EMPLOYING CONCEPTUAL CHANGE AND INQUIRY-BASED STRATEGIES WITH AFRICAN AMERICAN K-12 SCIENCE STUDENTS: A REFLECTION ON TWO CLASSROOM BASED PILOTED STUDIES

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ABSTRACT

The process of conceptual change can be described as a three phase process. The first phase involves students' possession of initial *naïve conceptions/misconceptions*, the second phase involves students undergoing a process of *assimilation*, and the third phase involves students undergoing a radical process called *accommodation*. Posner, Strike, Hewson, & Gertzog (1982) describe *assimilation* as a process in which students combine their initial *naïve conceptions or misconceptions* of a concept with new pieces of "truths" about that concept. Thus, the misconceptions and "truths" coexist within students' thought processes, neither one replacing or substituting the other. When, the student/students' misconceptions are replaced by "truths" about the concept being taught, this radical form of conceptual change is called *accommodation* (Posner, Strike, Hewson, & Gertzog, 1982). According to Ozdemir and Clark (2007), conceptual change researchers have made tremendous progress in respect to enhancing the "knowledge-as-theory perspective" and "knowledge-as-elements perspectives." However, it is felt that the "knowledge-as-elements perspectives" has not been as widely researched as the "knowledge-as-theory perspectives." Also, relatively few studies on conceptual change and inquiry-based learning focus on Black/African American K-12 students. Thus, my previous pilot studies outlined in this paper address the aforementioned gaps in the literature. The first study present findings on the use of instructional games to improve science learning among African American elementary school students and the second study reveals findings on the use of an innovative physics lab practical, which was used with African American high school students. The findings of the two studies showed that the employment of conceptual change strategies and inquiry learning with African American students led to improvements in their understanding of general science and physics concepts, which ultimately led to higher test scores (evident from students' post-test scores).

Key words: conceptual change, inquiry-based learning, African American students, physics learning, and general science learning

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INTRODUCTION

Conceptual Change Defined/Described

The process of conceptual change can be described as a three phase process. The first phase involves students' possession of initial *naïve conceptions/misconceptions*, the second phase involves students undergoing a process of *assimilation*, and the third phase involves students undergoing a radical process called *accommodation*. Posner, Strike, Hewson, & Gertzog (1982) describe *assimilation* as a process in which students combine their initial *naïve conceptions or misconceptions* of a concept with new pieces of "truths" about that concept. Thus, the misconceptions and "truths" coexist within the students' thought processes, neither one replacing or substituting the other. When, the student's/students' misconceptions are replaced by "truths" about the concept being taught, this radical form of conceptual change is called *accommodation* (Posner, Strike, Hewson, & Gertzog, 1982). Posner, Strike, Hewson, & Gertzog believed that four conditions should exist in order for full accommodation to occur.

- First, there must be dissatisfaction with existing conceptions—so students are unlikely to make major changes in their concepts until they believe that less radical changes will not work. So before an accommodation can occur, it is reasonable to believe that an individual must have collected a store of unsolved puzzles or anomalies and lost faith in his/her ability to solve the problems given his/her initial understanding of the concept (which is steeped in naïve conceptions/misconceptions) (Posner, Strike, Hewson, & Gertzog, 1982, p. 214).
- Second, a new conception must be intelligible—so the student must be able to grasp how experience can be structured by a new concept sufficiently to explore the possibilities inherent in it (Posner, Strike, Hewson, & Gertzog, 1982, p. 214).

- Third, a new conception must appear initially plausible—that is, any new concept must have the capacity to solve the problems at hand (Posner, Strike, Hewson, & Gertzog, 1982, p. 214).
- Fourth, a new concept should suggest the possibility of a fruitful research program—being able to lead to extension of concept and creation of new areas of inquiry (Posner, Strike, Hewson, & Gertzog, 1982, p. 214).

The information presented beforehand spoke to the definition/description of conceptual change. The next set of information presented covers a description of inquiry-based learning. Basically, how would one define inquiry-based learning?

Inquiry-based Learning Defined

Inquiry-based learning or discovery learning can be defined as learning that actively involves students in their own learning processes (Freire, 2005). Inquiry learning is steeped in constructivist ideas of learning, where students' knowledge is built from socially based experiences and processes (Inquiry-based Learning, Wikipedia, 2013). Sawyer (2004) is one researcher who strongly advocates more for inquiry-based teaching than traditional lecture style teaching, which does not allow students to co-construct their own knowledge. Thus, instead of students undergoing a traditional learning process of being told what learning outcomes/experimental outcomes are expected or being asked to confirm or show evidence to support what they are told, they are instead allowed to undergo a process called "open learning" (Inquiry-based Learning, Wikipedia, 2013, p. 3)

Banchi & Bell (2008, p. 2, as cited in Inquiry-based Learning, Wikipedia, 2013) describe four levels of inquiry-based learning in science. The four levels of inquiry-based learning in science are:

1. Confirmation inquiry—students can be provided with a question and procedure or method, in which the results are known in advance, and the confirmation of the results is the object of the inquiry. Two useful purposes of confirmation inquiry are to reinforce an idea learned previously and for practice of a specific inquiry skill.
2. Structured inquiry—students are provided with a question and procedure or method, but the task is to form an explanation that would be supported by the evidence collected during the procedure.
3. Guided Inquiry—students are provided with only a research question, their task is to design a procedure or method, and to test the question and the resulting explanations. This type of inquiry is one of the most difficult of the four types of inquiry and so it is more relevant to students who have had numerous opportunities to learn and practice various ways to plan experiments and record data.
4. Open Inquiry—this type of inquiry requires students to formulate questions and design procedures for carrying out an inquiry. Students are also allowed to communicate the results from their tested inquiry.

Moreover, in inquiry-based learning, students are being transferred from a world of "unknowns" to a world of "knowns" (Concept to Classroom, Educational Broadcasting Corporation, 2004).

UNKNOWNS---→ *KNOWNS*

Purpose and Significance of the Study

According to Ozdemir and Clark (2007), conceptual change researchers have made tremendous progress in respect to enhancing the "knowledge-as-theory perspective" and "knowledge-as-elements perspectives." Proponents of the knowledge-as-elements perspective support the notion that students' learning occur through a process of restructuring and reorganizing of facts, concepts, and mental models presented to them in their classrooms (Demircioglu, Ayas, & Demircioglu, 2005; Kang, Scharmann, Kang, & Noh, 2010; Ozdemir & Clark, 2007). Despite the perceived importance of this "knowledge-as-elements perspective" in successful learning, the "knowledge-as-elements perspectives" has not been as heavily researched as the "knowledge-as-theory perspectives," which focuses less on the restructuring of students' learning through the reorganization of concepts and facts they receive in their classrooms.

In addition to the aforementioned gap in the literature, very few studies have been conducted on the employment of conceptual change and inquiry-based strategies with Black students in general and African American K-12 science students specifically (exceptions being Grayson, 2004 who conducted her study with Blacks in South Africa; Swindell, 2006 who conducted his study with African Americans). Thus, my two previous pilot studies outlined in this article address the aforementioned gaps in the literature.

REVIEW OF LITERATURE

Conceptual Change, Science Learning, and Black Students

As mentioned before, there were very few studies that speak to conceptual change and science learning within the Black communities. Grayson's (2004) *"Concept substitution: A teaching strategy for helping students disentangled related physics concepts,"* was a study conducted with Black students in South Africa. In her study, Grayson conducted what appeared to be a quantitative, one group pre-test/post-test experimental research design with a group of 35 disadvantaged Black students in a pre-degree science program at the University of Natal in South Africa. Grayson held three central beliefs of instructors' and students' interactions during the conceptual change process. First, she believed that physics instructors need access to a range of effective instructional strategies to help students to move beyond their initial “unscientific conceptions” to “acceptable scientific conceptions” (p. 1126). Second, Grayson believed that physics instructors should possess strong pedagogical content knowledge in order to recognize and assess what non-scientific conceptions students are bringing into the classrooms and to determine how to address it. Third, in order to address students’ non-scientific conceptions, particularly in physics, Grayson felt that instructors should understand how they are derived. Grayson believed that students’ non-scientific conceptions may arise from either of the following: students’ self-contained explanations for what they as “physics-naïve students” see (p. 1126), students’ confusion of related but distinct physics concepts (p. 1127), and students holding on to “cluster concepts” that may be general and vague. For example, for students the word “electricity” may have elements of current, voltage, energy, and power all mixed together (Grayson, 2004, p. 1127).

Thus, to address the issue of physics students’ non-scientific conceptions, Grayson (2004) utilized the topic of *electric circuits* and used the instructional strategy of *concept substitution* to address two of the most prevalent conceptual difficulties in electric circuits, which were: (a) the belief that current is used up in a circuit, and (b) that a battery supplies a fixed amount of current, regardless of what is in the circuit. Grayson administered two pre-tests, homework assignments, and two post-tests, one of which was given 25 days following treatment/intervention, and the other was a delayed test, a final exam given 111 days after intervention/treatment. The interventions/treatments used were: (a) a discussion session on each of the two pre-testing sessions; (b) a laboratory session on measuring voltage across different parts of a circuit, relating voltage and current, and voltage in series and parallel; (c) a lecture on voltage; (d) demonstrations and discussion on the effect of unscrewing a bulb in a parallel circuit and in a series-parallel circuit in terms of voltage and resistance; (e) introduction of Ohm's law; and, (f) a laboratory session on Kirchoff's second law, Ohm's law, and real batteries (p. 1132).

Findings of Grayson's (2004) study revealed that the percentage of students in her Foundation Physics course who held prior misconceptions that current is used up in a circuit and that a battery supplies a fixed amount of current regardless of what is in the circuit, was greatly reduced during the course. Grayson felt that her use of "concept substitution" helped to reduce the number of students that held the misconceptions mentioned beforehand. Additionally, by using concept substitution, Grayson was also able to get her students to distinguish between current and energy, and between current and voltage. Moreover, Grayson found that by distinguishing between current and energy, her students were able to hold onto some of their correct intuition. So by making a distinction between current and energy, and current and voltage, Grayson found that her students were able to hold onto some of their correct intuition that the batteries are the same in some way, but do not supply the same amount of current (p. 1131). Grayson further revealed that both applications of "concept substitution" as was mentioned earlier, helped her students to develop an understanding of current as something that flows continuously through a circuit and that depends on the components and configuration of the circuit (p. 1131). So overall, students were able to move from initial misconceptions to full accommodation of scientific concepts because the instructor/researcher realized that the students' initial conceptions contained some correct intuitions, which were retained and built upon.

Inquiry-based Learning, Science Learning, and Black/African American Students

Swindell (2006), and Brickman, Gormally, Armstrong, & Hallar (2009) were two studies conducted in the USA that had African American students as a part of the studied group. Swindell (2006) utilized a sample of 100% African American students; whereas, Brickman et al.’s (2009) study consisted of Caucasians, and other ethnicities, of which 15% represented the “other ethnicities/minority grouping,” of which African Americans were a part of.

Swindell (2006) conducted a qualitative case study to examine the influence of an inquiry-oriented technology-rich classroom environment on eight economically disadvantaged African American middle school males who were labeled “at-risk for academic failure.” The study was conducted in a rural Northeastern Mississippi secondary school (grades 7–12) with a 100% African American student population. The population of the town was predominantly African American of a lower socio-economic status. Findings of the study suggested that providing an active, hands-on, structured, and technology-rich classroom for at-risk African American males helped to improve their academic achievement, their behavior, self-motivation to learn, and their leadership abilities.

Brickman et al. (2009) conducted a quantitative study titled “*Effects of Inquiry-based learning on students’ science literacy skills and confidence.”* Brickman et al. utilized a sample of non-science first year biology college students. The sample of students was made of Caucasians, African Americans, Asians/Asian Americans, Native Americans, and Hispanics. Additionally, six teaching assistants were used in this study. Some of the teaching assistants taught “inquiry-based only labs,” and some taught “traditional labs only.” In this study, Brickman et al, compared the benefits to students of inquiry-based lab instruction (where students are allowed to discover scientific answers of their own) as opposed to traditionally taught lab instruction (where students are told what to do and what to expect). Findings of Brickman et al.’s study revealed several things. First, students in the inquiry labs showed a significant improvement in science literacy skills and process skills. Second, there was significant improvements in students’ confidence to use science literacy skills after participation in the inquiry-based labs. Third, students in inquiry-based labs showed greater research skills, and valued more "authentic" science exposure than the traditionally taught students. The aforementioned research findings of Brickman et al. (2009), Grayson (2004), and Swindell (2006) made up the literature review section of this study. The next set of information presents two of my previous classroom based studies.

REFLECTIONS ON TWO PILOTED STUDIES (CLASSROOM BASED), WHICH UTILIZED CONCEPTUAL CHANGE AND INQUIRY LEARNING WITH K-12 AFRICAN AMERICAN STUDENTS

Utilizing Instructional Games as an Innovative Tool to Improve Science Learning among African American Elementary School Students

Pinder (2013, 2008) conducted a quantitative study in 2006. The study was a quantitative, one group pre-test/post-test experimental design study. The sample size of the study consisted of 10 African American first grade students from Atlanta, Georgia. The study was conducted between February 13, 2006 and May 1, 2006.

In the study, Pinder (2013, 2008) administered a pre-test to the students, followed by a treatment/intervention exercise (which were instructional games plus a lecture on living versus non-living things), and finally two post-tests were given. One of the post-tests was given immediately following the treatment/intervention (lecture plus use of instructional games), and the second post-test was given about two weeks later to assess how well students were able to retain information taught. Results suggested the use of instructional games with lecture (notes) were effective. In support of the aforementioned claim, data showed that 70% of students' pre-test scores were lower than that of their post-test scores (post-test 1). Also, the post-test mean score was 97.6%; whereas, the pre-test mean score was 72.9%. The higher post-test mean score, and the fact that 70% of the students scored higher on their post-test one than on their pre-test would suggest that the use of instructional games plus lecture (notes) were effective in improving the students' science test scores, and conceptual understanding of the concept "living vs. non-living things.". Pinder's (2013, 2008) positive findings concur with some of the findings of Brickman et al. (2009), Grayson (2004), and Swindell (2006) who also found that students' academic skills, conceptual understanding, and achievement improved after their instructors used inquiry-based and conceptual change strategies with them.

Utilizing an Innovative Laboratory Instrument to Clear up Urban High School Students' Misconceptions of Newton's Second Law: An Experimental, Action Base Research

Wairia and Pinder (2008) discussed the implementation process of an instructional instrument in the form of a laboratory tool that was design to teach the concept of force acting on a body in motion and its velocity. The instructional instrument was based on Newton's second law and was designed to assist students to understand the concepts of *forces acting on a body in motion* and *velocity*. According to Newton's second law, if a force acts on a body, it will accelerate, that is, change its velocity in the direction of the force. This force is directly proportional to the acceleration, and it explains how a body will change its velocity if it is pushed or pulled.

The design of the instructional instrument was based on the constructivist's view that students' prior knowledge about a phenomenon often differ significantly from the knowledge to be learned (Dekkers & Thijs, 1997). This view was evident in the pre-test results which indicated that students thought of force as an innate or acquired property of objects, which implied that forces were not seen as arising from an interaction between objects (Savinainen, Scott, & Viiri, 2004). The student's prior knowledge about a certain concept plays a major role in determining his/her learning outcomes. Similarly, research has shown that conceptual change teaching challenges students to modify or to change their alternative conceptions for better scientific ideas (Grayson, 2004; Hausfather, 1992). Post-test results indicated that there was a substantial gain in the students' knowledge about the relationship between force acting on a body in motion and its velocity. The present study was carried out in three stages which were: pre-test administration, implementation of the instructional instrument, and post-test administration.

Methods and Materials

Sample size

This study involved two physics teachers/researchers and eight 11th grade students. The study was conducted in an urban Baltimore school district. The eight students were all African Americans between the ages of 14 to 17. The students were given a pre-test, a laboratory practical (treatment/intervention), and a post-test.

Pre-test

The pre-test was administered on February 24th 2006, and consisted of two tasks of five points each. In the first task, there was a brief statement which explained the relationship between force acting on a body in motion and its velocity. In this task, students were required to state whether the given statement was true or false. Then they were required to support their position with an explanation as to why they chose true or false as an answer. The second task consisted of an extended response question. In this task, students were required to draw a motion diagram of a body being pulled by a string on a flat surface. They were then required to label the forces acting on the body while indicating the direction of acceleration and net force.

Post-test

The post-test was administered on March 16, 2006, a week after the implementation of the lab practical (treatment/intervention tool). The post-test consisted of five test items which covered the concepts of forces, motion of an object, and velocity/speed. The five items were similar to those that were covered on the pre-test. The maximum score for each item was five points. Below is a sample item from the post-test.

If you were to push a book in the forward direction, would its velocity be forward? Explain.

Laboratory Practical, Objectives, Materials, and Procedures

Two groups of students participated in the implementation of the instructional instrument. Each of the groups was made up of three students. The students were each assigned different roles as they participated in the laboratory exercise.

***Objective**:* To assist students to understand that the force acting on a body in motion is always in the same direction as the velocity of that body.

Materials

- Graph paper
- A pencil or a marker pen
- CD case
- Cup or Pan for holding marbles
- Marbles or some weights
- Meter rule
- Thin string
- Timer or a stop watch

Procedures

1. Place a CD case on top of the lab table. Take a piece of string, knot one end of the string and enclose it inside the CD case. Tie the other end of the string to a cup, such that it hangs from the table as is shown in Figure 1.
2. Mark or create a start point on one side of the table with a marker. Mark or create an end point at a distance of 50 cm from the starting point.
3. Place the CD case at the start point and hold it firmly. Another student is to place a marble in the cup.
4. The student holding the CD case will let it go, allowing it to move forward.

   Another student will record the time of travel of the CD case in their data table.
5. Repeat steps 3–4, putting two marbles in the cup. Record the time. Then keep repeating steps 3–4 with additional marbles being added to the cup. In every repeated instance, record the data collected on the data table.
6. Calculate speed in m/s.
7. Finally, plot the data on a graph paper. Label y-axis “Speed” in m/s. Label the x-axis “Force” with the unit being the number of marbles

Table 1: Data table

Number of Marbles	Time (sec)	Speed (m/sec)
1		
2		
3		
4		
5		
6		

Table 2: Lab Practical Questions and Physics Instructors' and Students' Discussion Points

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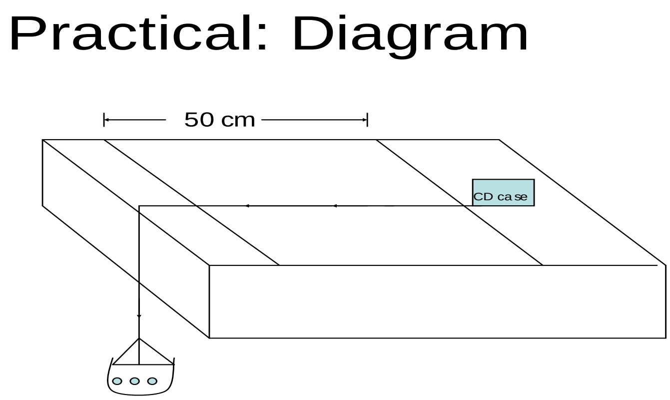
Questions:

1. What happens to the speed of the CD case when an additional marble is placed in the cup?
2. How would you describe the motion of the CD case from the starting point to the ending point?
3. Explain how the velocity of the CD case and the weight of the marble relate to Newton's second law.

Figure 1: Practical Diagram



Results of Lab Practical

Table 3 shows results obtained from one of the two student groups after the laboratory exercise

Table 3: Data from the Lab Practical

Number of marbles	Time (sec)	Speed (m/sec)
10	1.56	0.32
11	1.00	0.50
12	0.90	0.55
13	0.84	0.59
14	0.79	0.63
15	0.78	0.64

After collecting the experimental data, the two groups of students drew a graph of the “number of marbles” on the x-axis and the “speed of the CD case” on the y-axis. A linear graph was obtained showing that there was a linear relationship between the number of marbles and the speed of the CD case. The frictional force was assumed to be negligible throughout the experiment.

After the lab practical, each of the student group gathered together and responded to the three questions in the lab practical (see Table 2). For the first question, which asked students to describe what happened to the CD case when an additional marble was put inside the cup, the two groups gave similar answers. They indicated that the speed of the CD case increased as the number of marbles placed inside the cup increased. For the second question, which required the students to describe the motion of the CD case after it was released, the first group stated that the CD case started sliding slowly and then the speed increased more until it reached the end point. The second group stated that the CD case had a constant motion throughout the entire distance.

For the third question, which asked about the relationship between the weight of the marble and Newton's second law, the first group stated that as the number of marbles increased, the faster the CD case moved. This implied that the CD case accelerated when the weight was increased. A similar response was given by the second group. They stated that as the force was increased, the velocity of the CD case also increased.

Pre-test Results (pre-test given to students before lab practical exercise)

Pre-test results indicated that only two students out of the eight students had prior knowledge about forces acting on a body in motion and velocity/speed. One of the students stated "if you pull an object, it moves forward and the velocity of that object will be in the same direction as the direction it is pulled in," but for this student, it was difficult for him to illustrate how the forces acted upon the body/object in motion. This student scored eight out of a maximum ten points on his pre-test. A second student was able to recognize that the force acting on a body in motion is the same force that causes the body/object to move. As for the other students, four of them did not understand the concepts of forces acting on a body in motion and velocity/speed of that body/object that would result from the applied force. Table 4 shows students' pre-test and post-test scores in percentages.

Post-test Results (post-test given to students after lab practical exercise)

Results from the post-test indicated that the application of the instructional lab instrument and practical helped the students to better understand the concepts of forces acting on a body in motion and velocity/speed of an object/body. For instance, one of the students stated that the velocity of a body and the force acting on it must always be in the same direction. For the question that required them to describe what happened to the CD case when it was being pulled, most of the students indicated that since the CD case was moving in the forward direction, it was being pulled by the weight of the marble; so, the force and the velocity must also had been in the same direction. On the other hand, one of the students argued that the velocity of the CD case was in the same direction as the direction of the force because the string was attached to the CD case. Otherwise, the force and the velocity could have been moving in different directions.

Table 5 shows the students' pre-test and post-test mean scores and standard deviations. From the table, the students' post-test mean score was higher than that of their pre-test mean score, an indication that most of the students were able to better understand the concepts of forces acting on a body/object and the resulting velocity/speed of the object/body being acted upon. The positive post-test scores suggest that students' conceptual understanding of Newton's second law improved over time and it was believed that some of the students possessed initial "alternative conceptions" that might have been rooted in some knowledge that was productive and effective (Dekkers, et al.1997; Grayson, 2004).

Table 4: Pre-test and Post-test scores

Student	Pre-test (%)	Post-test (%)
1	10	15
2	65	85
3	45	50
4	55	50
5	60	75
6	80	90
7	80	95
8	40	65

Table 5: Pre-test and Post-test mean scores for the students

Pre-test Mean (SD)	Post-test Mean (SD)
54.36 (23.06)	72.86 (26.65)

Discussion of the Findings of Wairia and Pinder's (2008) Study

During the practical, some small adjustments were made due to the limited materials in the instructor's/researcher's lab (school). For instance, the distance between the start point and the end point was reduced to 50 cm because of the size of the tables in the lab. This affected the results of the practical; in that, it was difficult to measure the time of travel between the two points. Although the two groups of students obtained some results, they indicated that they had to either round up or round off some values to come up with the true measurements.

Moreover, for the students, results showed that there was a substantial gain in understanding of physics concepts on forces and velocity/speed. Wairia & Pinder (2008) believed that the lab practical helped in students understanding the concepts of forces and velocity/speed. Students were able to see that the force acting on an object is always in the same direction as the velocity of that object being acted upon. Results also indicated that conceptual change teaching may have challenged students to modify or to change their alternative conceptions for the better physics ideas their instructor presented; this finding concurs with that of Grayson (2004) and Hausfather (1992).

Overall Conclusions Based on My Two Previous Piloted Studies

Few instructors/researchers are employing conceptual change and inquiry-based strategies with African American K-12 science students in order to assess how effective these strategies are in improving students' academic skills and academic achievement (exceptions being Brickman et al., 2009; Grayson, 2004; Pinder, 2008, 2013; Swindell, 2006; Wairia & Pinder, 2008). Pinder (2013, 2008) and Wairia & Pinder (2008) are two of the few instructors/researchers that have conducted small classroom based studies with African American K-12 science students in urban settings. Pinder's (2008, 2013) study reported earlier indicated that African American elementary school students' general science test scores improved when innovative instructional games were utilized in combination with lectures. Similarly, Wairia & Pinder (2008) found that when they utilized an innovative lab practical with eleventh grade physics students, the students' conceptual understanding of Newton's second law improved over time. This was evident in students' test score results as 7 out of 8 students or

87.5% of the students' post-test scores were higher than their pre-test scores (Table 4). Also, the students' post-test mean score was higher than their pre-test mean score (Table 5).

Effective teaching should employ conceptual change strategies and inquiry-based learning. Instructors, particularly, science instructors should be able to transform students' conception from misconceptions to full accommodation. Thus, Posner et al. (1982) believe that students' understanding of a concept should move through the following pathway:

Misconceptions-----------------------→ Assimilation---------------------→Accommodation

However, Grayson (2004) and Wairia and Pinder (2008) postulate that students' understanding of a phenomenon should follow this path:

Misconceptions (containing some truths) --------------------------------→Accommodation

Thus, Grayson (2004) and Wairia & Pinder (2008) believe that in students' naïve conceptions/misconceptions, there are scientific truths and non-truths. The researchers also believe that the scientific truths should not be rejected or discouraged along with non-scientific truths, but rather, they believe non-truths can be discouraged /rejected, while the scientific truths can be retained and built upon. Moreover, studies are suggesting that employment of conceptual change and inquiry-based learning can help to improve students' conceptual knowledge of a concept, improve academic skills, and improve academic achievement (Brickman et al., 2009; Grayson, 2004; Pinder, 2008; 2013; Swindell, 2006; Wairia & Pinder, 2008). Given the aforementioned details, it is recommended that more studies be conducted with African American K-12 students to assess the benefits of the employment of inquiry-based learning and conceptual change teaching strategies with them. The aforementioned studies can be qualitative only, quantitative only, mixed-methods, or action based studies

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