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Investigating Secondary Science Teachers' Beliefs About Multiculturalism and its Implementation in the Classroom

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The purpose of this qualitative study was to explore secondary science teachers' beliefs about multiculturalism and its implementation in their classrooms. Participants included nine secondary science teachers, with experience ranging from 1 to 15 years of teaching. Data were collected through interviews, using a semi-structured interview protocol (Kvale, 1996). The interviews were coded, analyzed, and grouped into five themes aligned with the multicultural dimensions developed by Banks and Banks (2007): Content Integration, Knowledge Construction, Prejudice Reduction, Equity Pedagogy, and Empowering School Culture. Results of the research study indicated these participants harbored a general misconception that there was only one science; traditionally that has meant a Western Modern Science (WMS: Cobern & Loving, 2001). The research also suggests the participants in this study had limited knowledge pertaining to multiculturalism in their science classrooms. To these participants, Prejudice Reduction and Equity Pedagogy were the only two dimensions that were important when teaching science content.

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Introduction

The United States is growing more diverse with a variety of students from multi-racial and multi-ethnic backgrounds. With minority groups making up an increasing share of the population across most states, teaching—especially teaching science from a multicultural perspective—is becoming imperative. Margaret Mead (1970) described culture as a systematic body of learned behavior transmitted from parents to children. Weist (2001) offered a broader stance, explaining that culture was much more than food, styles of dress, or traditional customs of people; that it pervaded entire individuals and influenced how they thought, communicated, viewed, and interacted with the world. Students' cultural backgrounds play a vital role in how they learn and internalize a concept, scientific or otherwise. Anderson (1984) believes student's schemas depend on their social location that influence how they understand, interpret, and analyze everything in their world.

The achievement gap in science between cultural minority and majority students cannot only be attributed to a cultural mismatch between the teacher and students but also to the "Nature of Science" taught in schools. The science taught in school derives from a Western European viewpoint and science from other cultures is often viewed as "folk thought" (Stanley & Brickhouse, 2001,

p. 36). A mismatch often occurs between students from non-Western cultures and the Western science taught in class. There is a movement to integrate multiculturalism into all curricula (Banks & Banks, 2007) including the teaching of science. Specifically, this pertains to multiple perspectives of science content, especially those of non-Western origin (Cobern & Loving, 2001). Multicultural perspectives of science may include, but are not limited to, the perspectives of women as well as of those from various ethnic groups such as African-American, Hispanic, Asian, and Indian.

A popular stereotype perpetuated both by print media and television represents an image of a scientist that has persisted over the ages. Literature shows both children and teachers frequently visualize scientists as bespectacled, white-smocked, middle-aged, White males with wild hair, holding smoking, bubbling test tubes, and working inside a laboratory (Barman, 1997; Basalla, 1976; Ford & Varney, 1989; McDuffie, 2001; Moseley & Norris, 1999). Strongly ingrained views children develop about what scientists do, what they look like, and who they are often deter and discourage participation of girls and non-White minorities in scientific pursuits due to their inability to visualize themselves as future scientists. While other societal factors might adversely affect students' learning of science, primary among these are teacher beliefs (Bruner, 1996; Kennedy, 1997). Research conducted regarding English Language Learners (ELL) has been plentiful; however, there has been little recognition as to what knowledge and background these culturally diverse students bring to the classroom (Lee, 2005). Culturally diverse students have the expectations to succeed on standardized tests; therefore, teachers need to have both knowledge of science and an understanding of students' cultural backgrounds (Lee, 2001). In this article we explore secondary science teachers' beliefs about multiculturalism and its implementation in their classroom.

Literature Review

Banks & Banks (2007) stated that culture is the knowledge, concepts, and values that are interpreted by members of a group. The core notion of culture according to Kuper (1999) is not in the tangible artifacts or material objects of a group, but how those objects are interpreted. Objects do not enhance a culture; instead, culture is in the meaning and symbolism behind the object (Kuper, 1999). Erickson (2007, p. 33) contends that culture is all around us in scope and transmission, and that culture is "personal, familial, communal, institutional, societal, and global." Culture exists not only in ethnic groups, but schools and classrooms have in their own cultures and subcultures. An individual student is a member of both a larger cultural group (i.e., race, gender, and ethnicity) as well as several subcultures. Furnham (1992) identified seven areas that influence a student's science education: their family, peers, the school, mass media, and the physical, social, and economic environments. Students must navigate through each of the cultures and subcultures to be successful in learning science.

Historically the United States has been referred to as a "melting pot" (McCormick, 1984, p. 93). This metaphor describes the assimilation of immigrants in the country, amalgamated in the melting pot, yielding a final product of uniform consistency and flavor quite different from the original. However proponents of multiculturalism have challenged this metaphor stressing that as different cultures came together, it was their cultural differences that were valuable. As immigrant populations reach a critical mass in many communities, the melting pot metaphor no longer seems appropriate and is being replaced by a "salad bowl," or " cultural mosaic" metaphor where "each group reflected its unique identity *and* its American experience" (McCormick, 1984, p. 93). The salad bowl theory where each individual "ingredient" retains its flavor and integrity while successfully contributing to the final product promotes cultural pluralism. Laubeova (2000) presents a third analogy, that of the "ethnic stew", where there is a level of compromise between integration and cultural distinctiveness.

According to McCormick (1984) the ideology of cultural pluralism is a celebration of the differences between and among diverse groups of people where minority groups participate fully in dominant society yet maintain their individual differences. Educational settings are coping with an ever increasing number of culturally diverse students with dissimilar knowledge bases and ideas about how our world functions. Students bring their own "funds of knowledge" (González, Moll, & Amanti, 2005) varied learning styles, talents, and interests to each learning situation. Thus, it is important to be aware of and recognize individual student strengths rather than expecting conformity with a common standard.

Multicultural Education

James A. Banks (1999) describes multicultural education as the concept that all students, regardless of gender, social class, ethnic background, race, or other cultural characteristics, have equal educational opportunities. Toward achieving this end, he posited five dimensions to guide successful multicultural education reform. They include: "Content Integration, Knowledge

Construction, Prejudice Reduction, an Empowering School Culture, and an Equity Pedagogy" (Banks & Banks, 2007, p. 23). The first, Content Integration, determines the extent to which teachers use examples and content from a variety of cultures and groups to illustrate key concepts, principles, generalizations, and theories. Knowledge Construction, the second dimension, relates to how teachers help students investigate and determine "cultural assumptions, frames of reference, perspectives, and biases within a discipline influence the knowledge constructed within it" (Banks & Banks, 2007, p. 20). He also believes Knowledge Construction is a compelling idea in multicultural education because it can be taught across disciplines and content areas (Banks, 1999). Third, Prejudice Reduction, are lessons and activities used to help students develop positive attitudes toward different cultural groups. Schools are places where students can learn to construct knowledge, and prejudicial attitudes among students can impact both their academic performance as well as relationships with their peers. The fourth dimension, teachers' knowledge and application of Equity Pedagogy deals with the use of teaching procedures and styles that enables students from diverse groups to achieve academically. The fifth dimension is an Empowering School Culture and social structure that promotes equity of all cultures and groups. The appropriate school culture is one that promotes equity among genders, races, and social-classes and does not disproportionately group or label students. With these five dimensions of multicultural education as a guide, schools can begin to create equal opportunities for learning for all students. Banks & Banks (2007) did not conceptualize multicultural reform as achievable through the efforts of a single individual, but that it needed to be a joint effort in conjunction with all teachers as well as the school administration.

Multicultural Science

The United States is rapidly becoming a diverse and populous nation; thus, the idea of multicultural science education has very real implications in schools. The National Science Teachers Association (NSTA) (2011) position statement on multicultural education recommends that science teachers be knowledgeable about and use culturally-related instructional practices. Further that it is the teacher who shoulders the responsibility of involving culturally diverse children in science, technology, and engineering career opportunities. However, there are few resources available which articulate the norms, practices, and cultures of linguistically and culturally diverse students that teachers can use to enhance the science learning (Lee, 2005).

The National Science Teachers Association (NSTA) (2011) position statement on multicultural education recommends that science teachers be knowledgeable about and use culturally-related instructional practices.

Scientific knowledge has long held a central role and attained a dominant position in developed societies, but we cannot ignore the fact that other traditional, indigenous valid knowledge systems exist (Mazzocchi, 2006). Western science and traditional knowledge systems have several opposing views primarily in that the former is objective and adopts analytical and reductionist methods in contrast to the more spiritual, intuitive, and holistic view characteristic of traditional knowledge systems (Nakashima & Roue, 2002). Western Modern Science (WMS) is so named because of its origins in the Ancient Greek and European cultures (Cobern & Loving, 2001). As a culture all its own, WMS has maintained values, knowledge, and learned behaviors through generations of scientists (Aikenhead & Jegede, 1999). Stereotypically, scientists have been White, male, and middle class (Barman, 1997; Basalla, 1976; Ford & Varney, 1989; McDuffie, 2001; Moseley & Norris, 1999). Under-represented groups, such as women and minorities, seem to be in conflict with the culture of WMS (Krugly-Smolska, 1996) due to their values and beliefs systems. Stanley and Brickhouse (2001) contend the perspective of WMS is too narrow and exclusionary for the diversity in today's classrooms.

Ogawa (1995) expressed that every culture has its own science, which is transferred through the generations by social and cultural events. He refers to this type of science as "indigenous science or knowledge (IK)" (p. 585). Snively and Corsiglia (2001, p. 8) added that IK "interprets how the world works through a particular cultural perspective." Stanley and Brickhouse (2001) assert that viewing science from a multitude of perspectives such as from a non-Western origin presents a rich resource for science and science education. However, many science teachers believe science to be a single body of facts and theories, derived from WMS, and are unaware of multicultural aspects in the science curriculum (Krugly-Smolska, 1996). It is the science teachers' responsibility for introducing students to new and different ways of thinking about the natural world (Stanley & Brickhouse, 2001). Therefore, until

the gap between WMS and IK is bridged, students, especially from minorities, will see science classrooms as exclusionary rather than inclusionary.

Context of Research

Our purpose through this qualitative study was to explore secondary science teachers' beliefs about multiculturalism and its implementation in their classrooms. Two public school districts in the southern United States participated in this research project. School District "A" with a total of 918 students was small and rural consisting of a single elementary, middle, and high school.

School District "B" was a larger urban school district, comprising of 12 schools of which six elementary schools housed pre-kindergarten through grade 4, two intermediate schools (grades 5 and 6), two middle schools (grades 7 and 8) and two high school (grades 9–12). Table 1 contains demographic information for both school districts obtained by the Academic Excellence Indicator System (AEIS), a system of accountability for student performance used by the state (Texas Education Agency, 2007).

Participants

A total of nine science teachers volunteered their participation in this study; five were high school teachers, and the remaining taught science at the middle school level. Of these, four were male and five were female and all nine reported to be of "White" ethnicity. Participants ranged in teaching experience from 15 years to a first year teacher. All participants expressed that science was the only subject they have taught; however, teaching was the second profession for two of the participants.

Table 1. AEIS Report From Texas Education Agency (TEA)

	School District A		School District B	
School Population	Number	Percent	Number	Percent
Total students (K–12)	918	—	8,184	—
Ethnic distribution				
African American	42	4.6%	205	2.5%
Hispanic	235	25.6%	1,256	15.3%
White	590	64.3%	6,596	80.6%
Native American	3	0.3%	52	0.6%
Asian/Pacific Islander	48	5.2%	75	0.9%
Economically disadvantaged	572	62.3%	1,873	22.9%
Limited English proficiency	35	3.8%	51	0.6%
Students with disability	5	0.5%	134	1.5%
At-risk	200	21.8%	2,047	25%
Total staff	136	—	1,093.9	—
Professional staff				
Teachers	70.2	51.6%	636	58.1%
Professional support	8.8	6.4%	524.3	47.9%
Campus administration	5.8	4.2%	29	2.7%
Central administration	3.0	2.2%	8	0.7%
Total minority staff	13.9	10.2%	101.8	9.3%
Ethnicity of teachers				
Hispanic	3.2	4.6%	13	2.5%
White	67	95.4%	509	97.1%
Asian/Pacific Islander	—	—	2	0.47%

Methodology

Primary data collected was in the form of interviews lasting 20 to 30 minutes, using a semi-structured interview protocol. Kvale (1996) believes using the semi-structured interview process allows researchers to go in with a set or a sequence of themes and questions they wanted to cover. However, there is flexibility to change that sequence and the questions given the responses of the interviewee, allowing for a "greater breadth" of information to be collected (Fontana & Frey, 2005, p. 705). The focus of the interviews was to identify the participants' beliefs about multiculturalism, and to what extent those beliefs were implemented into their classroom instruction. Member checks and peer debriefing were conducted to increase rigor and trustworthiness of the research. Table 2 describes participants' demographic data.

Data Analysis

All interviews were transcribed and coded, and during this process data underwent constant comparison (Glaser & Strauss, 1967) and "theoretical questioning" (Charmaz, 2005, p. 511), accounting for trustworthiness and rigor. Interviews were coded with the date of the interview and line number, for example (11-05-07 L10) referred to an interview conducted on November 7, 2007, line 10 on the interview transcript. The data were analyzed and grouped into themes aligned with the dimensions of multicultural education developed by Banks and Banks (2007). The analysis afforded researchers a deeper understanding of the participants' understanding and implementation of multiculturalism in their classrooms.

Research participants, who were given pseudonyms, were asked to describe their overall notion of multiculturalism. All of them described multiculturalism in terms of different learning styles of their students. None of the participants specifically mentioned the five dimensions of multicultural education while discussing their notions of multicultural science education. None of the participants viewed science as having multiple perspectives or those students from different genders, races, or social-classes could relate in alternate ways to the content of science.

Table 2. Science Participant Demographics

Teacher	Grade Level/Subject	Years of Teaching	Gender/Ethnicity
Mike	7th/8th general science Department Head	9	Male/White
John	11th/12th grade Chemistry & Physics	1	Male/White
Elliot	7th Grade General Science	5	Male/White
Kari	8th Grade General Science	2	Female/White
Dana	7th Grade General Science	2	Female/White
Mr. S	Biology and Anatomy & Physiology	12	Male/White
Annabel	Health, Science 1 and 2, & Medical Terminology	8	Female/White
Madeline	Science	9	Female/White
Anna	Chemistry	11	Female/White

Content Integration

Content Integration (Banks & Banks, 2007) pertains to how teachers use examples and content from a variety of cultures to teach, and in this study specifically refers to science content. None of the participants of this study described integrating cultural content into any of their science lessons. "Science is science, no matter what culture you live in" as Steve asserted (11-06-07 L14). Eight of the nine participants interviewed agreed, and expressed that multiculturalism was not specifically important when teaching science content. When probed further, it emerged that this belief was based on the participants' perceptions that WMS was the only perspective of science they believed in, consequently there was no need to present science content from a multicultural standpoint.

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Knowledge of Construction Process

When queried about their own Knowledge Construction process regarding multiculturalism, participants in this study indicated learning about it only as part of a course. Steve noted that he learned about "different cultures in sociology and psychology courses, but not in my education courses" (Steve 11-06-07, L 14-15). Madeline, Steve, and Mike stated they learned about multiculturalism in a reading course. Annabelle agreed that her multiculturalism training also came while in college, especially nursing school, "we learned how to care for people from many other cultures .... [we learned how] to make the patient feel comfortable, understand their needs both social and emotional" (Annabelle, 11-06-07, L17-18). Mike learned about multiculturalism in college education courses and he added workshops in multiculturalism had been provided by his school district. However, when probed further about multiculturalism specific to science content and teaching, all participants stated they had not been trained with regards to multicultural perspectives of science or how to integrate multiculturalism and science content during their science methods courses.

Banks and Banks (2007, p. 23) stated, "Teachers need to help students understand ... how the implicit cultural assumptions ... within a discipline influence the ways in which knowledge is constructed." Science can be viewed as having its own culture, with its own "communication mode, values, and behaviors" (Krugly-Smolska, 1996, p. 23). Minority students and girls are often underrepresented, as members of this culture tend to be viewed as White and male (Barman, 1997; Basalla, 1976; Ford & Varney, 1989; Krugly-Smolska, 1996; McDuffie, 2001; Moseley & Norris, 1999). Therefore it is the teacher who needs to provide opportunities for these students to learn science effectively in the classroom. The participants in this study acknowledged that they did not have sufficient knowledge to present scientific content from a multicultural perspective. In addition, they did not perceive a need for presenting science from multiple perspectives to their students. As a result, by teaching science as they had learned it (WMS), the participants did not contribute to their students' knowledge about multiculturalism. Further, no attempt was made to make science instruction more appealing to minority students and females.

Prejudice Reduction

The focus of this dimension was on teaching methods and materials that could modify students' thoughts and feelings about another culture (Banks & Banks, 2007). When interviewed, participants averred that promoting equity and treating all students was important. Steve

stated his goal was "... to not have one culture more prominent then another, especially in the West [United States]" (Steve 11-06-07, L6-7). Madeline also stated she believed it was important to be "sensitive to the needs and beliefs of every student regardless of race" (11-02-7, L37). All the participants interviewed associated multiculturalism with the respectful treatment of students with diverse learning styles. However, in spite of teaching classrooms with diverse students, none of the participants could offer specific examples of how they achieved Prejudice Reduction in their science classroom.

Equity Pedagogy

Equity Pedagogy refers to utilizing teaching methods that will facilitate academic success for diverse students (Banks & Banks, 2007). Participants interviewed expressed concern about the learning styles of students in their classrooms. Elliot stated "we have in education a diverse group of learners all in the same classroom; we need to learn to address learning styles within their individual cultures" (Elliot 11-01-07, L9-10). Ann stated that "it is important to address the student's learning styles and respect them, but it [multiculturalism] is not specifically important when teaching science concepts" (Ann 11-06-07 L9-12). Although the participants asserted that multiculturalism was not important when it came to teaching science concepts, they all thought treating students the same and providing a high quality education to all was important. In addition, participants expressed that it was important to adapt lessons to the varied learning styles of their students, however no specific examples as in how they did so in their science classrooms were offered.

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Empowering School Culture and Social Structure

Creating an Empowering School Culture means developing a social structure that respects all students across racial, ethnic, and gender groups. Participants expressed that they felt schools were supportive of multiculturalism, and that their schools administrations treated students fairly. Mike and John, from School District A, thought their school also created a sense of community for all the students. None of the participants believed their school treated any culture disrespectfully. Mike discussed an extracurricular club called "Multicultural Club," a group of students and teachers who met once a month to learn about different cultures. John stated other ways cultures were being recognized and celebrated. He mentioned having students complete research projects about scientists from the student's culture.

Participants in School District B, the larger district, expressed concerns about the administration not doing enough in terms of multiculturalism. Kari stated that "in my opinion [my school] doesn't do as much as it should when it comes to addressing multiculturalism, mostly because it is not addressed on TEKS (Texas Essential Knowledge and Skills) so it is not important" (Kari 11-12-07 L42-43). Kari was not the only teacher with this concern; Annabelle also stated that her school "could do more but doesn't because multiculturalism is not something tested on the TAKS (Texas Assessment of Knowledge and Skills) test" (Annabelle 11-06-07 L38-39).

Discussion

This research study provided a glimpse into the beliefs secondary science teachers have about multiculturalism and its implementation in their science classrooms. It is evident that participants in this study had limited conceptions about multiculturalism and hence its implementation in the classroom was also severely limited. Prejudice Reduction and Equity Pedagogy were the only two dimensions addressed by the participants interviewed. Banks and Banks (2007) contend teachers dismiss the importance of multicultural education when they do not see it as relevant to their discipline, especially science, as indicated by participants interviewed in this research study. Participants unanimously averred there was only one science—WMS—to be taught and that multiculturalism applied only to learning styles or getting along with others.

The data obtained leads to the conclusion that this problem needs to be resolved within science education methods courses for pre-service teachers and workshops

for in-service teachers. Teachers must be taught that multiculturalism is more than Prejudice Reduction, Equity Pedagogy, or learning styles. They must be instructed on methods for integrating multicultural content into their content. Teachers need to be better informed with regards to indigenous knowledge and methods for incorporating it into the everyday science curriculum. In addition teachers should be made aware that science is not only WMS but has multiple perspectives.

Teachers need to create a science classroom where all races, ethnic groups, and genders feel as though they are members of the scientific culture (Krugly-Smolska, 1996). By creating a truly multicultural science class integrating both WMS and IK teachers will "introduce students to new ways of thinking about the natural world" (Stanley & Brickhouse, 2001, p. 47). Overall, teachers must be made aware of strategies and resources that make science more appealing to students of minorities so they can both identify with it and excel in it.

The students of today "cross cultural borders" when it comes to learning science (Aikenhead & Jegede, 1999, p. 271). These crossings can range from being easy for students to nearly impossible. The job of the teacher is to be the "culture broker" (Aikenhead, 1997, p. 231). The culture broker eases the transition between the two cultures for each student. Although participants interviewed expressed a concern for the success of their students, they lacked the knowledge to assist their students in crossing those borders successfully. The participants did not discuss methods by which indigenous scientific knowledge could be integrated into the content of science. A disregard for indigenous knowledge as an important part of science education could discourage some culturally diverse students by leaving them frustrated and unmotivated to learn either WMS or indigenous science. However, a teacher who becomes a culture broker uses the languages of WMS and IK to help students navigate learning both sciences and can motivate the students so that they may live competently in both cultures.

A teachers' knowledge of science in multiple perspectives needs to be increased and a "culturally responsive" curriculum is needed (Aikenhead & Huntley, 1999, p. 22). A culturally responsive curriculum is one that "addresses student achievement but also helps students to accept and affirm their cultural identity while developing critical perspectives" (Ladson-Billings, 1995, p. 469). Acknowledgement of IK concepts and WMS concepts into the science curriculum serves to enrich learning for all students. In addition, it would mean that both sets of knowledge would be equally as important in shaping the science literacy of our students today.

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