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## **Effects of Culturally Relevant Teaching on Seventh Grade African American Students**

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### **Abstract**

The purpose of the study was to examine the relationship between culturally relevant teaching and science achievement in seventh grade African American students when compared to standards-based instruction. The study also examined whether the use of culturally relevant teaching improved students' attitudes toward science, as well as their participation within the science classroom. The intervention was implemented over the course of eight weeks by using a unit test as a pretest and posttest, formative quizzes, a Science Attitude Survey, and field notes to analyze student performance. Although all participants made academic gains when comparing pretest and posttest results, the culturally relevant group made higher gains than the standards-based group. Data from the Science Attitude Survey revealed slight changes in students' overall attitude toward science except in one area. The intervention showed culturally relevant teaching can increase student achievement and improve student participation within the science classroom.

### **Introduction**

During the early 1980s, the Reagan administration publicly announced the "A Nation At-Risk" educational reform which identified a need for improving the science industry; however, this unfortunately did not motivate African American students "who are filled with self-doubt, stereotypes, discouragement, economics, and sometimes just wrong perceptions of what math and science are all about" (NewsOne, 2011; Alexander, 2012; Bell, 1992). Understanding science is imperative because science and technology are ubiquitous, and the industry is growing rapidly. All students

generally have difficulty with science, but African American students struggle more than any other ethnic group. African American students lag behind all other ethnic groups in all content areas, but the percentage of deficit increases within the science content. The major issue with retention of science concepts is communication barriers between teachers and African American students (Foster, Gomillion, Parsons, & Simpson, 2008).

### **Background Context**

The southern United States is home to many African American students, and the state of Georgia is the focus in the current study. According to the Governor's Office of Student Achievement (2011), the majority of Georgia teachers are White, and the number of African American students in Georgia public schools is gradually rising. The lack of communication between teacher and students develops from the different cultural backgrounds of the individuals (Paris, 2012; Redeaux, 2011). African Americans have a distinct communication pattern that does not mimic the communication pattern of science classrooms (Foster et al., 2008). In order to motivate African Americans to aspire to master the science curriculum, teachers will have to become better at employing the communication patterns of their students.

Foster et al. (2008) stated the discrepancy between race, culture, and socioeconomics among teachers and students causes tension in various areas, such as academic achievement. The National Center for Children in Poverty (NCCP, 2010) stated that 49% of African American children live in rural communities and 62% of those children live in low-income families with 52% percent of African American children in rural areas living in single parent homes. Within those homes are certain communication patterns that allow them to connect with their family and friends, but that same pattern is not followed inside science classrooms, which enables children to make connections with their teacher and/or science concepts.

**Deficits or difficulties in skill or knowledge: National data.** According to the National Center for Educational Statistics (NCES, 2011) eighth-grade science assessment scores, Whites outscored African Americans by 36 points and Hispanics/Latinos by 30 points. Also, students who were not eligible for free/reduced lunch scored 17 points higher than students who were eligible for reduced lunch and 30 points higher than students who received free lunch (NCES, 2011). There lies a distinct link between socioeconomic status and academic achievement, which highlights the need for continued research in various school settings to account for differences across locality, school structure, community composition, race, and intersectionality, in that no person has a single, easily stated identity (Martinez, Tost, Hilgert, & Woodard-Meyers, 2013; Alexander, 2012; Crenshaw, 1991).

**Deficits or difficulties in skill or knowledge: Research school.** The 2009-2010 Report Card (Governor's Office of Student Achievement, 2011) reported the rural South Georgia district evaluated in this research had a total of 7,425 students enrolled in school. Of the students enrolled in the district, 30 percent (N=2279) were African American, 14% (N=1040) Latinos, and 51% (N=3787) White. The district reported a total of 46 administrators, and only 6 were African American (Governor's Office of

Student Achievement, 2011). The 2009-2010 Report Card (Governor's Office of Student Achievement, 2011) reported 12% (N=66) of teachers in this district were African American compared to 86% (N=485) White teachers and one-tenth percent (N=3) Latina/o teachers. As reported by the Governor's Office of Student Achievement (2011), the middle school in this rural South Georgia district has a total of 123 teachers and 6 administrators. Of the administrators enrolled at the middle school, 17% (N=1) of administrators were African American while 83% (N=5) were White (Governor's Office of Student Achievement, 2011). The middle school in this district has a total of 75% (N=92) White teachers, 23% (N=28) African American teachers, and 2% (N=3) of other ethnicities (Governor's Office of Student Achievement, 2011). The 2009-2010 Report Card (Governor's Office of Student Achievement, 2011) also reported less than 1% (N=3) of the science teachers in this district were African American. This demographic personnel data does not complement the student demographics for this district.

In 2011, the Governor's Office of Student Achievement reported 22% of seventh graders did not pass the Science Criterion Referenced Competency Test (CRCT) at the middle school level in the teacher-researcher's district. Of the underachieving students 31% were African American and 19% were Hispanics/Latinos. The 2011-2012 Report Card (Governor's Office of Student Achievement, 2011) also reported, 26% of those students who did not meet the CRCT criteria originated from low-income families.

**Priorities to address deficits or improve performance: Research school.** The rural South Georgia middle school in the current study conducted science benchmark tests in grades six through eight, and the achievement gap was apparent between Whites and African Americans. The sixth grade benchmark results indicated Whites answered 64% correct and African Americans answered 53% correct. The seventh grade benchmark results indicated Whites answered 62% correct, African Americans answered 50% correct, and Latinos answered 57% correct. The eighth grade benchmark results indicated Whites answered 53% correct and African Americans answered 43% correct. On average, African American students have a 10% achievement gap from the White students in science. The Latino students are also scoring higher than African American students in science which demands faculty and staff to pay close attention to the African American subgroup.

The South Georgia middle school's Continuous Improvement Plan used for the current research outlines improving curriculum mastery as one of their measureable goals for the 2011-2012 school year (Governor's Office of Student Achievement, 2011). The Continuous Improvement Plan (CIP) also identified two goal areas that focused on African American student achievement. Goal area one stated, "Our first objective is to improve curriculum mastery in all grades on CRCT reading/ELA, math, science, and the Georgia 8th grade writing assessment" (Governor's Office of Student Achievement, CIP, 2011, p. 2). Within goal area one the leadership team specified to increase seventh-grade science proficiency in the African American subgroup to 65%. Goal area two stated, "Our strategic objectives are to improve instructional engagement and resources" (CIP, 2011, p. 3). In order to achieve these goals, the school must focus on the African American students.

**Need for research: Professional practice.** Based on the 2010-2011 Balance Score Card, this South Georgia middle school has met Annual Yearly Progress (AYP) for the last four years but has not made significant gains (Governor's Office of Student Achievement, 2011). The 2011-2012 CIP seeks to decrease the number of African American students that fail to meet the CRCT passing requirements. Researchers suggest that African American students are often more motivated by African American teachers, but the personnel demographic data displayed does not represent a balance among teacher-student ethnic groups, therefore some teachers are unprepared to teach in a school where the students' life experiences are essentially different from their own (Martinez, Unterriener, Aragon, & Kellerman, in press; Paris, 2012; Redeaux, 2011). Therefore, teachers will have to utilize different learning strategies to encourage African American students to excel in science (Bell, 1992; Valencia, 2010).

The current research is intended to provide teachers with culturally relevant teaching strategies to motivate African American students in science. Teachers will also be able to collaborate with administrators to extend the strategy to the school body. Parents will benefit from this research by becoming aware of the effect their home environment has on their children.

### **Literature Review**

Achievement and opportunity gaps (Carter, Welner, & Ladson-Billings, 2013; Gorski, 2013) among culturally, linguistically, ethnically, and economically ethnic groups present apprehension among educators and policymakers and show that teachers play an important role in the achievement of students (Gabriel, Martinez, & Obiakor, in press; Hughes & North, 2012; Valencia, 2010). Despite mixed evidence found in the literature about both successes and disparities in the education policies, approaches, and achievement of students with diverse backgrounds, when examining the science achievement gap that exists between specific ethnic groups, African Americans and Whites have the largest disproportion (Alexander, 2012; Beecher & Sweeny, 2008). Therefore, the review of the relationship between culturally relevant teaching and science achievement for African American students is essential in identifying effective ways to increase academic achievement, improve attitudes toward science and classroom behaviors.

### **Understanding the Problem**

Students of different cultures and backgrounds struggle to have teachers identify who they really are because of culture and language differences (Griffin, Martinez, & Martin, 2014; Paris, 2012). Culture is fundamental to learning for all students, but affects each one of them differently (Martinez et al., 2013, in press; Nieto & Bode, 2008). Nieto and Bode (2008) also declared if teachers and schools are oblivious of cultural differences it can lead to student and school failure. Many American teachers view culture as irrelevant to education, but the truth is that teachers are not adequately trained to incorporate culture into their lesson plans and are ill-equipped to effectively communicate with different ethnic groups (Gabriel et al., in press; Griffin et al, 2014;

Redeaux, 2011). There have been several strategies introduced to teachers that focus on African American retention of concepts (Niето & Bode, 2008).

**Standards-based instruction.** A teaching strategy that focuses on the concept retention is standards-based instruction. Standards-based instruction is the process of designing, assessing, and teaching students according to state standards. This type of instruction can be achieved by using differentiation strategies to assure all students obtain the same knowledge, but using different techniques. Allcock and Hulme (2008) questioned if different learning styles were a basis for differentiation to increase the knowledge of A-level students, in comparison to literary capabilities. Students in two classes of A-level psychology were examined. In one class, differentiation was organized by learning styles; and in the other class, differentiation was organized by academic ability. The two learning styles used were Honey and Mumford's Learning Styles Questionnaire (2006) and Gardner's Multiple Intelligences (1993). The study was conducted for a nine week period and monitored by class tests. Pre and posttests were provided to 33 participants, ages 17- to 19-years old (12 males and 21 females). There were a total of 17 students in the ability group and 16 students in the learning style group. Before the intervention, all students were given a pretest on a previous concept taught and two questionnaires. The teacher thoroughly planned for each lesson with differentiating activities for each class. After the implementation, both classes took a posttest over a concept taught during the intervention and another questionnaire concerning their experiences in the experiment. After data analysis, the authors concluded both classes significantly advanced from their pretest to final test, but there was no substantial difference in enhancement between the two groups.

The results from Allcock and Hulme (2008) yield the same conclusion as Beecher and Sweeny (2008) on the basis of differentiation. Beecher and Sweeny (2008) used curriculum enrichment and differentiation to decrease the achievement gap and increase student achievement in different ethnic and socioeconomic groups in an elementary school. The research was completed over an eight year period to include quantitative and qualitative data. The school improvement planning team at Central Elementary School (CES) developed a school mission to integrate gifted and talented strategies into the curriculum and detailed plans of action. The plan of action included (a) a school-wide enrichment team that includes parents and teachers to enrich and enhance student learning, (b) differentiation training for staff, (c) interdisciplinary differentiated lessons to include standards-based instruction, and (d) an extended day enrichment program. After implementing the eight year strategic plan, CES compared their 1997 state test scores to the 2004 state test scores. The analysis of the data indicated improvement in all subjects and a narrowing of the achievement gap from 62% to 10%. All ethnic and socioeconomic groups showed improvement in academic achievement. Results from the students in the lower socioeconomic status were reduced by 28% and the higher socioeconomic status was lowered to 4%. Allcock and Hulme (2008) and Beecher and Sweeny (2008) research studies both determined differentiation does increase academic achievement. Although academic achievement was increased, the student's attitudes towards science were not tested as a variable.

**Attitude toward science.** Some researchers propose African Americans have adverse attitudes, images, and interests towards science. Christidou (2011) believed science teachers portrayed a negative image of science to their students, especially girls, that initiates a negative attitude towards science. Students believe science is not relative to everyday life and they consider scientific professions to be a fantasy. Additionally, the author stated popular science is also tainted and portrays the stereotypical image of an old White male with glasses in a lab coat (Christidou, 2011, Bell, 1992). The authors of NewsOne (2011) agreed with Christidou about the stereotypes within science that give African Americans a false image of science.

Christidou (2011) implied that science teachers, science textbooks, and popular science must be reformed to influence students' interests and attitudes and recommended that new research involve the reform of science teachers, science curricula, and popular science to reveal a correlation between the way science is taught to students and the images of science the students depict. Christidou (2011) also advised that race, gender, age, and socioeconomic status be explored along with the relationships mentioned to address critical issues in science.

Christidou's (2011) study is related to Kirikkaya and Vurkaya (2011) who implemented alternative types of assessments to impact student success and attitudes. In comparison to conventional assessments, alternate assessments are used to yield positive results by developing higher order thinking skills. Kirikkaya and Vurkaya (2011) used three types of alternative assessments; structural communication grid (SCG), diagnostic tree, and predict-observe-explain activities and concluded that alternative assessment activities positively influenced students' science attitudes and increased their academic achievement because of the increase in test scores.

**Culturally relevant teaching.** The current research seeks to introduce culturally relevant teaching into classrooms in order to increase academic achievement. Previous studies have been conducted on cultural influences on academic achievement (e.g. Gay, 2010; Ladson-Billings, 1994, Paris, 2012; Scherff & Spector, 2011). Jackson and Jackson (2011) revealed that culturally relevant teaching helps students develop the necessary learning skills, and teachers that use this theory create a social relationship with their students to promote a safe and nurturing environment inclusive to learning. Jackson and Jackson (2011) addressed the social and academic needs of middle school African American students by using culturally relevant pedagogy theory and examined the beliefs and perceptions of middle school science teachers on culturally relevant teaching. In this study eight middle school teachers of low-income, African American students agreed to participate in this research study. The participants completed a two-part Likert-type scale questionnaire with items about beliefs and attitudes. Of the participants, four agreed to being interviewed for one hour answering questions regarding personal histories, culturally relevant teaching, and challenges they face as a teacher. Jackson and Jackson (2011) identified one teacher from the data analysis of the questionnaires and interviews to observe for the study. The African American female science teacher identified was observed every two weeks for six weeks at different times of the day. The authors gathered artifacts, audio files, and extensive field notes to draw a conclusion about culturally relevant pedagogy. Jackson

and Jackson (2011) determined that culturally relevant teaching helps students develop the necessary skills, and teachers that use this theory create a social relationship with their students to promote a safe and nurturing environment inclusive to learning.

Fierros and Conroy (2002) reported two developments in their data analysis. The first trend the authors noticed was that minority students were more likely to be removed from regular education classrooms than White students. The second trend Fierros and Conroy (2002) identified was how the African American students are often over-identified in disabilities. Christenson, Sinclair, and Thurlow (2005) implemented the check and connect intervention. The check and connect intervention identifies students who are at risk of dropping out of school and pairs them with mentors to focus on their needs. Christenson et al. (2005) found that the check and connect intervention decreased the dropout rate and increased school completion rates.

**Limitations of the literature.** Hayling, Kern, Serpell and Stevenson (2009) found a demand for culturally-responsive school-based intervention because African American males perform better in classroom culture that corresponds to their environmental culture. Christidou (2011) suggested that new research must involve the reform of science teachers, science curricula, and popular science to reveal a correlation between the way science is taught to students and the images of science the students depict. Christidou (2011) also suggested that race, gender, age, and socioeconomic status also be explored along with student-teacher relationships to address critical issues in science. Patricia Hill-Collins (2000) argued the same sentiments and noted that, “the politics of race and gender also influence knowledge.” Calebrese-Barton concurred with Christidou (2011) and Hill-Collins (2000) when she discussed how “science education has not incorporated the needs or concerns of children in poverty and children from ethnic, racial, and linguistic minority backgrounds” (Barton, 2001, p. 648).

There are several factors influencing African American academic achievement that have been identified: student’s attitudes, images and interests of the subject; teacher-student closeness; and cultural compatible education. Although these factors are imperative, they do not address how science teachers will be regenerated to become culturally responsive to African American provisions. When teachers become culturally responsive they will assess the ability to communicate effectively with African American students to increase their academic performance. Once teachers have become culturally aware, not necessarily competent or proficient, they will be able to effectively communicate with their African American students to increase science achievement within the subgroup.

### **Purpose Statement**

The purpose of the study was to examine the relationship between culturally relevant teaching and science achievement in seventh-grade African American students within the classroom when compared to standards-based instruction. Student attitudes and behaviors toward science were also measured for improvement. Students, teachers, administrators, parents, and district leaders will benefit from this research by

identifying effective communication with African American students to increase academic achievement, improve their attitude toward science and their classroom behavior.

### **Research Questions**

**Research question 1.** Will culturally relevant teaching increase seventh-grade African American students' science achievement compared to standards-based instruction?

**Research question 2.** Will culturally relevant teaching increase seventh-grade African American students' attitudes toward science compared to standards-based instruction?

**Research question 3.** Will culturally relevant teaching increase seventh-grade African American students' engagement compared to standards-based instruction?

### **Definitions of Variables**

**Culturally relevant teaching.** Culturally relevant teaching is a type of teaching strategy that is attentive to different cultures within the classroom (Gay, 2010; Ladson-Billings, 1994, Paris, 2012; Scherff & Spector, 2011). The teacher-researcher implemented culturally relevant teaching by utilizing role playing as a means for students to display their knowledge of science concepts (Jackson & Jackson, 2011).

**Standards-based instruction.** Standards-based instruction requires a student-centered environment with the teacher-researcher acting as a facilitator (Allcock & Hulme, 2008). The teacher-researcher will use standards-based instruction for the control group.

**Science achievement.** Science achievement is the increase in the attainment of science standards. The teacher-researcher measured science achievement by using test and quiz scores.

**Attitude toward science.** Attitude is a personal evaluation of concepts; an expression of favor or disfavor toward science (Christidou, 2011). Student attitudes toward science were measured by a survey.

**Behavior.** Behavior is a manner of behaving, acting and reacting (Christidou, 2011). Classroom behavior was measured by the use of behavior charts and graphs.

### **Methods**

#### **Setting and Participants**

This research was conducted in a science classroom at a middle school located in rural South Georgia. The county had an estimated population of 42,356 residents,

73.5% of whom were high school graduates and 12.1% of whom graduated with a Bachelor's degree or higher (U.S. Census Bureau, 2010). The high percentage of high school graduates compared to the low percentage of college graduates indicates a low number of students attend college from this area, which identifies the average student from this area does not have college educated parents. The 2010 U.S. Census identified that the county had a \$31,761 median household income and 25.9% of persons were living below the poverty level, all of which are lower than the state reported data (U.S. Census Bureau, 2010). The county's high poverty level indicates an economically distressed community.

The Continuous Improvement Plan identified 1,746 students in grades six through eight at this middle school (2011). There were 572 students in the seventh-grade. Table 1 illustrates the racial makeup of the middle school. Majority of the students at this middle school were from low-income families and the student ages ranged from 12-15.

Table 1

*School demographic data*

Demographic	Percentage	
Ethnicities	African American	32
	White	52
	Latino	7
	American Indian	7
	Multiracial	1
	Asian	1
Regular Education Students with Disabilities	7	
English Language Learners (ELL)	9	
Migrant	2	
Gifted	1	
	11	

A heterogeneous, convenience sample was used by the researcher to select participants for this study. The participants in this research were 50 seventh-grade students in two Science classes at a middle school in rural South Georgia. The current study focused primarily on the 15 African American students as shown in Tables 3 and 4. Demographic characteristics and achievement data provided by the 2010-2011 Report Card (Governor's Office of Student Achievement, 2011) of both the standards-based group and the culturally relevant group are provided in Table 2. Each of the students with a disability identified in Table 2, had an Individual Education Plan (IEP)

that addressed needs, goals and supports for their disability. Analysis of the data in Table 2 indicated that majority of the students scored on Level 1. The analysis indicated that only a few students meet the standards which specify a need for an increase of academic achievement (Governor’s Office of Student Achievement, 2011).

Table 2

*Demographic and achievement data for the standards-based and culturally relevant classes*

		Standards-based	Culturally relevant
Demographic		N=28	N=22
Ethnicities	African American	7	8
	White	14	10
	Latino	7	4
Gender	Males	13	13
	Females	15	9
Students with Disabilities		2	1
English Language Learners (ELL)		1	1
Migrant		1	1
Gifted		6	0
Achievement			
Level 1		15	16
Level 2		9	6
Level 3		4	0

The culturally relevant group was the second class of the day and experienced culturally relevant teaching; and the standards-based group was the last class of the day and experienced standards-based instruction. There were more males than females in this study. In the culturally relevant class, the number of students who scored at Level 1 was 16, 6 at Level 2, and none of the students scored at Level 3, on the science section of the CRCT (Governor’s Office of Student Achievement, 2011). In the standards-based class, the number of students who scored at Level 1 was 15, 9 at Level 2, and 4 at Level 3, on the science section of the CRCT (Governor’s Office of Student Achievement, 2011).

The teacher-researcher was an experienced seventh-grade life science teacher and taught both the standards-based group and the culturally relevant group. The teacher-researcher was responsible for lesson plan development, content delivery, instructional delivery, pacing guides, and assessment creation, as well as administration of all science curricula.

### **Intervention**

A mixed methods design was used in this research, which required the collections of both qualitative and quantitative data (Creswell, 2008). The qualitative data obtained were used to corroborate the quantitative data. The standards-based (SB) class was the control group and the culturally relevant teaching (CRT) class was the treatment group. Students were assigned to each block by the assistant principal prior to the beginning of the school year as usual. The intervention phase of the study took place during weeks two through eight of the first semester. During this time period, students received instruction on two science units. The first unit was a preview-review unit over lab safety, lab rules, metric system, and science tools. The second unit covered cells and body systems. Each class received 60 minutes of science content instruction daily from the same teacher in whole group and small group settings. Students were paired in groups according to their Lexile reading level. Behavior was noted on behavior charts daily in both groups by the teacher-researcher and evaluated in comparison to assessment scores.

The standards-based (SB) class received instruction from the teacher-researcher. The teacher-researcher used various standards-based strategies to present the content to the students. Every lesson was opened by using an activator and closed by using a summarizer. Instruction was provided by using explicit instruction. Explicit instruction provided the students with an example by the teacher first. Subsequently, the students assisted the teacher with an example. Next, the teacher assisted the students. Finally, the students provided an example while the teacher observed. The teacher-researcher assumed the role of facilitator; while the students were the instructors in the SB class.

The culturally relevant teaching (CRT) class received instruction from the teacher-researcher. The teacher-researcher used various culturally relevant teaching strategies to present the content to the students in this group such as role playing, researching different scientists of different ethnic backgrounds, and putting their knowledge to music (Jackson & Jackson, 2011). At the end of every class, the students wrote in their journals to express their feelings or questions about a lesson. The teacher-researcher read the journals each Thursday to provide feedback to the students and to answer any questions before an assessment. In the CRT class, the teacher guided students' concepts and rationales and the students were motivated to increase their knowledge of science.

Both groups were given the same assessments. Quizzes were given on Fridays in a multiple-choice format. A unit test was administered before and after instruction for both units. Students entered their scores on the classroom response system to receive immediate feedback and scores. The classroom response system would also chart

each student's progression throughout the unit; as well as the entire class. Science attitude surveys were also entered and scored on the classroom response system at the beginning and the end of the intervention. All data were gathered and analyzed by the teacher-researcher.

### **Data Collection**

The teacher-researcher used the following instruments to determine if achievement and attitude toward science improved when seventh-grade students were taught using culturally relevant teaching strategies in comparison to standards-based instruction.

**Quizzes.** The quizzes given were 10 to 15-item teacher-researcher developed multiple choice tests that assessed the science comprehension of seventh-grade students (see Renaissance Learning, 2013). The quizzes were given weekly. Each item on the quiz was worth equal value totaling 100 points. The SB and CRT groups were given the same quizzes. The quizzes were developed by the teacher-researcher using the unit test as a template. Content validity was established by a peer review completed by two content teachers (e.g., Renaissance Learning, 2013). The scores of the SB group were compared with the scores of the CRT group to determine if the students' academic achievement increased. Data were analyzed using descriptive statistics ( $M$ ,  $SD$ ) and an unpaired one-tailed  $t$ -test (Creswell, 2008).

**Science test.** The science test given before and after intervention was a teacher-developed 20-item multiple choice test that assessed the science comprehension of seventh-grade students. Each item on the test was worth equal points. The test was developed by the teacher-researcher and the seventh-grade science Department Chair. During the collaboration, the teacher-researcher and department chair selected questions from the Georgia Department of Education Online Assessment System (Georgia Department of Education, 2010) and Study Island. The SB group and the CRT group were given the same test. The test was given at the beginning and the ending of each unit. There were two certified science teachers who conducted a peer review to establish content validity. The scores of the SB group were compared with the scores of the CRT group to determine if the students' academic achievement increased. Data were analyzed using descriptive statistics ( $M$ ,  $SD$ ) and an unpaired one-tailed  $t$ -test (Creswell, 2008).

**Science attitude survey (SAS).** The survey was a 20-item teacher-developed instrument administered at the beginning and ending of the study to both groups. The instrument used a 5-point Likert-type scale (scored 1 – *I strongly agree*, 2 – *I agree*, 3 – *I am not sure*, and 4 – *I disagree*, 5 – *I strongly disagree*). The survey was developed to measure students' attitudes toward science. Content validity was established by pilot testing conducted by two students. The two students read a copy of the survey for clarity and understanding. Differences in attitude about science before and after the intervention were examined. Themes that emerged were discussed and compared for effects of intervention on students' attitude toward science. A paired one-tailed  $t$ -test was performed along with descriptive statistics ( $M$ ,  $SD$ ) to analyze data (Creswell, 2008).

**Behavior chart.** The behavior chart was a teacher-revised document that was used with both the standards-based (SB) group and the culturally relevant teaching (CRT) group (Mauro, 2012). The behavior chart contained the following information: participants' name, date, goals to achieve, and consequences. Students identified three behavior goals to be achieved during the nine weeks while in class. The consequences for not achieving those goals were as follows: first infraction: warning, second infraction: student will serve silent lunch, third infraction: teacher will contact parents, and fourth infraction: student will receive a discipline referral. A remarks section was provided for parents' signature and a description of the incident. Content validity was established by pilot testing conducted by two students. The two students were given a copy of the behavior chart to determine if they could understand the language and diagrams of the chart. The behavior chart was completed daily by the teacher at the end of class. A comparison was made of the number of behaviors displayed with how often the behaviors were displayed. Another comparison was made between the two classes. Data were analyzed using descriptive statistics ( $M$ ,  $SD$ ) and a paired one-tail  $t$ -test (Creswell, 2008).

**Field notes.** The teacher-researcher recorded field notes of any incidents that might have affected the intervention, such as students' behavior, classroom interruptions, or other relevant information that may have affected the study. Field notes were used to document themes or patterns in student behaviors, attitudes, questions, and comments during the intervention phase. These notes were used to explain incidents that might have increased or decreased the effectiveness of the intervention. The data were organized by using descriptive codes. All data was coded and analyzed for descriptive themes and patterns (Creswell, 2008). Based on the findings, a narrative was written to summarize the results.

## Results

The purpose of this study was to determine the effect of culturally relevant teaching on seventh grade African American students' science achievement, attitude, and behavior compared to standards-based teaching in a rural South Georgia middle school. Results of the study were based on the teacher-researcher's analysis of students' pretest and posttest results, scores on weekly quizzes, responses to science attitude survey questions, and field notes.

A unit test was given as a pretest to provide a baseline for determining the amount of science knowledge the students had before the intervention began. Both the CRT and SB groups were administered the same pretest at the beginning of the study. This same unit test was given as a posttest at the end of the study and a comparison of scores was performed.

The data from the pretest and posttest scores; as well as, the comparison of scores are shown in Table 3. Means and standard deviations for both the pretest and posttest for both groups are also shown below in Table 3.

Table 3

*Science Pretest & Posttest Achievement*

Class	N	Pretest			Posttest		Mean Gain/Loss	Comparison of Mean Gain/Loss	
		M	SD	M	SD	t- value		p	
Standards-based	8	32.13	13.97	69.25	17.85	37.12	-1.29	.11	
Culturally-relevant	7	20.43	13.19	65.14	9.04	44.71			

\*p < .05; \*\* p < .01

The SB group scored 11.70 points higher ( $M = 32.13$ ,  $SD = 13.97$ ) than the CRT group ( $M = 20.43$ ,  $SD = 13.19$ ) on the pretest. The pretest data in Table 3 revealed the SB group had more prior knowledge of the concepts taught than the CRT group. The SB group also scored 4.11 points more than ( $M = 69.25$ ,  $SD = 17.85$ ) the CRT group ( $M = 65.14$ ,  $SD = 9.04$ ) on the posttest. Although the SB group scored higher on the pretest and posttest, the CRT group made a higher gain. However, the mean gain of the CRT group was not significantly different ( $t(13) = -1.29$ ,  $p = 0.11$ ) from the SB group. The groups are similar enough for comparison. Based on the data in Table 3, the CRT group did improve their academic achievement, but not significantly.

Cohen's  $d$  was used to calculate the effect size of the implementation of culturally relevant teaching on science achievement. There was a significant difference in the mean scores of the two groups (see Table 2), but the CRT group had a small effect ( $d = 0.31$ ) on posttest scores.

The teacher-researcher expected that an average student in the CRT group would outperform about 62% of the students in the SB group. However, scores for both groups showed an increase from pretest to posttest with the CRT group showing an increase of 44.71 and the SB group 37.12. Culturally relevant teaching increased scores approximately 6%; therefore, increasing student achievement.

A comparison of the achievement of both the CRT and SB groups on weekly achievement quizzes (e.g., Creswell, 2008; Renaissance Learning, 2013) are shown in Table 4. Both groups were tested weekly by using quizzes. Table 4 shows the mean and standard deviations for both groups' quiz scores for four weeks.

Table 4

*Weekly Science Achievement Quiz Data*

Class	Quiz 1			Quiz 2		Quiz 3		Quiz 4	
	N	M	SD	M	SD	M	SD	M	SD
Standards-based	8	72.83	9.66	63.13	19.07	78.13	20.45	65.25	32.08
Culturally-relevant	7	69.86	19.11	60	14.14	73.71	17.72	71.43	48.86

The data in Table 4 revealed that student scores in both the SB and CRT groups decreased on quiz 2 from the scores on quiz 1. Both the CRT and SB groups made gains on quiz 3 after the initial decrease in scores, but the CRT group continued to increase from their initial mean score, while the SB group decreased on quiz 4. After analyzing the data, the CRT group outperformed the SB group on weekly quizzes.

Means and standard deviations for each graded assessments are provided in Table 4. The mean score of the CRT group ( $M = 68.75$ ,  $SD = 16.06$ ) was not significantly different ( $t(15) = 0.24$ ,  $p = 0.41$ ) from the mean score ( $M = 69.83$ ,  $SD = 9.19$ ) of the SB group after being taught using different strategies of culturally relevant teaching. Cohen's  $d$  was used to calculate the effect size of culturally relevant teaching on African American science achievement. The intervention had a negligible effect ( $d = 0.09$ ) on student quiz scores. An average student in the SB group would be expected to outscore about 54% of the students in the CRT group. Culturally relevant teaching would decrease quiz scores by only 2%. Therefore, the implementation of culturally relevant teaching did not significantly impact African American students' science achievement when assessed using weekly quizzes.

Data were obtained on student attitudes towards science from the surveys that were administered before and after completion of the intervention. Students were asked to complete the surveys using a 5-Likert scale. The responses ranged from 1 for "strongly disagree" to 5 for "strongly agree." Student responses to the pre and post intervention survey for the CRT group and the SB group are summarized in Table 5. The results of the pre and post intervention science attitude survey for the CRT group and SB group are shown in Table 5. The percentage of students in the CRT group who strongly agreed or agreed that science was fun increased from 65% prior to the intervention to 69% after implementation of the intervention. While the percentage of students who strongly agreed or agreed science was fun in the SB group decreased from 57% to 46%.

This data analysis revealed that some of the students in the CRT group that either disagreed or strongly disagreed changed their enthusiasm for science increased after the intervention.

Table 5

*Science Attitude Survey*

	Culturally-relevant Group				Standards-based Group			
	% Strongly Disagree or Disagree		% Strongly Agree or Agree		% Strongly Disagree or Disagree		% Strongly Agree or Agree	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Science lessons are fun.	35%	31%	65%	69%	43%	54%	57%	46%
I really enjoy going to science class.	24%	25%	76%	75%	43%	31%	57%	69%
I look forward to science class.	59%	44%	41%	56%	86%	77%	14%	23%
A job as a scientist would be interesting.	59%	56%	41%	44%	64%	62%	36%	38%
Science is one of the most interesting school subjects.	31%	0%	69%	100%	31%	21%	69%	79%
I would like to learn more about science.	18%	19%	82%	81%	36%	31%	64%	69%
My science teacher motivates me to do my best.	12%	13%	88%	89%	0%	23%	100%	77%
I would like to learn more about science	41%	19%	59%	81%	14%	31%	86%	69%

Table 5 revealed that the percentage of students who strongly agreed or agreed they looked forward to science in the CRT group increased from 41% to 56% after the implementation of the intervention. In the SB group, the percentage of student who strongly disagreed or disagreed that they looked forward to science decreased from 86% to 77%. Therefore, in both groups some students began to look forward to science. After analyzing the data, the teacher-researcher concluded that some students' attitudes toward science did positively change after the implementation of culturally relevant teaching.

In the CRT group, the percentage of students shown in Table 5 who strongly agreed or agreed that their science teacher motivates them to do their best increased from 88% to 89% after the implementation of the intervention. The percentage of students in the SB group who strongly agreed or agreed that their science teacher motivates them to do their best decreased from 100% to 77%. The results of the science attitude survey showed students maintained a positive attitude towards science in the CRT group. The results of the science attitude survey showed the positive attitude of students in the SB group decreased during the study, but the attitude of the students in the CRT group increased. This analysis revealed that the teacher-researcher motivated the students of the CRT more by using the different teaching strategies used during the implementation.

The data in Table 5 revealed that the attitudes of the students in the CRT group did change after the implementation. On average, the implementation positively impacted 12% of the students in the CRT group. After analyzing the data, culturally relevant teaching did improve seventh grade African American students' attitudes toward science compared to standards-based instruction.

A field journal was utilized throughout the course of the study. The field journal was used to make note of occurrences of discipline issues, off-task behaviors, and increased or decreased effectiveness of the intervention. These issues were also noted on students' behavior charts for parents to sign. Behaviors noted were off-task behavior, talking, and nonparticipation. At the beginning of the study, more students received demerits for behavior. There was a pep rally scheduled during the intervention period and it was hard for the students to focus and settle back down to work. The teacher-researcher noted behavior incidents on four of the students' behavior charts on the day of the pep rally. There were also behavior notes within the field journal provided by substitute teachers for five days the teacher-researcher was absent from school due to illness. On those five days, behavior increased and the implementation was not put into practice. On four out of the five days, three students received discipline referrals for various behaviors, such as fighting and insubordination.

Student completion of daily assignments also increased during the implementation of the study. The teacher-researcher recorded instances of off-task behavior in which one student in particular had to be redirected to the task at hand at least twice daily during the implementation of the study. The teacher-researcher noted gains in student willingness to work with a peer in order to complete assignments. Over the timeframe of the study, the field notes revealed a pattern of decreased off-task behavior in both the SB group and the CRT group. By the last week of the study, only two behavior charts were sent home in each group. After further analyzing the field notes themes and patterns with the behavior chart data, behavior was not significant in either but improved in both the SB and CRT group.

After analyzing the data within the tables, the CRT group did increase their science academic achievement when compared to the SB group. Although all participants made academic gains when comparing pretest and posttest results, the culturally relevant group made higher gains (44.71) than the standards-based group

(37.12). Data from the Science Attitude Survey revealed slight changes in students overall attitude toward science except in one area. In the culturally relevant group, 100% of the students agreed that science was an interesting subject after the intervention compared to 79% of the standards-based group. Although culturally relevant teaching did not decrease the behavior more than standards-based instruction, it did improve the classroom behavior of seventh-grade African American students. Culturally relevant teaching increased African American student academic achievement, and improved student participation and classroom behavior within the middle school science classroom.

### Discussion

To determine the effect of culturally relevant teaching on African American seventh grade students, the teacher-researcher compared achievement data scores of a standards-based group and a culturally relevant group before and after intervention. The results of the pretests and posttests, as well as weekly science quizzes, were compared to determine the effect of culturally relevant teaching on African American science achievement. The responses of students on a science attitude survey were also compared to determine the effect of culturally relevant teaching on the attitudes of African American seventh grade students. The teacher-researcher also used the number of behavior charts from beginning to end of the intervention, as well as field notes to determine the effect of culturally relevant teaching on classroom behavior.

In order to determine whether achievement increased when students were taught using culturally relevant teaching compared to standards-based teaching in science, the teacher-researcher utilized pretest and posttest results to determine the academic growth of students. When comparing the pretest ( $M = 32.13$ ,  $SD = 13.97$ ) and posttest ( $M = 69.25$ ,  $SD = 17.85$ ) data of the standards-based group, there were significant gains (37.12); however, when comparing the pretest ( $M = 20.43$ ,  $SD = 13.19$ ) and posttest ( $M = 65.14$ ,  $SD = 9.04$ ) data from the culturally relevant group, the culturally relevant group made higher gains (44.71). Therefore; culturally relevant teaching increased the science achievement of African American seventh grade students. This finding was in concurrence with Hayling, Kern, Serpell and Stevenson's (2009) findings that African American perform better in a classroom culture that corresponds to their environmental culture.

Weekly science quizzes were also utilized to determine the effect of culturally relevant teaching. A quiz was given weekly to assess the knowledge of the students. The teacher-researcher established that the results of the pretest and posttest data of the standards-based group corroborated the results of the quiz mean score ( $M = 72.83$ ) prior to the intervention being significantly different from the mean ( $M = 65.25$ ) after the intervention. The mean scores ( $M = 69.86$ ) of the culturally relevant group before intervention were lower than the mean score after intervention ( $M = 71.43$ ), which determined an insignificant increase for the intervention group. Although pretest and posttest results denoted significant gains in academic performance for all participants, no significant gains were noted on weekly quiz scores. Results were similar to the findings of Jackson and Jackson (2011), who determined that culturally relevant

teaching helps students develop the necessary skills and aids teachers that use this theory to create a social relationship with their students to promote a safe and nurturing environment inclusive to learning. An importance was placed on positive student-teacher relations during classroom activities and discussions. This too was in concurrence with the results from Jackson and Jackson (2011) because of the relationships that were created due to the culturally relevant teaching style.

In order to determine whether students' attitude towards science improved after receiving culturally relevant teaching compared to standards-based teaching, science attitude surveys were completed by participants. Comparisons of student responses before and after the intervention were analyzed. Data from the survey revealed that students maintained a positive attitude towards science in the culturally relevant group. The results of the science attitude survey showed the positive attitude of students in the standards-based group decreased during the study. Before the intervention in the culturally relevant group, 65% of students agreed that science lessons were fun, 41% of students looked forward to science class, 59% would like to know more about science, and 69% of the students agreed that science is one of the most interesting school subjects. After the intervention of the culturally relevant group, 69% of students agreed that science lessons were fun, 56% of students looked forward to science class, 81% would like to know more about science, and 100% of the students agreed that science is one of the most interesting school subjects. In the standards-based group, 43% of the students disagreed with the statement science lessons were fun before intervention and after the intervention 54% disagreed with the same statement. In the standards based group, 100% of the students agreed that their science teacher motivated them to do their best; this number decreased to 77% after the intervention. The results of science attitude survey showed students maintained a positive attitude towards science in the culturally relevant group. The results of the science attitude survey showed the positive attitude of students in the standards based group decreased during the study. The results of this study concur with the results of Christidou (2011) which revealed a correlation between the way sciences is taught to students and the images of science the students depict.

The students of the CRT group improved their positive attitude toward Science and decreased the number of classroom behavior issues within the science classroom. At the beginning of the intervention, the CRT group averaged four (50%) behavior charts a week to be set home and signed by their parents and the SB group averaged three (43%) behavior charts a week. At the end of the intervention, both groups were averaging two behavior charts being sent home, but for the CRT group the percentage decreased to 25% and the SB group 29%. Therefore, the culturally relevant teaching did improve the classroom behavior of African American students compared to standards-based instruction.

Although data from the survey were not statistically significant after the implementation of the intervention; pretest and posttest scores, weekly quiz scores, behavior charts and analysis of field notes suggest the participants' achievement, attitudes, and behavior toward science improved slightly.

## Implications and Limitations

Culturally relevant teaching has been proven to be an effective strategy to improve student achievement at various academic grade levels and subject areas (Carter et al., 2013; Gorski, 2013). Although standards based instruction has been proven to be effective in improving student achievement, educational researchers propose that culturally relevant teaching is more effective in increasing student achievement and attitude towards science. The implications of this study are important because they reveal some statistical significance regarding academic gains; improvements in achievement, attitude, and behavior. There are not any school-wide strategies in place currently that positively impacts African American achievement.

Another implication of the research is the limited amount of research on culturally relevant teaching in a middle grades science classroom. Majority of the research discussed differentiation or standards-based instruction in middle school. There were minimal research articles on culturally relevant teaching that were implemented at the middle school level, especially as it relates to science education. The intent of the study was to explain the use of culturally relevant teaching strategies in order to obtain the full benefit of the strategy. The extension of the study is to improve student achievement and attitude towards science. As the achievement increases, teachers and administrators can discuss possible implementation within all classrooms. This process would require further professional development on behalf of the teachers and administration.

Limitations may stem from issues related to the teacher-researcher's influence on the setting or the individuals being studied (Creswell, 2008), which included the number of participants of the study. There were 50 participants in this study, but only 15 were African American, which could have lessened the reliability of the data. The 15 participants were mostly female, which could also limit the amount of data because girls often times outscore boys in academic areas (Robelen, 2012). Additionally, the time frame in which the study was conducted limited the effective use of the strategies. There were also interruptions in the implementation which could have caused students to score poorly on some assessments. Also, the study was only conducted on African American students. Whether culturally relevant teaching will increase academic achievement for other ethnicities is unknown in this study. Therefore, the validity and reliability of the results were limited due to students' limited timeframe of culturally relevant teaching.

Lastly, the teacher-researcher's possible cultural bias may have affected the validity of the research. Interpreting and judging culturally relevant instruction by ideal characteristics to diverse cultures can be problematic. It is possible that the teacher-researcher may have compensated or made assumptions about language and/or social norm representation. The teacher-researcher's familiarity with students could have affected participants' responses to the science attitude surveys and/or skewed their answers to the assessments because of their relationship with the teacher-researcher. Results of the science attitude surveys, in addition to observations recorded in the field notes, were self-reported by the teacher-researcher, which increased the potential bias

in the reported results. Some of the data recorded could have been opinionated because they were self-reported which could have resulted in bias information.

### **Factors Influencing Implementation**

Several factors influenced the implementation of the study. The implementation time was reduced due to time restraints and different unit lengths. Originally, the teacher-researcher planned to complete the study within nine weeks; however, within that time frame three units would have been taught. Therefore, three different pretests and posttests would have been administered and would have potentially skewed data. Due to time constraint, the study only took place within the span of eight weeks overall. The strategy possibly would work better if it were implemented for a longer period of time.

Off-task behavior also influenced the performance of students. The teacher-researcher noted several instances where students were not actively involved in class while taking notes or during class discussions. A number of students were not consistently taking their medication, which helped them focus on daily instruction and some students caused behavior problems which distracted learners. Student and teacher-researcher absences also influenced the results of this study. If the students were absent one or more days, they missed valuable instruction which could have led to low scores on tests and/or quizzes. The days the teacher-researcher was absent the implementation was postponed which could have also led to low achievement scores.

### **Significance/Impact on Student Learning**

The implementation of culturally relevant teaching on student achievement did not significantly impact student achievement when comparing pretest and posttest scores. However, over 50% of the participants of the study made a gain in some degree. It is imperative that African American students make academic gains in science because of the school's goal to increase African American students' science performance on standardized assessments. Student scores were also conclusive towards the benefits of culturally relevant teaching in comparison to standards-based teaching through teacher lectures. The teacher-researcher used various teaching strategies with the culturally relevant group (Jackson & Jackson, 2011). The benefits and strategies of culturally relevant teaching are well documented by the teacher-researcher and can be utilized for any subject area. Further studies like the implementation of the current research may result in the improvement of culturally relevant teaching on science achievement with the ultimate goal of preparing all students for future success in education. Expanding the scope of the research to include related developmental teaching and learning skills that may impact teacher and student cultural proficiency may also increase the opportunities for improving understanding of best practices in science instruction.

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