch a unit, then the teacher can move to more abstract tasks. Any tasks used to explore a concept or deepen students understanding of a concept should be culturally relevant. In other words, all “word problems” or exploration activities should align with this culturally relevant framework. If they do not, the tasks should be modified appropriately. See the Appendix for an example of a culturally relevant Algebra I task.

<u>Criterion</u>	<u>Description</u>
Relevant context	The task is situated within a context that is relevant to the students’ experiences, community, or world.
Cognitively demanding	The task calls for students to develop conceptual knowledge of the mathematics – forcing students to understand <i>why</i> the mathematics works. Students are using a high-level of cognitive demand.
Multiple entry points	The task has an element of “openness” and does not suggest a particular method for solving a problem.
Encourages collaboration	The task allows students to think and talk about the mathematics with their peers.
Illustrates mathematics concept	The mathematics is not put in artificial situations. Instead, the mathematics is pulled from where mathematics truly exists in the world.
Empowering	The task assists students in developing either their cultural competence or critical consciousness. The task helps students to see mathematics as a tool to use in their real-life situations.

Table 2: Criteria for Culturally Relevant Algebra I Tasks

As seen in the criteria for culturally relevant tasks, collaboration should be and will be a natural part of the classroom. Students should be encouraged to talk mathematically

and think mathematically with their peers. A teacher may have to describe to students what productive group work looks like, and model the type of discussion that should be going on within groups. Algebra I teachers may consider assigning roles or job descriptions to each member of a group. This will help ensure that every student is contributing to and engaging in the learning. Teachers may also consider the use of peer tutoring. This is when students help their classmates with assignments or content reviews.

When deciding on how to form groups, a teacher should make sure diversity is present within each group. This means there should be both males and females and a mix of ethnicities within groups whenever possible. If appropriate, teachers may also consider students' ability levels when assigning them to groups. Either way, students need experience interacting with peers who are different from them. This will help students to become aware of, respect, and celebrate other cultures. This may also help get rid of any false, preconceived notions that students have about people from other cultures.

Not only should students be talking when working in small groups or with a peer on culturally relevant tasks, but the whole class should also be involved in discussions that are facilitated by the teacher. Questions should be asked of students to help develop their mathematics knowledge, critical consciousness, and cultural competence. The fact that tasks are situated in relevant contexts gives a perfect transition into meaningful discourse. Meaningful in the sense of deepening students' understanding of the mathematics and helping them connect mathematics to society. These discussions should come from a positive viewpoint, shedding light on the change that can be made with the help of mathematics.

Since culturally relevant teaching calls for a frequent variability in the classroom, teachers must break up the pattern of purely doing tasks (in groups) followed by discussion. Although these will still be the most prevalent instructional techniques, an Algebra I teacher might consider other techniques to empower students and promote positive mathematical identities. The following strategies are tailored to the African American and Hispanic populations of the Des Moines Public Schools:

- Teach Algebra I from a historical perspective, showing how a certain concept has evolved over time from culture to culture. Have students try to make sense of methods that were used hundreds of years ago.
- Have students watch a video related to the culturally relevant topic of that particular day. Use the video as an introduction to a task.
- Tell students historical or current stories that relate to the Algebra I content or mathematics. Many students do not realize all the drama and adventures that are present within mathematics. Consider using mathematics storybooks.
- Get students out of their seats. Create scenarios that will force students to walk around the room; this may be to collect data, talk with peers, or take part in an activity.
- Once a week, talk about a famous (or not so famous) mathematician. Either read or have students read biographies of these mathematicians, making sure a diverse group is highlighted throughout the year. Students could also do an assignment related to researching a mathematician and his or her contributions to Algebra.

- Take students on mini-fieldtrips to locations within the community. Show students places where the mathematics they are working on can be seen in real-life.
- Bring in speakers from the community – either individuals to talk about the community issue being discussed or individuals to get students interested in mathematics related jobs. These speakers should be as culturally diverse as the students.
- Incorporate technology and manipulatives whenever possible. Evaluate whether the materials are appropriate for a given concept, then have students engage with them appropriately.

Students should also be empowered and probed by what is on the wall of their Algebra I classroom. Since students will most likely see these visuals every day, teachers must select displayed materials wisely. The following are display ideas that would be appropriate to have in a culturally relevant, Algebra I classroom:

- Hang pictures of a diverse group of mathematicians. All pictures should be accompanied by a short biography of the individual or an information card. A portion of these mathematicians should have contributed to Algebra. Possible mathematicians to display include: Muhammad ibn Mūsā al-Khwārizmī, René Descartes, François Viète, Gerolamo Cardano, Benjamin Banneker, Thomas Fuller, Eleanor Green Dawley Jones, Jose Ádem, Manuel Sadosky, Ruth Gonzalez, Hypatia, and Ada Lovelace.

- Hang posters with information about how ancient cultures did mathematics or of how mathematics is being used in different cultures today. These posters should be eye-catching and make students want to learn more.
- Display quotes that are about mathematics, learning, culture, or whatever topic seems fit for the particular group of students.
- Display a list of jobs in which mathematics is heavily used – especially jobs that will appeal to high school students.
- Create a wall dedicated to the students. Students would periodically be assigned to bring in something to hang on the wall, such as their favorite quote, a hobby, a person who has inspired them, and so forth. As the year goes on, the wall would get filled with more and more information about the students and their cultures.
- Create a wall dedicated to societal or community issues that arise in class. Data and findings would be hung on this wall.

Conclusion

When culturally relevant pedagogy is carefully planned for and correctly implemented, teachers should see their students flourishing academically. Hispanic and African American students would likely be more successful in Algebra I if their teachers executed the application described within this section. Although this application focused on an urban, Algebra I classroom, culturally relevant pedagogy can be implemented in any mathematics classroom by following similar processes and guidelines. Mathematics teachers wishing to adopt a culturally relevant pedagogy should identify their academic content area and the cultures of their students, and adjust this application accordingly.

Conclusions and Recommendations

In the United States, standardized test scores run our schools. This emphasis on test scores has put extra pressure on teachers to make sure their students perform well. It is clear that students need to improve in mathematics. The problem is, a majority of teachers are not changing their pedagogies. Many are continuing to teach mathematics like it has always taught – teacher-centered with an emphasis on rote learning. Continuing to teach like this has made little impact on raising these scores or closing any achievement gaps that exist among students of different ethnicities, making it clear that there is still a lack of equity in mathematics classrooms across the nation.

Although culturally relevant teaching would make mathematics classrooms equitable, many mathematics teachers are unaware of culturally relevant pedagogy or have very little understanding of how to implement this pedagogy in their classroom. In order to make culturally relevant pedagogy better known, undergraduate and graduate programs for pre-service teachers, current teachers, and school administrators should make this pedagogy part of the required coursework. Administrators should also provide opportunities for teachers to learn about this pedagogy through professional development. When teachers become convinced of the power behind culturally relevant teaching and decide to adopt this pedagogy for their classrooms, proper resources should be made available in order to support them through their implementation. As more teachers begin to use culturally relevant teaching, test scores will reflect the impact the pedagogy is having on students.

Schools become so focused on standardized test scores that they often forget the purpose of education: to give students the tools they need to be contributing members of

society. Is it possible to achieve improved standardized test scores and create better citizens for our society? As seen in the example of the Algebra I class, the answer is yes – teachers implementing a culturally relevant pedagogy can meet both these goals. Not only will students retain information better after experiencing to this teaching, but they will also develop the awareness and consciousness needed to impact our world in positive ways. Therefore, teachers adopting a culturally relevant pedagogy will positively contribute to the futures of students, schools, and our nation.

Literature Cited

- Berlinghoff, W. P., & Gouvêa, F. Q., (2004). *Math through the Ages, Extended Edition*. Oxton House Publishers & The Mathematical Association of America.
- Berry, R. Q., (2003). Mathematics Standards, Cultural Styles, and Learning Preferences: The Plight and the Promise of African American Students. *Clearing House*, 76(5), 244-249.
- Des Moines Public Schools (2014). *Facts and Figures*. Retrieved from <http://www.dmschools.org/about/facts-figures/>
- Gay, G. (2002). Preparing for culturally responsive teaching. *Journal of Teacher Education*, 53(2), 106–116.
- Griggs, S., Dunn, R., & ERIC Clearinghouse on Elementary and Early Childhood Education, U. I. (1996). Hispanic-American Students and Learning Style. *ERIC Digest*, 1-6.
- Hubert, T. (2013). Learners of Mathematics: High School Students' Perspectives of Culturally Relevant Mathematics Pedagogy. *Journal of African American Studies*, 18(3), 324–326.
- Ladson-Billings, G. (1997). It Doesn't Add Up: African American Students' Mathematics Achievement. *Journal for Research in Mathematics Education*, (6). 697-707.
- Ladson-Billings, G. (2009). *The Dreamkeepers: Successful teachers of African American children*. San Francisco, CA: Jossey-Bass.
- Leonard, J., Brooks, W., Barnes-Johnson, J., & Berry, R. Q. (2010). The nuances and complexities of teaching mathematics for cultural relevance and social justice. *Journal of Teacher Education*, 61(3), 261-268.
- Leonard, J., & Guha, S. (2002). Creating cultural relevance in teaching and learning mathematics. *Teaching Children Mathematics*, 9(2), 114–118.
- Leonard, J., & Martin, D. B. (2013). *The Brilliance of Black Children in Mathematics: Beyond the Numbers and Toward New Discourse*. Information Age Publishing Inc.
- Lubienski, S. T. (2000). Problem solving as a means toward mathematics for all: An exploratory look through a class lens. *Journal for Research in Mathematics Education*, 31(4), 454-480.
- National Center for Educational Statistics (2014). *National Assessment of Educational Practice (NAEP), 2013 Mathematics and Reading: Grade 12 Assessments*. Washington, D.C.: National Center of Education Statistics.

- National Council of Teachers of Mathematics (2014). *Principles to Actions: Ensuring Mathematical Success for All*. Reston, VA: The National Council of Teachers of Mathematics, Inc.
- Park, C. C. (2001). Learning Style Preferences of Armenian, African, Hispanic, Hmong, Korean, Mexican, and Anglo Students in American Secondary Schools. *Learning Environments Research*, 4(2), 180-189.
- Rubel, L. H., & Chu, H. (2011). Reinscribing urban: Teaching high school mathematics in low income, urban communities of color. *Journal of Mathematics Teacher Education*, 15(1), 39-52.
- Scherff, L., & Spector, K. (2010). *Culturally Relevant Pedagogy: Clashes and Confrontations*. Rowman & Littlefield Education.
- Tate, W. F. (1995). Returning to the root: A culturally relevant approach to mathematics pedagogy. *Theory Into Practice*, 34(3), 166-173.
- Ukpokodu, O. N. (2011). How Do I Teach Mathematics in a Culturally Responsive Way? Identifying Empowering Teaching Practices. *Multicultural Education*, 18(3), 47-56.
- Waddell, L. R. (2014). Using Culturally Ambitious Teaching Practices to Support Urban Mathematics Teaching and Learning. *Journal Of Praxis In Multicultural Education*, 8(2), 1-21.
- Wiest, L. R. (2001). Teaching mathematics from a multicultural perspective. *Equity & Excellence in Education*, 34(1), 16-25.

Culturally Relevant Algebra I Task

Iowa Core Standard:

HAS.CED.A.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Culturally relevant Algebra I task:

Alexis recently moved out of her parents' house and into her own apartment. The apartment came with appliances, but Alexis has to furnish the apartment herself. Luckily, a few of her friends and family members were able to give her some of their old furniture. One thing Alexis does not have yet is a TV. She does not have the extra money to buy a TV, so she decides to go to a rent-to-own store. At the store, she decides on a 32" TV. Alexis has to decide between two options:

1. Monthly payments of \$50 for 15 months
2. Weekly payments of \$14 for 52 weeks

Given these two options, which payment plan will cost Alexis the least amount of money? Solve the problem using 3 different methods. Justify your chosen payment plan.

The TV Alexis could purchase from the rent-to-own store is listed for \$219.99 at the local Wal-Mart. Compared to the Wal-Mart price, how much more will Alexis pay for the TV at the rent-to-own store?

What other options, besides the rent-to-own store, does Alexis have to obtain a TV?

Create a weekly savings plan for Alexis so she will have enough money to buy the TV from Wal-Mart in 8 weeks. Represent your savings plan with both an equation and a graph.

Notes for teachers:

Prior to giving this task to students, teachers should explain to students how rent-to-own stores work, and how many stores of this type are in the surrounding area. Following the task, teachers should engage students in a discussion about how mathematics is being used to take advantage of people (in this particular case) and which people are being taken advantage of.

Additional resources:

- Information and data on rent-to-own: <http://www.rtohq.org/about-rent-to-own/>
- Rent-to-own store with monthly and weekly rates listed: <http://www.bestwayrto.com/>

This Study by: Julia North

Entitled: Culturally Relevant Teaching: Secondary Mathematics in an Urban Classroom

has been approved as meeting the thesis or project requirement for the Designation
University Honors.

12/16/2014

Date

Dr. Catherine Miller, Honors Thesis Advisor, Department of Mathematics

12/16/14

Date

Dr. Jessica Moon, Director, University Honors Program