



## Capturing Urban Middle School Students' Voices on the Use of Science Inquiry in their Classrooms

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### Abstract

The present study seeks to explore middle school students' perception of the kind of science instruction going on in their classrooms and its relevance to their daily lives outside the classroom. Data were collected using a five point Likert type survey instrument that was administered to 262 middle school (Grades 6, 7 & 8) students in six middle schools in Southern California. This instrument consisted of demographic information and thirty six statements organized in clusters to elicit responses on a number of statements about students' 1) their emotional disposition toward science, 2) perception of and understanding of the usefulness of science, and 3) emotional disposition towards science inquiry and their perceptions of their teacher's use of inquiry-based instruction in their classrooms. Results revealed that generally, students' percentage responses were low for all the three research questions even though they were high for specific survey statements for the three clusters of survey statements. Suggestions were made for future research on the topic.

**Keywords:** Perception, Inquiry, Professional Development, Emotional disposition, Adolescents, Voices

### 1. Introduction

As early as 1904, Stanley Hall warned that "the future of humankind was, in large measure, determined by the quality of education received at the crucial age of adolescence" (p. xv). According to Jackson and Davis (2000), "significant progress has been made in the journey to provide young adolescents with a developmentally responsive education". However, "we are only halfway up the mountain, with the most important and perhaps most difficult part of the climb remaining". (p. 5)

The National Assessment of Educational Progress (NAEP) seems to support this assertion by their report that the general National middle school achievement data reveals troublesome trends. In science, achievement has fluctuated, declining in the 1970s then increasing in the 1980s and declining again in the 1990s. (Mullis, Martin, Gonzalez, & Chrostowski, 2004). Furthermore, Grigg, Lauko, & Brockway (2006) reports that "on the average science score in 2005 showed no significant change compared to results in 1996 and 2000" (p.2). Evidence from Third International Math and Science Studies (TIMSS) 2003 report shows that by the eighth grade, the U.S. students had slipped to the middle of the list of nations and under-performed even students from several less-developed nations in science and math (Mullis et al., 2004).

Fortunately, the No Child Left Behind (NCLB) act of 2001 has put the spotlight as never before on the issues of middle school reform and recommends that schools use scientifically-based research to improve student achievement (US Department of Education, 2006). This act suggests that scientifically-based research provides evidence on how and why a program or practice works, its effect on student achievement, and its success in various settings and situations.

In conjunction with this stipulation, the National Research Council (NRC) conducted a research on science based education reform citing in its report that inquiry should be placed at the center of science teaching and learning (National Research Council, 1996). The national science education standards (NRC, 1996) suggest that students in

grades 5- 8 science classrooms should be provided with opportunities to engage in full and partial inquiries as they develop both “abilities necessary to do scientific inquiry” and “understandings of scientific inquiry”. The standard encourages science teachers to use these as “powerful vehicles to help students learn science content” (NRC, 1996, p. 121). It suggests that the use of appropriate curriculum and adequate instruction will enable middle school students develop abilities to carry out investigations and the understandings needed for scientific inquiry.

Review of the literature on inquiry-based instruction revealed that studies generally focused on student behaviors and products to the exclusion of the description of actual instructional practices that influenced those behaviors and products (Flick and Ault, 1995). Despite the long standing and persistent call for the use of inquiry-based instruction, the actual implementation of this strategy in the classroom has remained an assumption. The present study seeks to capture urban middle school students’ voices regarding the use of inquiry in their classrooms and these students’ understanding of the usefulness of science in their everyday life. This is especially needful because hitherto, studies are limited in the knowledge that exists about students’ perceptions of the kind of instruction that goes on in their science classrooms. Students’ attitudes and perceptions have been typically inferred through teacher or principal interviews and surveys (Powell, 1997), and other general information received from adults such as parents, teachers, and administrators, as data sources. Even though there are a few exceptions (e.g. Powell, 1997; Shultz and Cook-Sather, 2001), students’ voices are usually less solicited and honored as valuable perspectives on schooling and so are usually missing from important discussions about their schooling. Students are known to be thoughtful enough to provide valuable insight into what happens in their classrooms and schools (Jackson & Davis, 2000; Oldfather & McLaughlin, 1993). This study addresses the gap in the research literature by including students’ voices and examining middle school students’ perceptions and experiences with science, science instruction, and inquiry as members of a learning community. Specifically it seeks to address the questions:

- (1) What are middle school students’ emotional dispositions towards science?
- (2) What are middle school students’ perceptions of the usefulness of science?
- (3) What are middle school students’ emotional disposition towards science inquiry and their perceptions of their teacher’s use of inquiry-based instruction in their classrooms?

The NRC (1996) document defined abilities to do scientific inquiry as posing questions about objects, organisms, and events, planning and conducting investigations, gathering and analyzing data, using data as evidence to construct explanations, and communicating findings and understandings about scientific inquiry including knowledge of how scientists conduct their work as well as having in-depth conception of the nature of science.

Several studies on science inquiry have reported significant positive effects especially on academic, process skills, and attitudes toward science (Shymansky et al., 1990; Geban, Askar, & Ozkan, 1992; Ertepinar & Geban, 1996; Chang & Mao, 1998, Osisioma & Onyia, 2008). These positive effects have been attributed to 1) students in the inquiry classroom being involved in asking questions and formulating ways to answer their questions (Gibson & Chase, 2002; Hand, Wallace, & Yang, 2004), 2) inquiry-based instruction promoting students’ deep conceptual understanding (Lloyd, 1988), and 3) inquiry-based instruction being learner-centered allowing teachers to build on students’ prior experiences (Fradd & Lee, 1999) and engaging them actively in their learning.

The science education community have made laudable efforts for inquiry-based science to be implemented in the classrooms through reform-based science materials, science methods classes, and professional development programs, (Abell et al. 2005; Barton, 2001; Fraser-Abder, Atwater & Lee, 2006; Lowden, 2005; Osisioma & Onyia, 2008; Supovitz & Turner, 2000; Tobin, Roth & Zimmerman, 2001). However, one question that has continued to hunt the science education community is whether this research based strategy has found its way into the science classrooms and if it has, whether the students for which they are used are actually aware that it is being used and are benefiting from its use.

### *1.1 Science Inquiry in the Classroom*

The science education community has come to a consensus on the need to revive the concept of inquiry as representing the essence of science education. Indeed most recent science education reform efforts have focused on the development of inquiry-based programs for use at both professional developments, science methods courses and in the K-12 science classrooms. For example, two very important National reform documents-the National Science Education Standards (NSES) and Project 2061’s Benchmarks for science literacy have promoted inquiry as the central strategy for science instruction. The NSES presented inquiry as an indispensable form of learning that focuses on real questions generated by students themselves based on their prior experiences (NRC, 1996). In NRC’s (1996) contention, when students employ inquiry, they use their critical thinking skills effectively in asking questions about events, developing and testing explanations based on available scientific knowledge, arriving at conclusions based on evidence and communicating these to others. Unfortunately according to Bateman (1990), most teachers do not use it because they do not yet understand how powerful the strategy is in promoting meaningful learning of science concepts. Consequently,

they have held on to their traditional didactic mode of transmitting scientific knowledge. This traditional approach according Van Driel and Verloop (2001) has continued to promote students' lack of interest in science with its attendant poor understanding of the science concepts.

The foregoing necessitated the current call by NSES to deemphasize this traditional mode of transmitting information (which promotes rote memorization of de-contextualized science facts, Krajcik, et al., 2005) and create more student centered learning environments in which students are actively involved in their learning (Kennedy, 1998). There is preponderance of evidence that indicate that engaging students in inquiry is more likely to promote students deeper understanding of science content while equipping them with science process skills (e.g., Brown & Campione, 1994; Metz, 1995).

Krajcik et al (2005) contend that, "students need help to become knowledgeable about content, skilled in using inquiry strategies, proficient at using technological tools, productive in collaborating with others, competent in exercising self-regulation, and motivated to sustain careful and thoughtful work over time"(p. 284). This can only be achieved when students are guided through the process of making sense of what they are learning as well as using the knowledge that develops to create multiple representations of this knowledge. However, as at yet we have little knowledge of whether this is happening in the classrooms and if it is, how students are responding to it.

### 1.1.1 Professional Development

Literature is replete with national-level studies that indicate that many teachers lack teaching expertise in areas associated with science education reform (Haney, & Lumpe, 1995, Huffman, 2006). According to Jacobson and Doran, (1991) the most commonly used instructional strategies by science teachers are lecture, question and answer, and assignments. To corroborate this claim, Tali, Krajcik, & Blumenfeld (2006) argued that even those that have began to use inquiry based strategies in their classrooms are far from being fluent in doing so.

Spillane and Thompson (1997) reported that the capacity of local education policymakers was not enough to support instructional reform and that continued attempts to regulate teacher behaviors in the classroom through policies and programs have proved abortive. School leaders' responses to reform reflect fundamental differences in their views about the subject area, not only on what counts as knowledge in that subject areas but also in their perceptions of subject areas (Burch & Spillane, 2005). Several other researchers have found that teachers habitually remake or overlook policies that are anticipated to impact their classroom practices (Cohen & Ball, 1990; Wilson & Corbett, 1990, Huffman, 2006). Consequently, educators have turned lately to professional development as the best bet for changing teaching practices (Smylie et al., 1996) and improving student achievement.

A number of recent studies have explored the relationship between professional development and teaching practice. Borchers, Shroyer, and Enochs (1992) implemented a professional development program to encourage the use of technology in science classrooms and reported that effective professional development altered the beliefs of teachers and their subsequent behaviors. Based on this, they proposed that change in teachers' behaviors and attitudes are promoted by a professional development model that includes training, and continuous implementation support in the classrooms. Furthermore, Allen and Lederman (1998) reported the success of a Teacher Academy for science and mathematics that was based on rigorous professional development.

In another study in which teachers participated in Ohio's Statewide Systemic Initiative in science and mathematics, Supovitz et al., (2000) reported that intensive inquiry-based professional development altered teachers' attitudes towards reform, their readiness to use reform-based practices, and their actual use of inquiry-based instructional practices in their classrooms and that these changes persisted many years after the teachers finished the training.

This provided an implicit rationale for the current effort by the science education community to redirect their efforts in the use of professional developments to promote the use of inquiry strategy in the classrooms (Abell et al. 2005; Barton, 2001; Fraser-Abder, Atwater and Lee, 2006; Lowden, 2005; Supovitz & Turner, 2000; Tobin, Roth and Zimmerman, 2001). Studies of professional development that targeted the use of inquiry based instruction have however shown contradictory reports.

Okhee Lee et al., (2004) investigated the impact of professional development intervention with the goal to help elementary teachers promote science inquiry among culturally and linguistically diverse students on teachers' beliefs and practices. They reported a discrepancy "between teachers' perceptions of their improved science knowledge and practice (as indicated on the questionnaire and in interviews) and the lack of significant change in their actual instructional practices (as evidenced in the classroom observations)" p. 1037.

Even though most of these studies demonstrated the effectiveness of professional development in influencing general instructional practices, much is yet to be known about how students are responding to and what they have to say about the reform strategies. The knowledge of how students are responding to inquiry will help science educators re-evaluate and re-structure the way inquiry should be implemented in the classrooms to ensure that students benefit from it. Herein lies the focus of the present study that specifically seeks to explore students' perception of the kind of science

instruction being implemented in their classrooms by hearing student's voices about inquiry based science instruction in their classrooms and its importance in their everyday life.

### 1.1.2 Urban Students and Science Education

It is a well known fact that urban students see school science as a contradiction of their beliefs and experiences. They view science as impractical, alien and not having any connection with their homes or lives outside of the classroom. This situation according to Basu, & Barton (2005), accounts for students' association of science with emotions such as boredom, anxiety, confusion, and frustration. Over the years, there has been a general consensus that professional curriculum and instructional standards in mathematics and science especially in urban settings should reflect that learning is a process in which students are active participants in the acquisition and construction of knowledge (National Science Foundation {NSF}, 1998). Inquiry based instruction is essential for student learning (Lunetta, 1998; Roth, 1995), and allows for this active students participation. It is during inquiry instruction that students are provided with the opportunities "to find solutions to real life problems by asking and refining questions, designing and conducting investigations, gathering and analyzing information and data, making interpretations, drawing conclusions, and reporting findings" (Krajcik, Blumenfeld, Marx, & Soloway, 2005). According to NSES (NRC, 2000): developing the ability to understand and engage in this kind of activity requires direct experience and continued practice with the processes of inquiry. Students do not come to understand inquiry simply by learning words such as "hypothesis" and "inference" or by memorizing procedures such as "the steps of the scientific method." They must experience inquiry directly to gain a deep understanding of its characteristics. (p. 12).

This student centered type of instruction that emphasize inquiry and the use of open-ended questions, has been reported to be more effective in promoting deep conceptual understanding of science (Anderson, 1997; Darling-Hammond, 1996 in Von Secker, & Lissitz, 1999). However, verification of the extent to which teachers are already using this strategy is sparse at best (Von Secker, & Lissitz, 1999).

## 2. Methodology

### 2.1 Research Context and Participants.

The present study was conducted in a school district in Southern California with a high proportion of minority students from diverse languages and cultures. The ethnic make up of the student population was 83% Hispanic, 3% of African Americans, 1% Asian Americans, 1% Pacific Islanders and 2% other. Participants include 242 middle school students (88, 6<sup>th</sup> grade; 92, 7<sup>th</sup> grade; and 62, 8<sup>th</sup> grade). Of these, 42% were males while 39% were females. The current school district was selected by purposive sampling method for the study because for several years, the science teachers have been involved in intensive professional development on the use of inquiry-based science instruction through summer institutes and their follow up meetings in addition to taking science methods courses where inquiry-based science instruction has been the mainstay. The motivation for the study was based on the need to find out whether students' understanding of inquiry is aligned with studies that point to effectiveness of inquiry based professional development as a support for teacher effective planning and implementation of inquiry based instruction.

#### 2.1.1 Data Collection

Data for the present study was collected using a survey instrument that consisted of demographic information and thirty nine statements that elicited responses on a number of statements about students' perception of the kind of science instruction that goes on in their classrooms. Specifically, these statements were organized into clusters to reflect students' (a) emotional disposition towards science, (b) perception of and their understanding of the usefulness of science, and (c) students' emotional disposition towards science inquiry and their perceptions of their teacher's use of inquiry-based instruction in their classrooms. Students expressed their level of agreement or disagreement with 36 survey statements by choosing from one of a Likert-type scale- Strongly Disagree (SDA), Disagree (DA), Somewhat Agree (SWA), Agree (A), and Strongly Agree (SA). The coding of responses was: SD = 1, D = 2, SWA = 3, A = 4 and SA = 5. Non-response received a negative code. The data was analyzed to obtain percentages, means and standard deviations of students' responses.

Mayer (1999) as cited in Smith et al (2007) points out, "research has shown that survey measures of teaching, especially composite measures such as those we used in this study, can be effective in describing and distinguishing among different types of teaching practices" p. 180.

Science teachers in the study district administered and collected the surveys over a one month time period. This may have imposed some limitations to the study that include possible influence on student responses by teachers and lack of spontaneity of student response. Despite the use of simple words that the students would easily understand, it was still possible that students did not understand some of the technical words used in the survey tool hence the lack of response to several items on the survey instrument and/or responses that contradict earlier responses to similar questions in a different domain. A total of 95 percent (n= 242) of the surveys were returned.

### 2.1.2 Reliability and Validity

The survey used in this study was a one page questionnaire developed by researchers and an evaluation team. The survey was validated by a summative committee comprised of science teacher leaders, administrators who are aware of science practices and science methods professors. This team reviewed the construct validity of the survey statements to ascertain the fidelity with which the responses from this category were coded. Construct validity is an indicator of the logical, conceptual connection between a test and what it is designed to measure. Reliability analysis of the items resulted in an alpha coefficient of .92, indicating a strong internal consistency of items. This format ensured both reliability and validity of the instrument. The final student survey statements were reduced from 45 to 36 after the validation process.

### 3. Results

Data analyses for the present study are reported below based on students' responses on the three research questions and the clusters of survey questions namely 1) students' emotional dispositions towards science, 2) students' understanding of the usefulness of Science, 3) students' emotional disposition towards science inquiry and their perception of their teacher's use of inquiry-based instruction in their classrooms. For the purpose of this study, students' responses are documented in 1) percentages with the strongly agree and agree responses being merged into one to show students' general agreement and differences along grade level lines with each of the survey questions organized in clusters as shown in the figures and 2) means and standard deviations were used to provide further validation of students response data under the three clusters as shown in table 1. For this purpose, we calculated the mean value of the five rating scale for the survey statements to be 3. A mean score of 3 and above was therefore considered acceptable score for agreeing with the three clusters of survey statements.

Place Table 1 about here

#### 3.1 Research Question 1: Student' Emotional Disposition towards Science

Table 1 above reveals that 39.67% of participating students expressed positive emotional disposition towards science (mean= 3.02; sd =1.43). A closer look at students' responses to specific survey statements (SS) shows that 58% of students reported that they enjoy doing science very much (SS #1) {mean = 3.60; sd = 1.14}, 69% expressed likeness for the science activities they do in their classrooms (SS #2) {mean=4.2; sd= 0.99}, 79% thought that doing science experiments is fun (SS #3) {mean = 3.87; sd = 1.20 }, 61% expressed that they feel comfortable doing science (SS #4) {mean = 3.77; sd = 1.07}, and 58% reported that they usually understood what they talked about in science (SS #7) (mean = 3.63; sd =1.01). These high percentages of positive responses were for five out of seven statements that reflected positive disposition towards science. See appendices I and II.

It is also important to note the low percentages of students who responded in affirmative to statements that reflected negative emotional disposition towards science. For example, only 21% of students thought they did not like anything about science (SS #8), {mean=2.27, sd=1.32}, 22% expressed that they feel nervous when someone talks to them about science (SS #9), {mean=2.40, sd=1.32}, 17% reported that they feel nervous to think about science (SS #10), {mean=2.29, sd=1.25} 18% feel that doing science experiments is a waste of time (SS #11), {mean=2.08, sd =1.31} and 26% reported that no matter how hard they tried, they could not understand science (SS # 15) {mean=2.41, sd=1.34}. See Appendices I and II.

Comparing data for students' responses to the above research question by grade levels without taking other variables like students' maturity, length of exposure, and teachers' perceptions, shows that 7<sup>th</sup> graders (53.50%, mean = 3.32, sd = 1.24) expressed more positive emotional disposition towards science than 6<sup>th</sup> graders (37.34%, mean = 2.82, sd = 1.61) and 8<sup>th</sup> graders (32.42%, mean = 2.84, sd = 1.33). A closer look at specific survey statements reveals that a greater percentage of 6<sup>th</sup> graders responded positively to SS #s 1 through 4 with 73%, 92%, 98%, and 82% respectively. While 7<sup>th</sup> graders had 53%, 45%, 65%, and 49% and those for 8<sup>th</sup> graders were 45%, 71%, 74%, and 53% for SS #s 1 through 4. Looking at the survey statements that reflect negative emotional disposition (SS #s 8-11 & 15), the percentages for 6<sup>th</sup> graders were 2%, 3%, 0%, 10% and 5% while those for 7<sup>th</sup> graders were 45%, 47%, 42%, 41%, and 53% and those for 8<sup>th</sup> graders were 16%, 15%, 6%, 11% and 19%. This tends to suggest that not only does the high positive responses from 7<sup>th</sup> graders come from their responses to SS that reflect negative emotional disposition towards science but reveals that 6<sup>th</sup> graders had more positive emotional dispositions towards science followed by 8<sup>th</sup> graders. Furthermore, the standard deviation for each grade level compared to the mean score shows a cluster of response around the mean. Analyzing the grade level data based on the standard deviation and mean shows how close the distribution of the data set is from the responses to the specific sections of the survey instrument. This low cluster to the mean is reflected in all the data set for the research questions.

#### 3.1.1 Research Question 2: Students' Perceptions of their Understanding of the Usefulness of Science.

Table 1 shows that over all, 44.75% (mean=3.54, sd=1.04) of students expressed understanding of the usefulness of science. A close look at specific survey statements show that only 19% (mean=3.48, sd= 1.07) of students agreed with

the SS 16 which states that “science is useful for solving everyday problems”; while 65% (mean=3.83, sd=1.04) agreed with SS 17 in which they thought that “science is helpful in understanding today’s world”, 57% (mean=3.62, sd= 0.94) agreed with SS 18 that most people should study science. Thirty-eight percent (mean = 3.25, sd = 1.03) of these students did not see the need for science in most jobs.

A closer look at the grade level data for this research question reveals that a greater percentage of 7<sup>th</sup> graders (53.50%) expressed understanding of the usefulness of science compared to 42.25% of 6<sup>th</sup> and 38.25% of 8<sup>th</sup> graders. However, this high percentage responses reported for 7<sup>th</sup> graders mostly comes from SS 19 that stated that “there is little need for science in most jobs.” Interestingly, as the results suggest 57% of 7<sup>th</sup> graders did not see the need for science in most jobs. See Appendices I and II.

### 3.1.2 Research Question 3: Students’ Emotional Disposition towards Science Inquiry and their Perceptions of their Teacher’s use of Inquiry-based Instruction in their Classrooms

Data from Table 1 indicates that 44.71% (mean = 3.26, sd = 1.50) of the students agreed that some form of inquiry is being done in their classroom. However, further analysis of students’ responses to specific survey statements showed that 70% (mean =3.81, sd = 1.31 ) of students agreed with SS 21 which states that “their teachers made science interesting, 65% (mean =3.78, sd =1.18) agreed with SS 22 that they learn to state hypothesis, design experiments, and defend their conclusions, for SS 24 68% (mean = 3.83, sd = 1.24) thought that their teachers explains science in a clear way, while their responses to survey statement 28 indicated that 62% (mean = 3.79, sd = 1.17) agreed that they are able to ask questions about what they are learning and to find answers to these questions. Also, 51% of the students agreed to SS 29 (mean = 3.59, sd = 1.16) that they were actively involved in their learning and are able to express their opinions in their science class, while 57% (mean=3.64, sd= 1.01) agreed with SS 31 that they remembered most of the things they learned in their science classes.

Regarding students’ emotional disposition toward inquiry based instruction, results of the study tend to suggest that students have positive emotional disposition towards inquiry based instruction. This is corroborated by the fact that even though only 38% (mean = 3.21, sd 1.13) of students thought that most students in their class are “keen about laboratory assignments”, a greater percentage of them thought that: (a) “their science teacher made science interesting” (70%, mean =3.81, sd = 1.31), (b) “doing experiments gives them critical and analytical mind” ( 49%, mean =3.49, sd = 1.13), (c) they are able “to ask questions about what they are learning and to find answers to these questions” ( 62%, mean = 3.79, sd = 1.17), and (d) they are actively involved in their learning and are able to say their opinion (51%, mean = 3.59, sd = 1.16). These forgoing responses in our own opinion suggest that students have positive disposition towards inquiry based science. This explains why a large number of students recognized the benefits of their science instruction as reflected on their responses.

Across grade levels, even though results generally showed low percentages across grade levels, 6<sup>th</sup> (46.88%) and 7<sup>th</sup> ( 47.82%) graders had more positive emotion about inquiry and were more favorably disposed to the survey statements that agreed with their teachers’ implementation of inquiry based science instruction in their classrooms than 8<sup>th</sup> graders.

## 4. Discussion and Educational Implications

Results reveal that generally, students’ percentage responses were low for all the three research questions even though they were high for specific survey statements under 1) positive emotion towards science, 2) perception of usefulness of science for their everyday life, and 3) positive emotional disposition towards inquiry while affirming that inquiry-based instruction was being used in their classrooms.

### 4.1 Students’ Emotional Disposition towards Science

The findings of the present study reveal that overall, the percentage of study students who had positive emotional dispositions towards science were low even though they came up high on specific survey statements that supported positive emotions towards science. In this regards, the study results served as evidence in support, of Basu, & Calabrese Bartons’ (2007) finding that middle school students from low-income, inner-city backgrounds developed sustained interest in science when “their identity, beliefs, experiences, and conceptions of the future were built into the science they studied”. It also lays credence to their contention that “when students encountered science classrooms in which they could choose and engage in activities connected to their visions of the future, how they valued relationships, and their definitions of science, they developed a strong, long-term commitment to pursuing science” (p.487). This was evident in the study students’ positive responses to the survey statements that had to do with the importance of science in helping them understand the world. Sixty-five percent of the students responded in affirmative to this survey item and 57% thought that most people should study science.

However, this finding contradicts Basu, & Calabrese Bartons’ (2007) notion that “many urban, low-income students described science as a discipline that generates sentiments such as boredom, anxiety, confusion, and frustration” (p.466). Results of our study show that 79% of students claimed that “doing science experiments are fun” (SS #3), 61% expressed that they feel “comfortable in the science classroom” (SS #4) and 69% expressed likeness for the science

activities they do in their classrooms (SS #2). On the other hand, only 21% of students expressed dislike for science as a subject (SS #8).

Consistent with the above findings is the low percentage of students who responded positively to the survey statements that reflected negative emotional disposition toward science. We contend that study students may have developed likeness for and positive dispositions toward science as a result of the use of some form of inquiry-based instruction in their classrooms. Although teachers were not surveyed for their understanding or use of inquiry based instructional strategies in science, our position based on the foregoing is that the teachers of the study students may have been using some form of inquiry-based strategy in their classrooms and that this may have contributed to students' apparent positive attitude towards science that is evident in their responses to survey statements.

#### 4.1.1 Students' Perception of the Usefulness of Science to Everyday Life

Results show that a low percentage (44.75%) of the students reported understanding of the importance of science in every day life, even though 65% thought that "science is helpful in understanding today's world" and 57% agreed that "most people should study science". These survey responses present a concern regarding the role of science instruction in preparing students in urban school districts to understand the connection between the science content they do in the classrooms to their applications in everyday life. Data analysis also leads to an assumption that the 38% of students who did not see the need for science in most jobs may imply a lack of understanding of the survey questions or the inquiry process. This data presents research opportunities in the field of education in regards to finding out if there is a correlation between the responses of students that scored highly in the positive emotional disposition towards science with their understanding of its usefulness in every day's life.

With regards to grade levels, there appears not to be much difference between the different grade levels in their understanding of the usefulness of science.

#### 4.1.2 Students' Emotional Disposition towards Inquiry based Instruction and its Implementation in their Classrooms.

Generally, students' responses under this survey cluster not only point to the presence of inquiry in their classrooms but show that students agreed to have developed positive emotional disposition toward inquiry-based instruction even though the percentage of their overall responses are not considered high. ( 44.71%).

A note worthy finding of the current study is that much of what the students reported through the survey point to the use of inquiry-based instruction in their classrooms. For example, 62% of students reported that they were able to "ask questions about what they are learning and to find answers to these questions", 65% agreed with SS 22 that they "learn to state hypothesis, design experiments, and defend their conclusions", and 51% reported that they were "actively involved in their learning and were "able to say their opinion". We contend that their responses confirm the presence of inquiry attributes in their classrooms and resound NRC's (1996) assertion that when students employ inquiry, they use their critical thinking skills effectively in asking questions about events, developing and testing hypothesis and explanations based on available scientific knowledge.

The result of this study supports several studies reported in Gipson and Chase (2002) which showed that students who use an inquiry approach have improved attitudes towards science compared to those taught through traditional methods. Students' responses to survey questions used in this study point to the benefits of the use of inquiry-based instruction as reported by (a) Fradd and Lee (1999) who posited that inquiry-based instruction is learner-centered allowing teachers to build on students' prior experiences, and (b) Lloyd's (1988) that inquiry-based strategy helps students to engage actively in their learning, while promoting their deep conceptual understanding.

We however, are unable to ascertain that students actually understood what inquiry-based teaching looked like based solely on their responses. The conclusions and recommendations from their responses will present opportunities for further research in science education and psychology. Since there is a dearth of literature reporting students' perception about inquiry, and even though the present study is froth with obvious limitations, we posit that this is a good starting point in involving students in the inquiry process in such a way that they actually understand the concept of inquiry enough to enable them make claims about its strategy and process in the science classroom.

Across grade levels, the lack of clear distinctions between the responses to some questions by 6<sup>th</sup> and 7<sup>th</sup> grade students might just reflect their level of understanding at the time of the study. However, the perceived differences between 6<sup>th</sup>, 7<sup>th</sup> grades and 8<sup>th</sup> grade might actually suggest that the 8<sup>th</sup> graders had better understanding of both the inquiry process and the survey statements than 6<sup>th</sup> and 7<sup>th</sup> graders. There is need to probe further into these differences in future research in order to make more valid and reliable conclusions.

#### 4.1.3 Summary

The present study provides evidence for the need to use multiple survey questions to solicit students' voices regarding the teaching and learning process that go on in their science classrooms. It also provides support for research studies that validate the use of inquiry based science instruction to facilitate students' positive attitudes, understanding and

interest towards science. It is apparent from the result of the study that urban middle school students can be guided in using the right kind of instructional strategy to develop interest in science to the extent that they would intentionally choose science content that will enable them successfully pursue a science oriented career. Traditional methods of instruction, which often include lectures, note taking and “cook-book” science may not be as effective as inquiry-based strategies in doing this. There is however a dire need to conduct further studies on this aspect of student involvement in their learning, especially in science. These studies we recommend should use in addition to surveys, other data collection measures such as observations, formal, and informal interviews as a means of eliciting further clarifications from students about their perceptions of the kind of science teaching and learning going on in their classrooms. Observing teachers in the study schools may be beneficial in finding out what exactly students perceive as inquiry based instruction. It will also add to the body of educational research if a study is conducted with a wider student population. In addition, studies can be conducted to check if there is a correlation between the responses of middle school students and their teachers’ training in inquiry based instructional strategies. In conclusion, this study provides a critical area for future research work that will take into consideration variables that can motivate urban middle school students to become more interested in science.

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Table 1. Summary of Percentages, Means, and Standard Deviations of Students' Responses to Survey Statements.

Three Clusters of Survey Questions	Grade 6			Grade 7			Grade 8			All Grade Levels (6-8)		
	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD	%SA & A	Mean	SD
Students' Emotional Disposition Towards Science.	37.34	2.82	1.61	48.86	3.32	1.24	32.42	2.84	1.33	39.67	3.02	1.43
Students' Perception of their Understanding of the Usefulness of Science.	42.25	3.52	0.94	53.50	3.67	1.07	38.25	3.38	1.09	44.75	3.54	1.04
Students' emotional disposition towards science inquiry and their perceptions of their teacher's use of inquiry-based instruction in their classrooms?	46.88	3.33	1.83	47.82	3.31	1.26	36.18	3.09	1.26	44.71	3.26	1.50
All	42.16	3.14	1.68	50.16	3.35	1.24	35.62	3.02	1.28	43.04	3.19	1.44

### Appendix 1

Table 2. Students' Emotional Disposition towards Science

Survey Questions (SQ)	Grade 6 N= 88			Grade 7 N= 92			Grade 8 N= 62			All Grade Levels (6-8)		
	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD
1	73	4.01	0.90	53	3.34	1.16	45	3.35	1.22	58	3.60	1.14
2	92	4.51	0.70	45	3.26	1.26	71	3.79	1.23	69	3.87	1.20
3	98	4.90	0.34	65	3.79	1.09	74	4.15	1.00	79	4.29	0.99
4	82	4.23	0.77	49	3.43	1.11	53	3.57	1.15	61	3.77	1.07
5	45	3.35	1.10	59	3.54	1.18	27	2.74	1.37	44	3.27	1.24
6	59	3.64	1.02	50	3.29	1.29	39	3.25	1.17	49	3.41	1.81
7	73	3.85	0.82	47	3.42	1.13	53	3.59	1.01	58	3.63	1.01
8	2	1.35	0.65	45	3.19	1.26	16	2.27	1.18	21	2.27	1.32
9	3	1.71	0.88	47	3.17	1.35	15	2.19	1.16	22	2.40	1.32
10	2	1.50	0.77	42	3.17	1.25	6	2.15	0.99	17	2.29	1.25
11	0	1.22	0.54	41	3.07	1.30	11	1.89	1.16	18	2.08	1.31
12	10	2.05	1.01	33	2.93	1.30	21	2.60	1.14	21	2.52	1.22
13	13	2.37	2.50	59	3.67	1.10	21	2.47	1.20	31	2.88	1.85
14	2	2.05	0.75	46	3.25	1.35	15	2.40	1.12	21	2.59	1.22
15	5	1.58	0.88	53	3.37	1.25	19	2.23	1.12	26	2.41	1.34

Table 3. Students' Perception of and their Understanding of the Usefulness of Science,

Survey Questions (SQ)	Grade 6 N= 88			Grade 7 N= 92			Grade 8 N= 62			All Grade Levels (6-8)		
	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD
16	13	3.36	0.92	32	3.73	1.17	13	3.26	1.02	19	3.48	1.07
17	76	4.09	0.87	62	3.69	1.06	56	3.62	1.17	65	3.83	1.04
18	60	3.69	0.78	63	3.66	1.03	47	3.46	0.98	57	3.62	0.94
19	20	2.94	0.80	57	3.60	1.01	37	3.20	1.15	38	3.25	1.03

Table 4. Students' Perception of the Implementation of, and their Emotional Dispositions towards Inquiry Based Instruction in Their Classrooms.

Survey Questions (SQ)	Grade 6 N= 88			Grade 7 N= 92			Grade 8 N= 62			All Grade Levels (6-8)		
	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD	% SA & A	Mean	SD
20	3	1.90	0.92	60	3.51	1.37	23	2.58	1.33	29	2.67	1.40
21	97	4.74	0.51	52	3.15	1.30	58	3.42	1.36	70	3.81	1.31
22	84	4.24	0.81	46	3.22	1.30	66	3.92	1.11	65	3.78	1.18
23	36	3.32	1.03	51	3.24	1.26	27	2.98	1.02	38	3.21	1.13
24	97	4.59	0.60	50	3.18	1.38	56	3.66	1.22	68	3.83	1.27
25	59	3.81	0.97	57	3.54	1.08	31	2.91	1.22	49	3.49	1.13
26	49	3.51	0.97	51	3.30	1.23	31	3.14	1.06	44	3.34	1.10
27	7	1.56	0.95	48	3.22	1.31	11	3.16	1.11	22	2.33	1.35
28	75	4.14	1.87	53	3.51	1.29	56	3.71	1.23	62	3.79	1.17
29	68	4.02	0.87	46	3.24	1.26	40	3.46	1.18	51	3.59	1.16
30	44	3.49	1.03	55	3.41	1.18	39	2.89	1.31	46	3.30	1.18
31	68	3.90	0.82	54	3.45	1.09	48	3.52	1.08	57	3.64	1.01
32	8	2.03	0.98	49	3.31	1.27	16	2.60	1.10	24	2.66	1.26
33	18	2.68	1.05	51	3.38	1.12	34	3.03	1.20	34	3.03	1.16
34	8	2.90	5.28	51	3.45	1.09	18	2.60	1.15	26	3.02	3.32
35	10	2.50	1.66	47	3.25	1.22	19	2.66	1.21	25	2.64	1.31
36	66	2.85	1.08	41	2.81	1.52	42	3.27	1.08	50	3.32	1.34

**Appendix II. Attitude toward Science and Inquiry Lessons**

This questionnaire seeks your views about your science lessons. Please fill in the blank spaces in Sections A and place a check mark ( x ) in the box that best describes your view in Sections B and C.

**SECTION A**

Name of school (Optional).....

Grade level.....

Sex.....

Male/Female.....

Science Subject..... Ethnicity.....

**SECTION B**

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
<b>Students' Emotional Dispositions Towards Science</b>				
1. Science is something which I enjoy very much.				
2. I like the laboratory activities we do during science classes.				
3. Doing science experiments are fun.				
4. I feel comfortable in a science lesson.				
5. I like to read about science.				
6. Science is easy for me.				
7. I usually understood what we talked about in science lessons.				
8. I don't like anything about science. It is boring!				
9. When I hear the word science, I have a feeling of dislike.				
10. I feel nervous when someone talks to me about science.				
11. It makes me nervous to even think about doing science.				
12. Doing experiments is a wastes time				
13. Most of the ideas in science aren't very useful.				
14. I spend too much time in school studying science.				
15. No matter how hard I tried, I could not understand science.				
<b>Students' Understanding of the Usefulness of Science</b>				
16. Science is useful for the problems of everyday life.				
17. Science is helpful in understanding today's world.				
18. Most people should study some science.				
19. There is little need for science in most jobs.				

**SECTION C**

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
<b>Students' Perception of the Implementation of and their Emotional Dispositions Towards Inquiry based Instruction in Their Classrooms</b>				
20. In our class, the teacher tells us the facts; we do not carry out experiments to find things out				
21. My science teacher makes science interesting.				
22. In our science class, we learn to formulate hypotheses, do experiments, and defend our conclusions				
23. All students should develop abilities necessary to do scientific inquiry and understandings about scientific inquiry				
24. Most students in my class are interested in doing lab. work				
25. My science teacher presents material in a clear way.				
26. Doing experiments makes me think critically				
27. I am able to think independently because of our science inquiry lessons				
28. We should avoid doing experiments in science classes because it is dangerous				
29. My teacher prefers to use the textbook to teach science				
30. I am able to ask questions about what I am learning and to find answers to these questions.				
31. I am actively involved in my learning and I am able to say my opinion in my science class.				
32. The teacher makes us do stuff by ourselves and this has improved my confidence.				
33. My science teacher allows me to do stuff by my self during science lessons				
34. I remember most of the things I learned in science.				
35. Inquiry lessons are rowdy and uninteresting				
36. I would rather be told scientific facts than find them out by investigating.				

THANK YOU

In many cases (92%), the respondents reported that the professional development activities are linked to the mission of their institution (mean = 4.15; sd = .91). Additionally, 99% of the respondents report that professional development activities contribute to student learning (mean = 4.37; sd = .67).