Ethnicity awareness intervention: effects on attitudes and behaviors of science educators

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Ethnicity awareness intervention: 
Effects on attitudes and behaviors of science educators

by

Carlie Collins Lyster Tartakov

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Department: Professional Studies in Education
Major: Education

Approved:
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For the Graduate College

Iowa State University
Ames, Iowa

1995

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DEDICATION

This dissertation is dedicated to my children, grandchildren, nieces, nephews, grand-nephews, grand-nieces, and young cousins: the children, for whom my work is primarily focused. They are our present, past, and future.

You look harder if you know talent is there.
You look better when you are clear about its manifestation.
You look more closely, with less bias if you know how perceptions can be contaminated.
You look more urgently if you identify with the children.
You get hooked on looking when you find a pearl.

—Author unknown
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CHAPTER I. INTRODUCTION

H. Kenneth Bechtel, in his introduction to *Blacks, Science and American Education* (Pearson & Bechtel, 1989), wrote:

Science is a pervasive and dominating force in American society. It is a primary source of the understanding of the worlds—physical, biological, behavioral and social—in which we live; directly and indirectly, it shapes the boundaries and the directions of all phases of American life. (p. 1)

Science provides us with knowledge of the biophysical environment and social behavior necessary in dealing with global and local problems that can only be approached by a scientifically and technologically literate citizenry (Clark, 1989). In addition, the continuous development and creation of new technologies will extend our capacity for survival "in which the human species is at peace with itself and its environment" (Clark, 1989, p. 12).

Unfortunately, our nation's educational institutions are not meeting the challenge of providing students with the necessary strategies and techniques to become literate in science and technology and are far behind the global nation states of our world. According to the 1986 report of the National Assessment of Educational Progress (NAEP) the National Science Board's Commission on Pre-College Education in Mathematics, Science, and Technology in 1983 stated:

Alarming numbers of young Americans are ill equipped to work in, profit from, and enjoy our increasing technological society. Far too many emerge from the nation's elementary schools with inadequate grounding in mathematics, science, and technology. As a result they lack sufficient knowledge to acquire the training, skills,
and understandings that are needed today and will be
even more critically needed in the 21st century.
(Mullis & Jenkins, 1988, p. 5)

In spite of increased standards and requirements, the national scores for
proficiency remain low in mathematics, science, and technology. Today's
kindergarten through third grade students will be among the leaders and the
decision makers in the Twenty-first century; however, the NAEP states that
today's high school graduates are inadequately prepared to assume these roles.

Volumes have been written on the status of science and mathematics—
singly, the most important factor in determining whether a student will be able
to compete successfully in the sciences (Vetter, 1990). What the future holds for
our nation and the world depends largely on the wisdom with which humans
use and develop science and technology (Rutherford & Ahlgren, 1990). The
pressing concern is that our nation's students are not being adequately prepared
in the sciences and mathematics for the Twenty-first century. The claim is made
that educators are unprepared to provide a curriculum which can address science
and mathematics needs (Bechtel, 1989; Berryman, 1985; Harding, 1993; NAEP,

The reduction of skilled workers in scientific and technical fields will
mean less efficient production and less ability to compete in the world's
economic marketplace. Thus a lower quality of life for all U.S. citizens will
evolve (Office of Technology Assessment, 1986). For those who measure
national success by our standard, the lowering of this standard is an important
reason to focus on our science education today. For those who have emphasized
the importance of science and technology in ridding the wider world of the
devastating effects of poverty, disease, and other adverse social and economic
conditions, the issue is the same (Harding, 1993). Regardless of the reasons for improving the position of science in the curriculum, a definite and urgent need to do so is expressed by various individuals and groups (Clark, 1989; Mullis & Jenkins, 1988; NAEP, 1983; Rutherford & Ahlgren, 1990).

Also of concern to the future of our country is the 25% drop in the U.S. birthrate between 1961 and 1975. This drop, mainly due to a reduction in the births of European Americans, resulted in the reduction of the number of students entering college in the 1980s. Sciences and engineering classrooms will continue to experience lower enrollment through 1999. Further, many scholars predict that by the Twenty-first century there will be a serious shortage of scientists and technicians, due to the drop in the matriculation of white males who now dominate the field and these reduced numbers entering the pipeline of the scientific and technological fields (NAEP, 1983; Vetter, 1990). Unless drastic measures are taken, including reaching out to the under-represented groups, a poorer quality of life will be the result for all U.S. citizens, particularly poor whites and people of color who are not currently active in the scientific fields (Malcom et al, 1975; Mullis & Jenkins, 1986; NAEP, 1983).

A key issue in solving a shrinking scientific work force in a time of growing need may be in the under-representation of whole sectors of our population in the sciences at all levels. It is, possibly, the under-representation of these groups—people of color, white women, and the physically challenged—that causes the shortfall of qualified workers in this area (Matyas, 1987). In fact, the only solution to the shortfall in the work force may lie in providing more and better science education to current marginalized groups.
By the year 2000, more than 80% of the entrants into the general work force will be people of color, white women, internationals, and people who are physically challenged. Only by reaching out and bringing members of these now under-represented groups into the mainstream can the nation meet future shortfalls in its scientific work force (George, 1989).

Since 1954, the expansion of educational employment activities for Blacks, Chicanos, Puerto Ricans and American Indians—historically absent from key professions—has been attempted through a wide variety of educational experiments undertaken to alter existing patterns in society. (Finnell, 1982, pp. 55, 56)

Although some strategies have led to talented leadership, little positive change in this area has occurred for the majority of our minority status populations.

An analysis of the educational patterns of minorities shows that traditional barriers hinder Blacks, Hispanics and Native Americans from entering the scientific and engineering majors in college. These obstacles have included racial discrimination, inadequate and biased counseling, inadequate mathematics preparation, and lack of role models in science and technology at all educational levels.... these factors limit the career options of minorities and, in instances, confine them to non-scientific jobs. (George, 1980, p. 87)

American Indians, African Americans, Latinas and Latinos do not participate fully nor effectively in most areas of education in this country as compared to European and Asian Americans today. The participation of these three groups in the sciences is especially poor. In 1985, fewer than 65 members of these former groups received doctorates in engineering. Of these, 24 were
African American, 31 Latino and two were American Indians. Minority status 
groups combined represented 20.4% of the population, but only 5% of the science 
and engineering work force (George, 1989). Thus, we have a pair of well aligned 
needs: a nation in search of scientists and technicians, and a population of 
minorities in search of education.

As Bechtel and Pearson (1989) and other scholars have pointed out, the 
institutions of science, like the rest of society, reflect white male dominance. 
Unless more of the under-represented groups are in all our institutions studying 
the sciences, our nation's ability to prosper and grow productively will be 
seriously undermined. In spite of the evidence that young white females and 
minority status students report finding the sciences interesting and want to learn 
more, they do not seek them as career options as readily as white males (Kahle, 
1979; Matyas, 1991).

The situation of each ethnic group is quite distinct. In 1987, American 
Indians represented .6% of the national population and were .5% of the scientific 
work force (O'Brien, 1993); this sounds encouraging, but it may not be true.

Currently available data on native Americans, however, 
should be viewed with caution since sample sizes for 
native Americans are small, and statistical reliability is 
thus lower for data on this racial group. Additionally, 
data based on an individual's perceptions of his or her 
native American heritage; such heritage may change over 
time. (NSF, p. viii)

In 1987, African Americans represented 12.5% of the general population, 
but only 2% of the employed scientists and engineers. Latinos, the fastest 
growing minority, were 9% of the population but only 2% of the scientific and
engineering work force. White women, 43% of the population, were only 10% of employed scientists and engineers.

People with disabilities are the largest official minority status group in the U.S. work force with 22 million citizens of working age, but only 7.2 million are employed. The NSF reported in 1986, "about 94,200 scientists and engineers—2% of the total—reported physical disability" (NSF, 1990, p. ix). In 1989 white women, Americans Indians, and African Americans accounted for 64.5% of the total population but only 14.5% of the employed scientists and engineers.

Starting early is one of the major strategies that has been identified by educators for improving the participation of people of color and women in the sciences and technical fields. Well-trained teachers at the early stages of a student's schooling are essential if students are to be prepared for contributing and living productively in the Twenty-first century. Studies suggest that effective teaching in these areas must occur before the students enter high school.

Most of the nation's people of color and women have been the least successful in the science arena, it is clear that most teachers will need more effective methods, strategies, and techniques made available to them as they encourage more people to enter in and profit from an ever increasing science and technological world. They will need to understand and provide for students with diverse backgrounds and needs. Teacher training must include awareness of different learning abilities and teaching styles, the effects of stereotyping and the self-fulfilling prophecy, and how their expectations help or hinder children's progress.
Purpose of the Study

The purpose of this research was to examine the effects of an ethnic awareness workshop on educators' sensitivity to attitudes and behaviors that encourage or discourage minority status children from considering science as a career. A questionnaire was utilized to examine attitudes and behaviors of participants. The intent was to determine if an ethnicity workshop could be an effective tool in helping educators adopt attitudes and behaviors that encourage participation of minority status children in science careers.

The independent variable was "having experienced" or "not having experienced" a workshop entitled "Kindergarten Through Third Grade Science Activity-Based Workshop; Emphasizing Ethnicity and Gender." The workshop provided classroom-tested activities, techniques, and materials for kindergarten through third grade (K-3) educators to use in teaching science. The workshop included activities and discussions of gender and ethnicity, with a particular emphasis on behaviors and attitudes of school personnel that encourage or discourage people of color and white females from participating in the science arena as fully as white males. The dependent variable was the subjects' attitudes and behaviors exhibited when teaching science.

Research Question and Null Hypothesis

The major research question and subsequent hypothesis was investigated by the use of a treatment and a control group. The control was assumed to be an unbiased sample of the population and representative of all K-3 science focused teachers.
The data focus of this research were the pretest-posttest change scores of the treatment and control groups. This is reflected in the research question for this study. The availability of related data is the basis for ancillary research questions. Ancillary questions are focused on data from other science/ethnicity workshops. The researcher is aware of the limited validity, reliability, and useability of the ancillary results because of the lack of control groups. A second ancillary data focus was the written evaluation of materials from all 1992 ethnicity workshops.

Are there differences between the pretest-posttest change scores on the Science and Ethnicity Teacher Attitude and Behavior Survey (SETAB) of those who participated in a science workshop that emphasized science/ethnicity and those who participated in workshops that dealt only with science?

H₀: There are no significant differences between the pretest-posttest change scores on the Science and Ethnicity Teacher Attitudes and Behavior Survey (SETAB) for those who participated in a science/ethnicity workshop and those who participated only in a science workshop.

Ancillary Question and Null Hypothesis
1. Are there differences between the pre and post scores on the SETAB survey for educators participating in science ethnicity awareness workshops for the years 1989, 1992, 1993, and 1992 control group.
There will be a larger positive change by those participants with a component on ethnicity versus those participants without ethnicity in the workshop of their behaviors and attitudes when dealing with ethnicity in all years in the teaching of science by the participants after taking an ethnicity and science awareness workshop.

H₀: There are no significant differences between the pretest and posttest SETAB scores for those participating in science ethnicity workshops for the years 1989, 1992, and 1993.

Limitations

The confounding of variables is a possible limitation. The participants may have been exposed to outside experiences between the time the two questionnaires were administered. During this time the participants could have acquired additional experiences and knowledge from other sources. A teacher may have been exposed to the local or national media in the form of newspapers, magazines, or radio programs that gave special attention to some areas discussed up in the workshop. Exposure to a pretest could be a factor in predisposing the participants to the issues introduced in the workshop, but having a control group and applying the test of significance will assist assessing this effect.

Definitions

"Language is always changing. It responds to social, economic, and political events and is therefore an important barometer and descriptor of a society at any given point" (Nieto, 1992, p.14). For names of ethnic groups, I have
based my use of descriptive terms on two major principles that Sonia Nieto uses in her book, *Affirming Diversity: The Sociopolitical Context of Multicultural Education* (1992)—what people want to be called and what is the most precise term available. Nieto also points out that not all people will agree on the same term for the same ethnic group.

**African Americans**—people of African heritage in the U.S.

**American Indians, Native Americans**—indigenous people of the Americas

**Asian Americans**—people of Asian heritage.

**Blacks**—people of African heritage.

**Ethnicity**—a population of people who share distinctive cultural and historical traditions. These distinctions are often associated with religion, nationality, or perceived notions of “race.”

**Ethnocentrism**—the belief that one’s ethnic background is the center around which all others are judged.

**European Americans**—people of European heritage.

**Latinas/Latinos, Hispanics**—people of Latin American or Caribbean heritage.

**Minority Status Groups**—refers to people with disabilities, African Americans, Latinas, Latinos, American Indians, and Asian Americans.

**People of Color**—people who are identified as Asians, American Indians, African Americans, Latina and Latino Americans.

**Race**—a social construct that categorizes individuals on the basis of physical characteristics.

**White**—people of European heritage.
CHAPTER II. REVIEW OF LITERATURE

The broad category called "Science" covers a wide area of research and literature, too vast for this review of literature. Even limiting the science area to science education leaves a very large body of literature to review. This study is focused on the educating of school age children. Strongly suggested in the literature is a need for more emphasis on teaching more science before students enter high school. Thus, in this review, particular attention will be paid to science education in the elementary grades.

Noted regularly in the literature is the need for greater representation in the scientific and technical work force of minority status populations: internationals, people with disabilities, women, and people of color (Malcom, 1991; Matyas, 1987). In an attempt to deal with a reasonable part of the minority status populations issues, it was decided to limit this aspect of the study to the most strikingly under-represented minority status groups in the sciences: people of color. Least successful in the educational system are American Indians, African Americans, Latinas and Latinos, who have received the least attention in science education.

The review of the selected literature is divided into three sections. In the first, Minority Status Groups in Science, an overview of the present situation of these minority status groups in science education in the United States is given along with their arguments for increased participation in the sciences fields. In the second section, Minority Status Groups and Social Influences, the literature on problems that discourage the participation of minority status groups is reviewed. Within this section, a special emphasis is placed on the intersection of
"race," class, gender, role models, stereotyping, and the self-fulfilling prophecy. In section three, Factors that Influence Participation, the most frequently cited solutions for encouraging minority status groups participation in science are presented.

In that the focus of the major variable for this study was awareness, attention was not given to numerous other factors that could be influences in minority status students improving their representation in the science area. There are a number of studies that deal with the learning styles and other factors that are present in different ethnic groups. Because this workshop did not focus on those discrete differences in great depth, they are not presented in this review of the literature. Awareness and the effect of awareness were considered the important variables for the study. Thus, the literature section deals with the lack of minority status groups in science, and the assumption is made that the major cause is lack of awareness.

Minorsity Status Groups in Science

The state of minority status groups in science in the United States continues to pose serious problems. Certain segments of this population are especially affected, namely people of color (Matyas, 1991; U.S. Congress, 1989). Aside from the fact they are not being adequately trained for the demands of the Twenty-first century competencies in science and technology, they are not getting the experiences that will help them understand their world and their relationship to it. Many people of color are used as subjects in studies, often against their will and their best interests (Harding, 1993; Washington, 1994). They are not giving input into forming the basic principles, attitudes, and
purposes of science and technology, and its development and use (Black Scholar, 1993; Proctor, 1993). And, at the very least, they are not acquiring the basic skills that could ease the burden of their lives (Harding, 1993) and assist in making decisions in their communities that would benefit everyone.

Many of the same factors that work to deter minority status individuals in the sciences also work against women. Teacher expectations, sex role stereotyping, and lack of positive role models in the educational setting also discourage women from pursuing careers in the sciences (Humphreys, 1980).

In comparing 17 countries, a Columbia University study (Science Achievement in 17 Countries: A Preliminary Report, 1988) found students in the United States were among the lowest achievers in science. Coupled with the NAEP (1986) results, the future looks bleak for this country to compete as a dominant and effective player on the world economic stage, where the standing depends on the knowledge of science and having technological skills. The NAEP attributes this to the failures of the elementary science instruction, especially in the less affluent schools. Unless these conditions change dramatically, today’s (K-3) students will not perform any better in the Twenty-first century than 17-year-olds do now (NAEP, 1983). In other words, these students will be ineffective in future leadership roles (Mullis & Jenkins, 1986). The situation is more extreme for students who arrive in kindergarten without the opportunities enjoyed by the majority population (Rock, 1984). In the sciences, African Americans, Latinas and Latinos are at least four years behind their Anglo high school peers at age 17.

African Americans, American Indians, Latinos, women, and persons with disabilities are under-represented in the areas of science, engineering, and
technology. In 1991, women were 16% of the employed scientists and engineers (NSF, 1990), yet they comprised 45% of the U.S. labor force. African Americans, Latinas, and Latinos comprised 10% and 7%, respectively, of the U.S. employed work force, but each were only 3% of the science and engineering work force (NSF, 1990). African Americans, Latinas, Latinos and American Indians are 20% of the population, yet they “are only 5% of the U.S. professional science and engineering work force, including biologists, chemists, physicists, mathematicians, psychologists, and sociologists” (Matyas, 1987).

The status of American Indians is unclear due to the small samples and reported difficulties of the investigators to verify American Indian heritage. However, their true representation in the scientific and technological work force is believed to be low in comparison to the mainstream population. This conclusion is reached because of the documentation that confirms the belief that American Indians do not fair well in the U.S. educational system and are not likely to do well in an area that seems restricted at this point in time to accommodating over 80% of the mainstream white males.

Definitions of disabilities may vary, but it is clear that such persons suffer a high unemployment rate. In 1990, The Task Force on Persons with Disabilities reported that unemployment was anywhere from 2% to 16%. As Marsh L. Matyas, in Investing in Human Potential (1991), points out, part of the problem is that many potential full time workers with disabilities have little incentive to take full-time work, due to the federal assistance they would lose. In the summary of Matyas' article, Women, Minorities and Persons with Physical Disabilities in Science and Engineering: Contributing Factors and Study Methodology, that
... minorities, women, and persons with physical disabilities often face barriers which the typical, able-bodied White male never encounters. In the difficult and highly competitive area of science and engineering, it is not surprising that these barriers are reflected in the low initial enrollment and persistence rates in science and engineering among these three groups. (p. 23)

Although this paper focuses on ethnic minority status groups, it is important to understand that the poor, where most people of color are positioned, are also seriously denied access to the benefits of the science and technological training resources. A number of studies show that African Americans, Mexican Americans, Puerto Ricans, and American Indians are disproportionately poor and suffer ill effects of poor housing, health, and inadequate schooling. As the disparity between those who have and those who do not becomes more apparent, so will these inequalities impact on the many who do or do not benefit from science education.

Minority Status Groups and Social Influences

*Asians and Pacific Islanders*

Asians and Pacific Islanders have reached a measure of success on the whole, compared to other minority status groups in science education. They are the largest minority status group represented in engineering, the physical and biological sciences, computer science, and mathematics. Still, Asians and Pacific Islanders represented only 2% of the overall U.S. labor force in 1988 (Hu, 1989) and not all sectors of this group were experiencing the 'starry' heights (Suzuki, 1989; Pang, 1990). Generally Asians and Pacific Islanders received a lower share
of science and engineering doctorates as a whole granted to U.S. citizens than their proportion of the population.

Eighty-five to ninety-five percent of the Asian scientists and engineers in the U.S. are either naturalized citizens or foreign nationals. This indicates American Asians and Pacific Islanders of second, third, and fourth generations, who bear the legacy of 130 years of discrimination and social oppression, and who trace their ancestry to poor, immigrant peasants, are probably not over-represented as scientists and engineers.

Asian Americans complain "they are restricted, underpaid, and under promoted, and believe their advancement is blocked by discrimination" (Suzuki, 1989). The education of Asians does not result in as much earning power as the same education does for Whites, nor are native born Asians seen in high management and administrative positions, as compared to their white counterparts. According to Betty Vetter's progress report (1990), *Women in Science and Engineering*, "More than half of all engineering Ph.D. awards from American universities since 1980 have been made to foreign citizens (Vetter, 1990 p. 18)." Foreign Asian women, however, are less frequently represented among Ph.D.s, even in engineering, than American women.

As with the other groups mentioned, the census category includes a diverse set of Asian people (Pang, 1990; Suzuki, 1989). To be understood, their histories, cultures and perspectives should be examined separately and thoughtfully. The newest Asian Americans (the Southeast Asians, such as the Hmong and Mein refugees of the 1970s) are different from the Chinese, Koreans, Japanese, and East Indians. Each of these ethnic groups is different from the
others. They each face different challenges as they try to become part of our society (Li, 1988).

Today the "yellow peril" syndrome, that portrays Asians as inhuman, threatening, hordes, and other anti-Asian sentiments is on the rise as Asians continue to suffer from many of the same devastating effects of discrimination and alienation as do other people of color in the United States (Hamill, 1990; Pang, 1990). Since 1982, when a Chinese American engineer, mistaken for Japanese, was beaten to death by two laid off auto workers in Detroit, the nation has seen an escalation of violence towards Asians (Suzuki, 1989).

The stereotype of Asians as the "Model Minority Student" is dangerous to all students, including Asians. If we have fixed in our minds that Asians are especially good in mathematics and science, then it is easy to think that certain other minority ethnic groups are innately bad in those same areas. Stereotypes also limit Asians to less diverse opportunities. Giving Asian Americans special status in the science arena is a devious trap, disguising a variety of negative issues behind what appears—paternalistically—to be positive. Segregating Asians into the sciences unfairly places expectations on Asians who are not interested in science careers and lowers expectations for other ethnic groups.

The danger of immobilizing people as fixed in their arbitrarily assigned roles cannot be emphasized enough. Other ways of knowing and acting are not allowed to be utilized. If East Asians are stereotyped as science whizzes, American Indians are equally stereotyped as mystical types without a practical grip on moral reality. Americans Indians have tried to show us an alternative relationship with the land that may yet help save our planet (Selin, 1993), by replacing the present model of domination over nature with a first American
value—coexisting with it. Native voices are not heard by the dominant society because the society has set American Indians in a mystified, unrealistic past, and continues to depict them as savage, superstitious, romantic, and backward.

The stereotype of African Americans as athletes and entertainers rather than as scientists and engineers has limited their opportunities in society and also their chances to take full part in science careers and have new and diverse perspectives. If a more satisfying environment for all is to be created, all voices must be heard and all resources pooled.

Not all people in the United States have equal access to the resources that could improve the quality of their lives. The richest communities spend twice as much per pupil than the poorest communities (Howe, 1991). In addition to most people of color, women, who fall into all classes and ethnic groups, are also generally diverted away from the science and engineering fields. In many cases two or all three of these factors reinforce each other. Poor white people, that is, the majority of the poor in this country, and people of color, who are disproportionately at the bottom of the economic ladder, also suffer from a lack of access to the educational structures and institutions that could improve their chances for a decent life.

A perspective that includes awareness of class, race, and gender, and their points of intersection is necessary as the reasons are examined concerning the differences in the participation and success of our ethnically distinct populations in the educational system and the work force (Harding, 1993; Nieto, 1992). It is impossible to talk meaningfully about ethnicity, class, or gender without these issues overlapping. For instance, to talk about the high percentage of foreign-born Asians who receive doctorates in the sciences and not to mention the fact
that Asian women are not well represented is to ignore an important aspect of that situation. In this case, there would be the implication that foreign born Asians as a whole were doing well, when the fact is that foreign born Asian males are doing well, while foreign born Asian women lag behind the men (Leggen, 1987).

The doubly oppressed situation of African American women, who may suffer isolation and the non-support from male peers, while at the same time undergoing excessive scrutiny and criticism, will affect their participation in the sciences in terms of gender as well as race. The lack of economic resources that often accompanies this situation adds the issue of class. Thus, in this case we have an example of all three issues coming together to reinforce each other. Sandra Harding reminds us in the Racial Economy of Science (1993), “Gender, race and class are not parallel and independent social phenomena, but interweaving and mutually constructing ones” (p. 200).

Social class, while not as rigid as the caste system, is in part defined by a person’s economic standing, a status that most people are born into, grow up in, and stay in for the rest of their lives. A person born into a low economic position in the society will have limited opportunities (Bowles & Gintis, 1976). They will most likely grow up in a neighborhood that will be unable to provide a school environment that is fully supportive of high academic aims. If politicians do not see science as a priority, as is commonly the case for the under-funded schools in poor communities, their schools will be ill-equipped in staffing and laboratories. Science will be made to seem irrelevant to the lives of the students. In 36 Children, Herbert Kohl (1967) illustrates the point. The science materials in the poor Harlem school where he taught, were hidden from the teachers and the
children because the administration was convinced that the students were not capable of using and appreciating such equipment. It is probably a safe assumption that this was not the case in the schools attended by the administrators' own children in the more affluent communities.

In Jonathan Kozol's book that exposes the disparities in America's school system, _Savage Inequality_, (1992), one of the science laboratories at an East Saint Louis High School is described, as 30 to 40 years outdated, lacking running water, no lab tables, few microscopes, and almost no chemical supplies. This is ironic, as Kozol mentions that East Saint Louis is a city that is polluted by the chemical plants of the area. For the most part, the curriculum is taught with outdated texts. And, in twenty-three years, according to an interview with a biology teacher, only two students from that school ever graduated from Massachusetts Institute of Technology. The physics teacher (who has been teaching physics in the same school for 40 years) reported: "The heating system never worked correctly. Days when it's zero outside it will be 100 Fahrenheit within this room. . . . I have no storage space. Those balance scales are trash" (pp. 27, 28).

As far as the science education provided for most of our inner city schools, where most of the children of color go today, it would seem that there are few differences between the school of Kohl's 36 _Children_ in the '60s and the schools described in Kozol's _Savage Inequality_ of the '90s. In both cases, science is not seen as a necessity for children of color. In other words, over the 30 years that educators have been expressing concern for better educated students in science, the target audience for effective science education curriculums in the schools has not been for people outside the upper and
middle classes. The descriptions only seem to point to a decline in opportunities for the disenfranchised of our nation's children.

The kinds of sports, toys, and hobbies children engage in while they are growing up, are determined by class. Not many poor households will be equipped with a computer, though it is clear that familiarities with computers is increasingly necessary for gaining essential computational skills. In a poor neighborhood, it is more likely to have role models pursuing sports, than using technological tools or being role models to encourage their use. In impoverished communities, by class definition, there are few people with the technologically sophisticated training or jobs necessary to stimulate school-aged children in recognizing how computer training will benefit their lives—or encouraging their families to make the monetary sacrifice necessary to get the computer (Anderson, 1989).

Factors that Influence Participation

If the factors militating against some groups developing an interest in science are relatively well established, so, too, are those factors in the educational system that retard their success when they do come into contact with science education. Tracking, mathematics training, role models, and the self-fulfilling prophecy are all significant. In looking at the literature, these are the factors that contribute to the success or failure of children taking an interest in, or pursuing science, as an obtainable career (Adler, 1992; Anderson, 1989; Barquet; 1992, Shipman 1976).
Tracking

The tracking of students in the elementary grades, that eventually leads to further tracking when they reach junior high and high school, has a profound impact on the direction of educational careers (Bates, 1992; Oates 1988). Tracking tends to place students together early where they will see the same set of peers and be taught a single curriculum by the same methods and teachers. This placement continues throughout their school careers. As long as we have non-science and low-science tracks, potential students will be channeled away from science. Tracking prepares students for particular types of careers.

A science career demands the student be in a science track. But access to a science track is not likely for many of the already under-represented groups. The systematic placement of African Americans into remedial classes and vocational tracks has contributed directly to their declining achievements in science. Students not exposed to upper level materials cannot compete on the same level as those who have been (McDonald et al, 1990; Daniels et al, 1990; Oates, 1990). Lower level courses stress textbooks, board work, and testing while offering less-stimulating projects and fewer hands-on activities (Davis, 1989).

In Tracking Perpetuates the Class System in the United States of America (1992), Norma Barquet, director for National Origin Equity, points out that lower tracked students are expected to perform at the lower end “of Bloom's taxonomy: knowledge, comprehension and application... the learning of mathematics, for instance, is reduced to activities that require basic computation and memorization of arithmetic facts” (p. 5). The tasks that demand higher level critical thinking skills are reserved for higher level tracked student. The majority of the students on our fast tracks come from the upper socio-economic
classes (Oates, 1985; Oates, 1988). If a lower track lacks a high potential science component at the beginning, the students in this track are not likely to get a chance later.

Tracking of students begins with assessment of the student's linguistic abilities (Adler, 1992), which, in general, means student's skills in standard middle class English. Latinos, American Indians, and African Americans, who mostly come to their first classrooms linguistically distinct from standard American English speakers, are often assigned special classroom placements due to an initial assessment that devalues non-standard English and language other than Standard American English (Harvard Education Letter, 1991) as if it were an indication of defective language skills and does not recognize the positive linguistic abilities that most children of color and poor whites may bring to the classroom.

Educators need to understand the important variety of roles that language plays in student learning. In the case of many Latinos, the Spanish language influences the self-determination, identity, and integrity of their lives before school and outside school (Plata, 1988). The paradox, according to Masimino Plata, is that inside the world of education, "Spanish is not the language used for interacting with the school, socializing with peers in dominant culture or school authorities." Unless schools value the primary language of their student personality formation, the learner will not be able to function as effectively in the second language of their education. Latinos are over-represented in remedial tracks and under-represented in gifted programs (Hyland, 1989). Their experience is emblematic of that found among African Americans and American
Indians and not only those whose first language is not English, but also those whose English is not middle class or standard.

Judith Greenbaum, points out in *Special Education: Changing System* (1992) "Special education classes are, for all intents and purposes, low-level tracks" (p. 18). People of color are disproportionately placed in special education classes for learning, and/or behavioral disorders. The reverse is true for their placement in classes for the gifted. Given that science has a mystique of being difficult and demanding, it does not seem likely that the students will be recommended for special projects in science, even when such are available.

There is no good reason to continue the counter productive strategy of tracking for remediating learning problems, when it is clear that tracking does not work in helping children to be successful learners (Friere, 1974), but rather serves to continue ego defeating divisions and the status quo (Oates, 1985). When something does not work, why not eliminate it. Tracking should be eliminated in our nation's schools and in society (Finn & Ravitch, 1988; Friere, 1974). Economics may predict that children born into impoverished neighborhoods will be tracked for life into dead end occupations and unemployment. But, there is no reason why our educational system must enforce this prediction by tracking children as the “yellow bird” people on the lowest level of instruction, even before they get an opportunity to develop.

**Mathematics**

Mathematics, which relies on logic and teaches creativity, plays a central role in modern culture. Most important, an understanding of mathematics is required for scientific literacy (Anderson 1989; Rutherford & Ahlgren, 1990). A
strong background in mathematics is essential for a career in science, but few minorities are encouraged to take undergraduate courses required for entry into a science program. In the literature on science careers, a rigorous preparation in mathematics throughout any science training is stressed. Confidence in mathematics is one of the major factors determining choice of science as a career (Betchel, 1989).

"In the ‘tracked’ schools of America, algebra acts as a switching station" (Linn, 1992, p. 23). To be on the fast track, algebra is the math course necessary; it is the gate-keeping course. Unfortunately people of color and women are regularly lead not to take the necessary mathematics courses in high school to give them this background to compete in the college science and mathematics courses.

**Role Models**

Most teachers of minority status students are culturally distinct from their students and know little about their lives or backgrounds. The most effective teachers, however, are those who respect and appreciate their students and their student's cultures and welcome the diversity it brings to their classroom. This does not mean they must be of the same culture or ethnicity as their students, but it does mean they must know and appreciate the diverse perspectives their students bring to their schools.

Students also need to see themselves reflected among the people they perceive to be their leaders. If no one in their school's hierarchy—no teacher or major administrator looks like them or belongs to their ethnic or gender group, it will be difficult for them to see the possibilities of success or leadership for
themselves. They need role models to point to whom they can be and whom they are allowed to be. If they have no contact with people with whom they can identify directly, they are being taught they should not aspire to those positions (Tartakov, 1991).

According to Albert Bandura (1986), self-efficacy is the way people judge their personal capabilities. These judgments will vary depending upon the activities pursued. The extent to which people judge themselves to be capable is important. It determines how much effort a person will put forth in completing a particular task. Individuals judge their capabilities as they relate to what they can see of their successful completion of the specific tasks at hand (Bandura, 1986).

Bandura's studies show that vicarious experiences are one of the four ways people gain knowledge about themselves. Of the four—performance attainments, vicarious experiences, verbal persuasion, and physiological states—performance attainments and vicarious experience are the two most powerful and effective self-evaluative experiences. Individuals who see or visualize others master comparable activities can be persuaded to become successful at those activities also. Perceived self-efficacy can be changed by relevant modeling influences (Bandura, Adams, Hardy & Howells, 1980). The converse of this scenario is also possible. It follows then, if people of color and white women see or know of scientists who are also like themselves, they will begin to believe more strongly that it might be possible for them to become scientists as well. As part of the American legacy, there are too few science role models for people of color or white females to relate to in the schools. We need to work hard to
develop more science educators from all ethnic backgrounds in order to overcome this negative legacy.

Expectations, the Self-fulfilling Prophecy

One of the strongest reasons that people of color and white females turn their attention away from the sciences is that most teachers do nothing to draw them in. The general perception held by educators seems to be that minorities and women are not as capable in the area of science as white males. These stereotypes and misperceptions do great damage to student's academic self-esteem, and destroy potential as scholars and scientists (Office of Technology Assessment, 1986). This is, of course, a general perception extending far beyond the schools.

Other sources of social learning are provided by a variety of symbolic modeling

... by television, films, and other visual media. The advent of television has greatly expanded the range of models available to people...both children and adults acquire attitudes, thought patterns, emotional bents and new styles of conduct through symbolic modeling.

Bandura, 1986 (p. 70)

In addition to the media, toy manufactures, parents, and peers all conspire to hold students back from advancing in the science arena. Books, movies, magazines, and television all portray stereotypical images of who is, and therefore should be, a scientist, an athlete, a college professor, a doctor, or a sales clerk. Many have observed that toys dealing with science or engineering activities, such as chemistry sets, erector sets and toy trains, are usually found in
the boy's section of the toy store. This is opposed to the nurse kits and dolls that are found in the girl's section. Rarely is a person of color seen on the cover of a science toy. Even the colors used in products are defined with pinks and pastels for girls and the stronger blues, reds, and yellows for boys. This packaging helps to perpetuate the stereotypes about who should and who should not pick what toys. These practices predispose students' perceptions from an early age by indicating who should engage in what activities (Berryman, 1985). Dwanne Tracy, in the *Journal of Research in Science Teaching* (1990) reported a study that “suggests that sex-role typed play behavior, i.e., . . . the tendency for girls to play with one set of toys, while boys play with another, may contribute to development of sex-typed spatial abilities” (p. 638).

The expectations of parents, relatives, and friends also play an important role in influencing young people as to whether or not to enter the science fields (Lemkau, 1983; Manis et al, 1989; Mullis & Jenkins, 1988). Many parents have learned little about what scientists are and what they do. So, often parents can discourage their children from being interested in science simply because they do not have enough understandings to help their children develop their mathematics (Toliver, 1993) and science interests and skills. Parent education is a mediator of minority participation in mathematics and science. First generation college graduates are more likely to go into education than science. Most college students of color are first generation students.
Interventions

It is important that we deal with what is occurring in our schools, but a paradigm shift and move from the schools to a more societal focus must be made.

The best answer to the question, "What must be done to encourage the under-represented groups to move into the science arena?" is another question: What interventions are necessary to break down the barriers that prevent under-represented student groups from fully participating? One suggestion would be to look in the direction of the programs already documented to see what successful interventions already exist. Although learning more about the factors inhibiting minority involvement are ongoing, a great deal of effective research has already been done.

The wider culture beyond the school affects our attempts to make significant change. A well designed program can make a difference (Office of Technological Assessment, 1986). Following are the strategies commonly cited by researchers in science education.

Start Early

Starting early to encourage young people to take an interest in science and mathematics is important (Matyas, 1991). The problem is not one of students failing to take an interest because interest is there (Matyas, 1991; Kahle 1979). The problem lies in our societal prevention of those students developing their natural interests. Children who engage in classroom and extra curricular activities and programs that focus on science and mathematics develop and strengthen their interests in the area through familiarity (Mullis & Jenkins,
The language used to describe science and mathematics experiences provides students with practice in manipulating the tools of the trade. Just as young males take an early interest in manipulating toy trucks, trains, and cars and are generally encouraged to put things together and take them apart, young females are encouraged to play house, tend babies, thus avoiding mechanics and the sciences.

People of color and females need early opportunities in manipulating the materials and concepts of mathematics and science. This will require more resources made available for these subjects in poorly-equipped schools. Also required will be a curriculum that includes involvement in science fairs and science projects with hands-on experiences that appeal equally to both gender and all ethnicities.

**Provide Science Role models**

Science role models are strong and essential motivators. Students cannot easily decide to become what they do not see as possible (Matyas, 1991). Science role models offer students identifications to link them to career opportunities. They also provide students with access to practical information on how to pursue these careers, even if they are still unusual for their group. These exposures need to start early, before ninth grade, if they are to have a positive effect. One major reason for low participation of Latinos in science education is they actually face different career opportunities and challenges in science education than Anglos. Science instructors may have different expectations of Latinos than they do of Anglos. Often Latinos have different science backgrounds than Anglos. For these reasons, successful Latinos or Latinas will
have the ability to assist students in meeting these challenges. The same goes ostensibly for each distinct group. In a study by Hill, Pettus, & Hedin (1990), one conclusion reached was that for African Americans, a major correlation with success in the sciences was teacher encouragement and personal familiarity with a science specialist.

*Provide Models of Other Institutional Leadership*

In addition to role models in the sciences, students need other leadership role models in their academic setting. As the schools are among the first and most important situations within which individuals see themselves in society, it is imperative these institutions are supportive of societal goals and ideals in a manner that neither shuts out students nor confines them to a marginal class. Curriculum is important, but role models indicative of potential are equally important. Role models give clear indications of who will be allowed to learn and grow into respected citizens (Tartakov, 1991).

In general, the role models presented in our nation’s schools today are limited and in ways damaging to the image of people of color. By the end of this decade, a third of the population will be people of color (Hodgkinson, 1985). The majority of our teachers, however, will be of European descent. More significantly, the percentage of teachers, principals, and administrators of color are diminishing. Predictions reported by Jordon Irvine (1988) indicated that by 1990, minority teachers would comprise only 5% of the teaching work force. This is a significant drop from 1971, when black teachers alone represented 8% of the nation’s teachers.
It is not only people of color and other under-appreciated groups in our society who are forming expectations of success and finding out who can be successful, white children are watching and listening, too. They are learning who has the power and will lead, who makes the rules, who is respected, and who will succeed. If we are to be taught equity and parity, then all children need to see diverse models in their institutions. If Whites are depicted in our schools as superior, the myth of that superiority will grow and develop into a self-fulfilling prophecy. Everyone internalizes racism regardless of their ethnicity.

*Project High Expectations*

Today, people of color see few scientists in history who resemble themselves. American Indians, African Americans, and Latinos rarely have the dream that helped Mae Jemison, the first African American woman astronaut, to soar above the clouds. It is very true as she said at an address she made at Iowa State University in April of 1994, "Failure to recognize the possibilities is the most dangerous and common mistake one can make. Don't limit yourself because of others limited imagination."

The despair that members of the underclass experience is a result of what Langston Hughes questions in his poem, *Harlem*, on a dream deferred (Hughes, 1990, p. 268).

What happens to a dream deferred?

Does it dry up
like a raisin in the sun.
Or fester like a sore—
and then run?
Does it stink like rotten meat?
or crust and sugar over—
like a syrupy sweet?

Maybe it just sags
like a heavy load?

_Or does it explode?_

In the case of the sciences, not many Americans Indians, African Americans, Latinas or Latinos ever have the dream. Too often children of color internalize society's negative images of themselves. Once they have internalized this perception of their limitations, they become enemies of their own progress. The powerful effects of expectations of others on our behaviors have been documented by many researchers (Bandura, 1986; Rosenthal & Jacobson, 1968; Sears & Sherman, 1964; Shipman, 1976).

A challenge for educators is understanding the role of self-esteem developed in the school and how it influences children's ability to succeed in school. Pauline Sears and Vivian Sherman, _In Pursuit of Self-Esteem: A Case Study of Eight Elementary School Children_ (1964), defined self-esteem

... as possession of a favorable opinion of self, or a favorable (self-concept) in the child, judgments about self are made in relation to problems and tasks of development. The self-concept represents expected success in the child's endeavor to meet these problems and tasks. (p. 10)

Over a period of two years, eight fifth and sixth grade children's behaviors were studied. It was found that, first and foremost, the children's feelings about themselves depended on behaviors of their dedicated teachers.
According to Nathaniel Branden (1969), one of the most basic aspects of self-esteem is the will to learn. As long as a child does not give up on the willingness to try new learning, self-esteem will remain intact. He emphasized that productive achievement is a consequence and an expression of healthy self-esteem, not its cause. The cause of authentic self-esteem, is psycho-epistemological: the rational, reality-directed character of a mind’s thinking process. The causal sequence is as follows: a rational psycho-epistemology leads to the attainment of self-esteem; the two together lead (under normal conditions) to achievements; achievements lead to pride. Metaphysical efficacy leads to particularized efficacy. (p. 123)

The effect of teachers’ expectations on their students can have positive or negative consequences (McCormick, 1994). Virginia Shipman and others conducted a six-year study of children from low income homes and investigated the influence of home and school on the development of the children. They found despite the fact that children enter school with the same average in self-esteem regardless of socio-economic background, after three years a significant drop in the self-esteem can be measured among the children from the low-income homes as compared to middle class homes. The implications are that teachers who have low expectations for children will have an adverse effect on these children’s performance in the classroom (Tiedt & Tiedt, 1986; Shipman, 1976). Certainly the school setting cannot be responsible for all the images children get of themselves, but its role in providing opportunities to develop positive self-images cannot be over estimated. The experiences provided in
school are powerful, contributing factors to a child's later expectations and performance.

**Attention to Teaching and Learning styles**

Teaching styles of instructors often conflict with the learning styles of their students. Many factors influence the way a student will process information. These include culture, gender, class, and ethnicity (Anderson & Adams, 1992; Nieto, 1992). Many scholars have written about the different cognitive, psychology, and anthropology of people who share a common heritage.

Most classrooms operate under a set of mainstream values, orientations, and expectations that are not necessarily those of many of their students. According to Lee Stiff and William Harvey (1988), a negative relationship exists between black children and the mathematics education process. The mainstream western model, characterized by directness, precision, and conciseness has led to an abstractly intellectual mathematical system. There is a dissonance between this and the model in African cultures, that emphasizes manipulation of concrete objects and incorporates verbal and motor skills to communicate mathematical ideas (Stiff & Harvey, 1988).

African Americans are characterized as "field dependent" learners, who approach work in a holistic manner, with a view of the world and themselves in relative terms. American Indians and Latinos have also been described in this manner. Within this model of pedagogy, the value of cooperation is necessary and appreciated (Stiff & Harvey, 1988). Working together and nurturing relationships are important parts of interacting with the material. Teaching styles based on competitive learning are not congruent with cooperative learning.
understood by Pacific Islander children either (Mau, 1990). Field dependent learners will find themselves alienated and isolated when their ways of processing information are not considered.

In the everyday world of scientists, who normally work in teams, our teaching methods contrast with the actual way that science is carried out in society. Scientists who are trained in cooperative learning may indeed be at an advantage. But this advantage will not be capitalized on if students' different cultural styles are not appreciated.

It would be a mistake, however, to place all members of a group together. Many variations occur within every group. There is evidence that suggests human beings are capable of many different independent ways of processing information, and that differences in style may be based on what is valued or normal in a particular person's culture (Guilford, 1959). The implications for the classroom are great. If there are multiple, different sorts of intelligence, as Guilford's study suggests, then teachers need to develop multiple learning environments. In addition, teachers need to know the values, beliefs, and orientations of students to accommodate their needs.

**Societal Level Interventions**

Most intervention programs tend to focus on the problems that lie with the students exclusively and not within the school. Administrators of the programs see the child as needing to be "fixed," and fixing would be going on mainly within the context of the child's response to the school's curriculum. It is as if the students were broken, and the school curriculum was a workshop with which to repair the student—or label the student as "unsuitable." Teachers and
other school personnel are trained to do the fixing, and to see their students as problematic. There is a major flaw in this logic. The problem of bringing more female and minority status students into the sciences is not exclusively or even primarily one of student interest or skill. The center of the problem lies outside the students in school and societal attitudes.

Until now, not enough attention has been given to the wider environment that restricts the access of many ethnic minority status groups to the sciences. The issues of race, class, and gender and the effect they have on a child's ability to be accepted into the mainstream of school need to become a basic part of the discussion. This takes us beyond the child to its relationship with not only teachers but society as a whole. It takes us beyond the classroom into the wider public sphere of society. The ability to change this is the major limit on the ability to attain long lasting, positive changes which will bring us the scientific and technologically-trained people we need. This may be called the Rosy the Riveter paradox. Not until it is decided that our non-traditional genders and ethnic populations are needed in scientific fields will they be allowed to do what they could have done all along—like the World War II's Rosy—(The Institute for Research on Higher Education, 1994).

Science and science education have been developed for conditions that nurture mainly white males best (Harding, 1993; Bechtel & Pearson, 1989). The conditions in place demand parental finances and interests for which only white males of the middle and upper classes have been given the keys. This is true of a number of disciplines: economics, architecture, diplomacy, etc., but is most exaggerated for the sciences and mathematics. If this situation is to change, a climate able to support a more diverse clientele must be developed. So far,
through individual efforts, a few individuals have prospered, but many have not found the conditions capable of sustaining growth. Despite the best efforts they have withered, died, or been stunted and thus prevented from reaching their full potential. No amount of technical expertise or individual effort can succeed with students who must work in the sub zero temperatures of a society that does not want them to succeed.

**Pressure on media and manufacturers**

If more scientists are to be produced from under-represented groups, it must be recognized they are either female, people of color, or from the most economically-deprived classes, or all of these groups. This means that not only their education must be changed, but also society’s attitude toward people of color and women’s involvement in sciences. More science-rich environments are needed for schools which are under-financed and science-impoverished. To accomplish this, teachers must work beyond the classroom. This will require pressure by parents and teacher organizations on the media and toy manufacturers to portray a different balance in whom they project as scientists. Parents and educators have allowed media and manufactures far too much power and control over their children’s lives.

Mexican Americans are paying a high price for Frito-Lay corporation’s caricature of Latinos as dishonest and unsavory, and other ads depicting Latinos as lazy, dirty, and stinky (Martinez, 1968). How can Mexicans be imagined in lab coats or working at a computer if images show them asleep against a wall?

American Indians continue to be humiliated by the use of their names as mascots for ball teams. Before knowing who their senator or representative is,
most children know our nation's capitol has a team of Washington Redskins who play on television. This is a shameful lack of respectful recognition for our nation's first biologists and horticulturists. We've heard talk and seen the wringing of hands about the role of television, movies, and other media on degrading various groups. Change will require an active political strategy by potentially powerful organizations. This requires parents and teachers to reach beyond school yards.

The Florida Orange Juice Board recently dropped radio host, Rush Limbaugh, as their spokesperson due, in part, to the pressure brought by the National Education Association (NEA Juice, 1994). Why was the NEA threatening to boycott a commercial product? Teachers, as a group, had come under attack by Limbaugh and they decided to strike back. They claimed Mr. Limbaugh expounded demeaning ideas about the teaching profession, minorities, and women. Following the NEA's boycott threat, Florida Orange Juice dropped Limbaugh as their half-million-dollar-a-year poster boy. If teachers can act politically in self defense, they can act pro-actively to advance proposals for better education, joining with other organizations who are pro-children and pro-equality. They can work to form a better social consciousness. The fact is, they already speak out on issues such as media's depictions of role models and how we finance our public schools. It is now important to step up this activity to a much higher level. If boycotting offensive materials or striking for better working conditions has been an effective strategy for change, why not strike for fairness in school funding and employ boycotts for better media portrayals?

Educators and parents need to see the wider culture influencing the schools as part of the field in which they are active. Unless they become more
active in the struggle to improve the education for all, the gains we make with individual students or programs will prove illusive dreams that fade, dwindling away—as drops of salve in an ocean of need.

If science is to be raised to greater importance in the school agenda, social activism must be used to raise the issue in the wider public arena, changing the color of science in the Twenty-first century.

Important factors have been presented in this review of literature. These factors will provide the basis for the workshop and the research instrument. It is assumed that people participating in the workshop based on these factors will change attitudes and behaviors. The details of the workshop and questionnaire as well as the hypotheses are presented in the methodology chapter.
CHAPTER III. METHODOLOGY

Introduction

The purpose of this research was to examine the effects of a science ethnicity awareness workshop on the science teaching attitudes and behaviors exhibited by the participants. More specifically, the purpose was to determine whether an ethnicity workshop component could be effective as a tool in helping educators become more sensitive and effective in encouraging minority status groups to participate in science and science careers.

In this chapter the design of the study, the subjects, the workshop goals, objectives activities, the design methods, and the data gathering survey questionnaire are reviewed. Workshop support and the budget presented in the appendix are briefly discussed.

Design of the Study

The research design utilized was quasi-experimental, i.e., non-equivalent Control Group Design and non-random assignment of subjects to groups.

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Non-probability sampling, in this case, Purposive Sampling, was used to pick the subjects from the accessible population. Equal numbers of subjects were matched for similar characteristics and placed in either the control or treatment
group. Considered in the selection were the educator's position, gender, age, grade level, size of school, and ethnicity. This information was obtained from the application forms of the applicants (Part A of questionnaire).

The researcher included as much as possible in the sample selection an equal number of people from K-1-2-3 grade level and support personnel group. Applicants were selected and assigned to Group A, the treatment group, or Group B, the control group. Both groups had 25 participants. Group B participated in an activity-based science workshop that had the exact same science component as the experimental group, but did not include the ethnicity and gender components, i.e., no discussions or activities related to ethnicity and gender of students or of scientists. Both workshops, however, were facilitated by the same science consultants. The two one-week workshops were conducted within a week of each other.

Six months before the workshop was scheduled to take place, permission for conducting the study was requested and obtained from the Human Proposal Committee at Iowa State University.

Subjects

The population considered was kindergarten through third grade teachers and support personnel of administrators, science specialists, and principals of school districts in Iowa who elected to take an activity-based science workshop. The science/ethnicity treatment group of educators was taken from the accessible population of the applicants pool from the Des Moines Public School District, who agreed to participate in a four-day workshop in the summer and a follow-up workshop in the fall. As incentive for attending the workshop, a $200 stipend,
was paid to each participant on completion of the program. University credit registration was available for those who wished to receive one semester hour of credit.

The control sample group consisted of Burlington Educational Agency (AEA-16) educators. These educators had also elected to take a workshop focusing on science in the elementary school. The workshop difference between the control group and the treatment group was the ethnicity and gender components not being presented to the control group. The control group's workshop concentrated exclusively on activity-based science education. Because the control group was not scheduled for a follow-up workshop meeting in the fall, the posttest was mailed to the control group participants. Incentives for returning the questionnaire were posters or booklets sent to the respondents after completing and returning the questionnaire. Both the treatment and control workshops had a basic goal—the combining of scientific information with problem-solving skills. In addition to the enhancement of teaching science, the treatment workshops had the additional goal of providing an understanding of the problems and possible solutions for retaining people of color and white women in science.

The Workshops

The Creation and extension of science activities for the existing science curriculum was the vehicle utilized. The participants were provided 1) a model for developing activities, and 2) sources for classroom tested activities, techniques, and materials. A previous Educational Economic Security Act
workshop by the Burlington Educational Agency served as a model for this workshop.

The review of literature in Chapter two supports an approach that focuses on awareness, knowledge and interventions as a viable means of encouraging minority status individuals. Based on the review of literature, the science ethnicity workshop focused on factors that encouraged or discouraged people of color and women in the science arena and highlighted science contributions of diverse individuals and groups which subsequently identified role models for students. The following clarifies the ethnicity aspect by first focusing on daily activities and then focusing on four basic strategies.

Twenty-five educators from the Des Moines Public School District in Iowa, participated in the four-day workshop. These educators interacted with American Indians, Latinas and Latinos, African Americans, gender consultants and science specialists to enhance K-3 educators effectiveness in dealing with ethnicity and science. These presentations included the following titles: "Stereotyping and the Self-fulfilling Prophecy in the American Indian Community," "The Latina/o Community," "The African American in the '90s," and "Gender Considerations in Science." See Appendix E for workshop agendas.

Most of the first day was spent setting the climate for ethnic diversity in science. During the first hour of the workshop, after the pretest questionnaire was administered, the participants examined their own unique heritage and explored how this perspective influenced their attitudes toward themselves and others different from themselves. This activity was designed to stimulate interest in one's own ethnicity and in the background of other ethnic groups. Many experts believe that the key to understanding others' ethnicity and culture
is to understand your own first. Participants were divided into groups of five by their Chinese Zodiac birth sign. The following questions were asked:

1. How far back can you trace your ancestry? When did your parents or ancestors come to this country? Where did they come from? Do you know why they came and under what circumstances?

2. Do you identify with any particular ethnic/cultural/religious groups? If so, which group? Did you grow up in an ethnically distinct neighborhood? Were most of your family’s friends members of a particular group?

3. Did you consider your own background as an important influence in your life? For example, does it influence in any way the friends you choose, the foods you eat, the religious beliefs you have, or the politics you embrace?

4. Have you ever experienced discrimination because of your background?

5. To what degree do you feel that you have assimilated into the so-called “WASP” middle class culture? Give examples.

6. Attempt to “think out” a definition of culture in terms of your own background and experiences.

The second hour of the workshop was spent investigating the social status of women and people of color. The participants were introduced to some specific ways in which behavior and attitudes could affect the student’s learning. The objective was to have participants become familiar with the issues and problems confronting people of color and women in the United States, especially, in terms of their under-representation in the science and technical fields. The key issues presented and discussed were:
1) minority status groups and women in the sciences.
2) role models, historical perspectives, and contributions of minority status groups to science.
3) ethnocentrism, the process of stereotyping and the self-fulfilling prophecy.
4) teaching and learning styles, and
5) diversity of cultural expectations.

During the next section of the workshop, participants were introduced to some specific ways in which their behaviors and attitudes could effect their students. The participants heard this directly from the voices of the individuals from the effected groups. This provided the participants personal exposure to a group perspective with which they may have had little, if any, previous contacts, and one which gave them a personal connection to the people involved.

The first ethnically-distinct group explored was American Indians. A speaker told of the self-fulfilling prophecy and stereotyping experienced. While the speaker's examples applied specifically to American Indians, they were also applicable to other groups. The next speaker, an African American, told about the significance of role models and the importance of the need to include contributions of African Americans in science. The speaker gave examples of specific persons of note and their impact on the American way of life. Latina and Latino speakers stressed the importance of the fundamental Latina and Latino cultural values and how they are influenced by: allocentrism, simpatia, power distance, personal space, time orientation, familialism, gender roles, and religion.
After lunch, a gender specialist gave an hour presentation on females in the sciences. Titled "Short Changin' Girls, Short Changin' Science," the presentation covered the status of women in the scientific and technical fields and the effects of stereotyping and expectations on the success of girls and women in the sciences. Emphasized were the ways females are screened out of taking an interest in and participating in the sciences and technical fields.

During the next two and one half days, the workshop participants experienced several presentations that highlighted the lives of scientists of color and the need for people of color as role models in the sciences. At every opportunity, the program included some aspect of interplay of science and culture. As much as possible, the meals were ethnically distinct from mainstream American meals. The meal period also included performances by ethnically diverse groups.

At the first meal, Latina dancers performed while a historical explanation of the dances and costumes was given by the Latino consultants. On the second day, American Indian creation stories were told by a dramatist from Iowa State University's Minority Theater Workshop Troupe. On the third day, at the evening banquet, performers from a local theater group, The Langston Hughes Players, dramatized the accomplishments of African American scientists and inventors. Earlier, at a noon luncheon, a young man, dressed as George Washington Carver, spoke about the scientist's life, his accomplishments, and thoughts. Excerpts from Carver's letters were both instructive and entertaining. So, too, were the collard greens and sweet potatoes served.

The presenters and performers were available during the day of their presentation and were able to continue interacting with the workshop
participants, and, in many cases, to set-up additional times to either talk or arrange future visits to their schools. They became immediate resources for the schools represented.

The workshop included speakers from the Ames Laboratory, Ames, Iowa. The speakers were interested in helping teachers and their students become familiar with their laboratory facilities and see them as future resources.

Although Asians, on the whole, seem to enjoy more success in the sciences as compared to other minority status groups, little time in the workshop was spent exploring this group. There is growing evidence to suggest that Asians, the fastest growing minority group, are still affected adversely by the stereotyping and expectations placed on them in our society. It is important to be aware that their apparent success in the sciences is not without a price, and not all Asians are successful in the educational setting. They, like the other groups, suffer from discrimination that limits their educational potential. Racism and discrimination are still the major forces which act to keep under-represented groups from enjoying the full benefits of our educational system. These forces need to be recognized and dismantled for any changes to be effective.

Workshop Strategies

*Teacher Strategies, Philosophies, and Concepts*

Teachers can change their behaviors and become more responsive to the needs of their students when they get the information and resources that support their attitudinal change. Once educators recognize the problems and the challenges faced, they are more likely to change their behaviors when reinforced
with appropriate materials. Although just “throwing money” at a problem is not effective in itself, concrete supports can strengthen and aide the process. For instance, providing posters highlighting the accomplishments of minority status scientists give the students, as well as the teacher, information and role models for under-represented groups. Carefully chosen resources can also serve as examples of the types of materials available to use in instruction that would promote equity and diversity in science.

*Importance of Concrete Supports*

Teachers’ needs for concrete examples and tools to implement effective programs are recognized by the project principals. Having the correct attitude is fine but without materials or concrete examples to draw from, the increasing demands and dwindling monetary support undermine educators’ enthusiasm for changing what is familiar.

This project provided both monetary support and materials. The workshop provided a $200 stipend and $50 worth of science materials (of the teacher’s choice to each participant). An additional $50 worth of handouts and ethnically diverse posters were provided. This was to give educators a starting point. Teachers commented several times during the workshop that they felt supported on many levels by the workshop program, the materials, and the consultants.

*Collaboration, Modeling, Demonstration*

A central feature and exciting aspect of the project, noted by the workshop planners, was the exchange of knowledge and appreciation among the
participants for each other's area and the constant collaborating that went on throughout the existence of the project. When the workshop focused on science, ethnicity and gender experts were always on hand to demonstrate how to maximize or incorporate elements of ethnicity and gender. The reverse was also true. The science consultants helped the ethnicity and gender consultants and workshop participants relate perspectives of ethnicity and gender to science.

Workshop participants learned from each other how they could work with topics as they emerged in the discussion. For example, shortly after an estimation exercise (estimating how many seeds in a pumpkin) there was a discussion of pumpkins and the contributions of American Indians in the cultivation and use of many of the foods used in experiments. Although the science consultants might have this information, they might not think of talking about it in the context of a science lesson. This kind of discussion encourages teachers to do this in their classrooms.

Changing Expectations

One main objective of the workshop was to challenge some long-held assumptions about how individuals experience their world. Because world views can be very diverse, learning in science is regarded as an interpretive process. Students learn as a result of interacting in an environment and making sense of the world in which they live. They come to school with a set of already-established cultural experiences. Therefore, it is necessary for science teachers, if they are to be effective, to draw on the children's existing knowledge and views. This seems difficult for most science teachers to do.
Teachers assume that most students, regardless of their backgrounds, look at the world and interpret what they see in the same way. Because children come to school with a set of experiences from which they interpret their worlds and not as a blank slate, they will not experience a phenomenon in the same way—not even a science phenomenon, which is usually thought of as clear cut and precise. Though obvious to some teachers, to many, especially in the sciences, this point is lost. The fact is that people interpret the same phenomenon in different ways.

European Americans and Latina or Latino Americans may interpret what they read about a particular plant in entirely different ways depending on their experiences—if these Latino students come from families of field workers, their interpretations may be different from the suburban students who may see the plant as an esthetic extension of their home or school experiences. Neither view should be seen as wrong. They are both correct. Depending on the experiences of the teacher, however, one or the other may be so unfamiliar to the evaluator that the response is not properly validated.

Teachers need to find as many ways as possible to help students use their already existing knowledge and cultural tools. These include language and cognitive referents which may include personal beliefs, values, and learning styles.

The Questionnaire

The questionnaire was written by the researcher after consultation with experts in the field and an examination of the literature in the field. Five experts evaluated the questionnaire for clarity and conciseness. Suggestions from each
were taken into account and evaluated. In addition, the questionnaire was field-tested in workshops the previous two years before using it with the 1992 subjects. The questionnaire was deemed to provide consistent information.

In the literature, it is suggested that the demographic variables become sorting variables in evaluating the data. A Lickert format response was used with the questionnaire items and placed over a line to imply the variables were continuous and not discrete. The most important factors affecting the participation of minority status groups in the science arena included in the questionnaire were:

1. Teacher expectations
2. Appreciation and respect for diverse cultures
3. Appropriate role models
4. Teaching strategies and techniques

The content of the workshop was designed to address these major areas of concern for educators as they relate to science and minority status groups. The 30-item questionnaire dealt with the areas that were directly addressed in the workshop. With the questionnaire it was inappropriate to consider factor analysis. The sample size was too small for factor analysis.

Assumptions

It was assumed that the participants responded without undue influence from a social desirability factor. In addition, it is assumed that changes between
the first and second response to the questionnaire indicated "real" subject change.

Data Gathering and Analysis

The method of data gathering was a questionnaire that was given immediately before the workshop began on the morning of July 6, 1992, and at the beginning of the follow-up final session near the end of October, 1992. By delaying the administration of the posttest for four months, the workshop participants were given an opportunity to practice and demonstrate possible changes in behaviors in the school setting, including not only attitudes but behaviors.

The questionnaire was administered to all subjects (Group A and Group B) one hour before the workshop began to avoid any contamination. Before administering the questionnaire, the researcher gave an explanation of procedures to be followed for its completion (See instructions in Appendix D).

An explanation of the purpose of the study was provided as were procedures for maintaining anonymity and the assurance that no individual responses would be reported. Finally, participants were informed of the follow-up survey questionnaires to be completed in the fall. Informed consent was implied by the participants' completion of the survey instrument.

The subject's change scores were examined by using a t-test for mean differences, with change scores obtained by subtracting pretest from the posttest for both the 1992 treatment and control groups. Comparison was also made of grouping of the questionnaire items: teacher expectation, appreciation and
respect for diverse cultures, appropriate role models, appropriate teaching strategies and techniques.

Ancillary qualitative analysis procedures were used with the written and final workshop evaluations for treatment group individuals. Since the amount of qualitative data was small, a computer analysis was not done. The approach used was to examine the two most prolific individuals in order to establish possible coding categories. This was followed by analysis of the rest of the responses from the workshop participants.

Ancillary quantitative analysis was also done with two other workshops groups to examine for similarity of patterns with the treatment group of this study. Each of the three treatment groups (1989, 1992, and 1993) were examined using a pretest-posttest means difference t-test for correlated samples.

**Significance of Study**

Research on the effects of ethnicity and gender awareness activities in the sciences is minimal, yet criticisms for spending ever limited resources on programming that remediate an ailing educational curriculum continue. More evidence must be gathered for educators to evaluate these programs so there will be better programs to prepare teachers to work with the increasing diversity of their students.

The problem of under-representation of women and people of color in the sciences will worsen as more students leave an educational system without the skills they need to be successful in the science arena. Studies that address the effectiveness of teacher preparation will add valuable insights into the nature of change. In time, this may have an impact on the other areas of the school’s
curriculum. If the study indicates that teachers' behaviors and attitudes can change in a positive direction when dealing with science and ethnicity, educators may begin to see how they may be limited in other areas of the curriculum. This would eventually leading to their including diverse materials and perspectives into their teaching.
CHAPTER IV. FINDINGS, RESULTS, AND DISCUSSION

The purpose of this research was to examine the effects of an ethnic awareness workshop on the science teaching attitudes and behaviors exhibited by the participants. More specifically, the purpose was to determine whether an ethnicity workshop component could be an effective tool in helping science educators become more sensitive and effective in encouraging minority status groups to participate in the sciences.

This chapter contains the results of the data analysis of the effects of a science/ethnicity activity-based workshop on the behaviors and attitudes of kindergarten through third grade educator's. A brief review of the research procedures and results will be presented in this chapter. The results will first be presented for the main research questions and then ancillary research data will be presented.

Major Research Group Data

Demographic Data

The 1992 science/ethnicity treatment group consisted of 20 kindergarten through third grade Iowa elementary school educators, one administrator, and 19 teachers (Table 1). The educators were primarily from the Des Moines Public School District, and one was from the Ankeny School District. Eighteen were female and two were male. Their ages ranged from 21 to over 60 years. Fifteen (93.8%) of the subjects identified themselves as European Americans, one as an African American, and four did not specify an ethnicity. The researcher,
however, perceived one of the four to be African American and the other three to be European Americans. Six (31.6%) had grown-up and lived in Iowa, exclusively; thirteen (68%) had not grown up in Iowa. The participants had been in the field from one to 36 years. Seven educators reported they had been raised in a multicultural setting and 12 had not. There was a wide ethnic range reported in the percent of minority status students who attended the educators' schools and in their classes, from 2% to 70%. One person (5.9%), reported spending from zero to nine hours on multicultural topics, six others reported more than 50 contact hours, and the rest had taken from one to three credit hours of course work in multicultural education.

The 1992 science/ethnicity control group consisted of 15 female K-3 teachers from the Burlington AEA (Table 1). Fourteen were European Americans; one was American Indian. Eleven of the 14 had always lived in Iowa and 4 had moved here from other areas of the United States. Thirteen (86.7%) were employed in rural school districts and two were employed in urban settings. Their ages were between 26 and 59 and they had been in their present positions from two to 30 years. All but one person reported from under 1% to 5% of their students in the classroom were of ethnic minority status. Seven (46.7%) reported having no children of minority status. The highest was from one person teacher reporting 33% of the children of ethnic minority status. The populations of ethnic minority status children in their schools ranged from 0% to 40%. Two-thirds of the respondents had spent less than 29 hours in courses of multiculturalism.
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Courses Taken in Ethnic/Multicultural

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Ancillary Research Data

The 1989 science/ethnicity treatment group consisted of 17 females and two male educators from six districts in the state of Iowa (Table 2). All 19 teachers reported as European Americans. The group consisted of 16 teachers, two administrators, and one science consultant. Twelve (66.7%) of the teachers had always lived in Iowa, while six had come to live in Iowa from other communities in the United States. Seven of the teachers came from urban areas and the remaining six educators came from rural communities. The teachers were K-3 teachers and the administrator and specialists worked in elementary grades K-6. Seven of the 17 had no ethnically diverse students in their classrooms. Seven others reported having 7% or less. Two respondents had between 15% and 39%. Five had no experience in courses that dealt with multicultural topics, six had less than 29 hours, and two had more than 50 hours.

The 1993 science/ethnicity group consisted of 15 educators who were responsible for students in the elementary grades, K-6 (Table 2). All of the teachers were responsible for students from K-3 grades. Fourteen of the 15 (93.3%) reported themselves as European American. One individual did not report, but was perceived by the researcher as European American. The ages of the subjects ranged from 26 and 60. There were 11 females (73.3%) in attendance and four males (26.7%). Eleven of the participants were teachers (73.3%), three were administrators (20.5%) and one was a science consultant (6.7%). Seven of the schools were located in urban areas (46.7%), and eight (53.3%) in rural communities. Nine of the fifteen had always lived in Iowa (60%), while six (40%) came to live in Iowa from other communities in the United States. Fourteen percent (14.3%) of the educators reported they had from zero to nine
hours of multicultural courses or experiences. Twelve of the 15 (80%) reported they had not been raised in a multicultural setting opposed to the nine (20%) who had been raised in a multicultural setting. Six (40%) of the people reported they had no courses in multiculturalism, seven (46.7%) had one course, and two (13.3) had two courses.

Table 2. Demographic Data 1989 and 1993 Science/ethnicity Groups

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Have Always Lived in Iowa

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School Location

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% of Ethnic Minority Status in Classroom

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Data Analysis

Major Research Null Hypothesis

There are no statistically significant mean change score differences between responses of those who participated in a science/ethnicity workshop and those who participated in a science only workshop.

The data were analyzed by using a t-test for change score mean differences, with change scores obtained by subtracting the pretest from the posttest scores. There were 30 items on the questionnaire; hence 30 instances in which this null hypothesis was examined. Of the 30 t-tests examined for significance, three were found to be statistically significant at the .05 level (Table 3).

Table 3. Significant Change Score Mean Difference 1992

<table>
<thead>
<tr>
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<th>X</th>
<th>SD</th>
<th>t value</th>
<th>Prob</th>
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<tr>
<td></td>
<td>T</td>
<td>C</td>
<td>T</td>
<td>C</td>
</tr>
<tr>
<td>2. Invite science speakers from minority backgrounds</td>
<td>1.2</td>
<td>.40</td>
<td>1.30</td>
<td>.74</td>
</tr>
<tr>
<td>11. Ethnicity, culture and values are part of science curriculum</td>
<td>1.1</td>
<td>.14</td>
<td>1.25</td>
<td>1.09</td>
</tr>
<tr>
<td>17. Minorities have contributed much in science</td>
<td>.45</td>
<td>-.14</td>
<td>.75</td>
<td>.77</td>
</tr>
</tbody>
</table>
The science/ethnicity treatment group significantly increased the use of minority speakers in the area of science more than the control group. Of the other two items, which reflect a knowledge or attitude concerning minority status groups, one indicated a mean score increase for the treatment group. That is, item 11 dealt with ethnicity, culture, and values as being part of a science curriculum. Item 17, minority status group's contributions to science, appears to be influenced by a decrease in the mean chance score for the control group.

Ancillary Research

Ancillary data were obtained from two additional science/ethnicity workshops in 1989 and 1993. The same questionnaire was used with the 1989 and 1992 ethnicity/science groups as was with the 1992 treatment ethnicity/science group. The analysis of these science/ethnicity group workshops did not involve a control group; thus the data are ancillary.

Ancillary questionnaire data for the 1989 and 1993 science and ethnicity workshops were examined by using the t-test for mean differences of correlated samples. The data were examined to determine if an individual pretest score differed from their posttest score. While the results of their test of significance lack a control group comparison, this ancillary analysis can serve as a sign-post when used with other analysis results. The 1992 science/ethnicity treatment group is included to assist with identifying a possible trend between the various years.
Null Hypotheses

There are no statistical mean differences between the pre and posttest responses for those who participated in the science/ethnicity workshops for 1989, 1992, 1993.

The 30 items on the questionnaire gave 30 instances in which this null hypothesis was examined for each year. With the 1989 science/ethnicity workshop participants responses, three items were statistically different (Table 4). Three items are in the area of behavior change and indicate an increase in the use of resources.

Table 4. Significant Mean Differences for the 1989 Science/Ethnicity Workshop

<table>
<thead>
<tr>
<th>Items</th>
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<th>Posttest</th>
<th>t value</th>
<th>Prob</th>
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<tbody>
<tr>
<td>1. Display materials that depict minority status groups in science</td>
<td>2.39</td>
<td>3.06</td>
<td>2.20</td>
<td>.040</td>
</tr>
<tr>
<td>2. Invite science speakers from ethnic minority backgrounds</td>
<td>1.41</td>
<td>2.00</td>
<td>2.79</td>
<td>.010</td>
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<tr>
<td>22. Use community resources to promote minority achievement in science</td>
<td>2.11</td>
<td>2.94</td>
<td>4.12</td>
<td>.001</td>
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</table>

The 1992 science/ethnicity treatment group data has eight items that were statistically significant at the .05 level (Table 5). Seven of the eight items are in the area of doing something different in terms of materials and
classroom behavior. One item (17), learning about the cultures of the students, focuses on the teacher’s attitude.

Table 5. Significant Mean Differences for the 1992 Science/Ethnicity Treatment Group

<table>
<thead>
<tr>
<th>Items</th>
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<th>Pretest</th>
<th>Posttest</th>
<th>t value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
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<td>1. Display materials that depict minority status groups in science</td>
<td>2.75</td>
<td>3.55</td>
<td>2.63</td>
<td>.017</td>
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<tr>
<td>2. Invite science to speakers from ethnic minority backgrounds</td>
<td>1.80</td>
<td>3.00</td>
<td>4.06</td>
<td>.001</td>
<td></td>
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<tr>
<td>6. Enhance my curriculum with resources that promote inclusion</td>
<td>3.15</td>
<td>4.00</td>
<td>3.10</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>11. Ethnicity culture and values are part of science curriculum</td>
<td>3.15</td>
<td>4.25</td>
<td>3.93</td>
<td>.001</td>
<td></td>
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<tr>
<td>15. Learn history, values and cultures of my students</td>
<td>3.65</td>
<td>4.25</td>
<td>2.35</td>
<td>.030</td>
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<td>17. Minority have contributed much in science</td>
<td>4.20</td>
<td>4.65</td>
<td>2.65</td>
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<td>19. There are chances to teach cultural values in sciences</td>
<td>3.55</td>
<td>4.25</td>
<td>2.33</td>
<td>.031</td>
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<tr>
<td>22. Use community resources to promote minority achievement</td>
<td>2.55</td>
<td>3.40</td>
<td>3.10</td>
<td>.006</td>
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</table>

The 1993 science/ethnicity workshop participants data have 11 items that were significant at the .05 level (Table 6). Five of the significant items are directly related to curriculum activities. These are display visual materials (1), use resources to promote minority inclusion (6), curriculum encourages
participation (9), community resources to promoted minority achievement (22),
and strategies and techniques to encourage participation (24). Three significant

Table 6. Significant Mean Differences for the 1993 Science/Ethnicity Participants

<table>
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<th>t value</th>
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<td>2.33</td>
<td>3.73</td>
<td>5.50</td>
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<td>6. Enhance my curriculum with resources that promote inclusion</td>
<td>3.06</td>
<td>3.86</td>
<td>2.35</td>
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<td>7. Cultural values are an issue with my students</td>
<td>2.66</td>
<td>3.46</td>
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<td>8. Have same expectations for all my students in science</td>
<td>4.40</td>
<td>4.80</td>
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<td>9. My curriculum encourages using participation of all students</td>
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<td>10. Need to understand own culture</td>
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<td>4.66</td>
<td>3.39</td>
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<td>16. Aware of contribution of minorities</td>
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<td>17. Minorities have contributed much in sciences</td>
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<tr>
<td>22. Use community resources to promote minority achievements use</td>
<td>2.33</td>
<td>3.06</td>
<td>2.58</td>
<td>.022</td>
</tr>
<tr>
<td>24. Variety of strategies and techniques</td>
<td>3.73</td>
<td>4.60</td>
<td>2.58</td>
<td>.022</td>
</tr>
</tbody>
</table>
items reflect the instructor's knowledge or attitude. These are: understanding own background (10), aware of minorities contributions (16), and minorities have contributed (17). The remaining two items, cultural values of students (7), and some expectations for all (8), focus on student characteristics.

The 1992 ethnicity control group data has one item that was statistically significant at the .05 level. "I enhance my curriculum by using the resources that promote the inclusion of minority participation in the sciences" (Table 7).

Table 7. Significant Mean Differences for the 1992 Science/Ethnicity Control Group

<table>
<thead>
<tr>
<th>Items</th>
<th>X</th>
<th>Pretest</th>
<th>Posttest</th>
<th>t value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Enhance curriculum by with resources that promote inclusion</td>
<td>1.93</td>
<td>2.93</td>
<td>3.24</td>
<td>.006</td>
<td></td>
</tr>
</tbody>
</table>

Related Ancillary Data

Other data collected were the 1992 science/ethnicity treatment group participants' questionnaires, open-ended oral and written evaluations at the end of each day, and at the end of the workshop. Throughout the workshops, following each day's session, the treatment group participants were asked to give their reactions to what they were experiencing during the workshop. At the follow-up workshop in the fall, four months later, participants were asked to give a written summary of what their perceptions were concerning the overall effectiveness of the workshop. These oral and written evaluations focused on
the participant's thoughts and feelings as they were exposed to new materials and concepts. Participants responses were explored with the following question:

Do the oral and verbal responses from the 1992 science/ethnicity treatment group reflect a fundamental change of the participants attitudes and behaviors of the participants about minority status groups and science?

The explicit question that the respondents reacted to was: "Do you feel that your attitudes and behaviors in the classroom, as they relate to ethnicity and gender, have changed as a result of your participation in the summer workshop?" Next they were asked to explain their answer as fully as possible. The instructions continue: "After you have written your response, please enclose it in the attached self-addressed envelope and mail to me before November 15th. Thank you for participating."

The first step in analyzing the data was the researcher reading through the responses for each group to determine if category groupings could apply. The responses were found to fit into what could apply. The responses were found to fit into what previously had been decided as goals for the workshop. These areas were 1) teacher expectation, 2) appreciation and respect for diverse cultures, 3) appropriate role models, and 4) teaching strategies and techniques. The oral and written responses are presented as results of this analysis and the groupings will be presented under these headings.

Teacher Expectations

The 1992 data revealed that one-third of the respondents believed that their level of awareness or their behavior toward minority status groups had
been changed significantly as a result of their attending the workshop. Items they emphasized on an awareness level were: Awareness of discrimination, and more awareness of their interactions with diverse cultures. In terms of changes, one educator reported teaching methods had changed, and now teaching was directed towards encouraging females and people of color to become more involved in the sciences. This change was directly attributed to the workshop.

Another respondent revealed that more attention is now given to encouraging females to get into areas where they were previously under-represented, in addition to becoming more aware that science needs to be emphasized more for minority status girls and boys. Other reactions dealt with the awareness of ethnicity and gender discrimination, heightened awareness of biases, and the need to promote science professions and women in professional roles. One teacher recognizes that boys of color and girls are often not encouraged to participate in school activities; also mentioned was more awareness of how they were interacting with their class to encourage minority status and female students to become more involved in science.

**Appreciation and Respect for Diverse Cultures**

The largest number of individuals responses fit into this category. Eleven of the fifteen respondents (73%) commented in this area. Many said they had learned a lot about other cultures through reading, had a heightened value of their own culture and the value of other cultures, had focused more on culture, were adapting to “hands on activities” to meet the needs of students, taking more into account when dealing with other cultures, had more insights into diverse perspectives, avoided gender sex-role stereotyping, improved in all areas,
had more understanding of the importance of the issues related to ethnicity and gender, became more aware of things that are not fair, and "picked up on sexist and racist behaviors and shared with others who aren't as aware."

Other written responses that indicated the teacher developed a greater appreciation and respect for diverse cultures are listed below.

- Has made me more aware of how important it is to present each culture and its contributions to the field of science to the class;
- Brought in more books on ethnicity;
- Gained awareness that I thought had, and think it is imperative to be exposed to other cultures;
- Focus on awareness much more;
- More open to the ways other people think;
- Make other children aware of how different cultures react to the same event;
- Trying to keep up with different cultural events that take place in the area; and
- Awareness of own culture makes it easier for respondent to understand responses students make.

Appropriate Role Models

One respondent had a heightened awareness of the need for diverse role models and now provides examples by collecting and ordering materials that are used in everyday projects; uses pictures from ethnically distinct magazines for
A respondent who identified herself as an African American believed the perception of the role of African American's contributions to science has changed.

**Teaching Strategies and Techniques**

Several teachers reported that the experience in the workshop has strengthened their resolve to learn more about their students cultures and they now emphasize and direct their curriculum to include more math and science for girls and minority status children. In addition, they have developed ways to modify teaching and were grateful for the strategies they had developed in the workshop.

One teacher said the belief that "children learn best by doing" was reaffirmed while taking the workshop. This teacher is responding to students when they use sex-role stereotyping. The teaching strategies and materials that were provided to educators while participating in the workshop were a welcome bonus, according to several participants. This was a start for many to add pictures of people of all colors to their classroom setting. One teacher said the workshop had "... changed my teaching for the better" and wrote that now more considerations are taken to meet the needs of teaching children of diverse
backgrounds. The importance of adapting “hands on activities” to meet students' needs was reported. An administrator reported working toward improving awareness of ethnicity and gender in all areas of the school environment, even the playground.

Other Themes

There were some items that did not fit under any of the above four categories, but related more to the workshop, in general, in terms of the interaction process that took place.

The participants in the workshops consistently expressed their gratefulness to the directors and consultants for providing them with resources they could use in their classroom or educational settings. They noted the importance of having examples of resources, and believed these were a key to their success in teaching equity in the sciences.

Another point highlighted was an appreciation of being treated as professionals. The participants felt that the directors and consultants started from the premise that they were competent and, as one person expressed, “open to change.” However, a few did express resentment toward one of the minority status speakers, whom they perceived as “hostile and angry,” when the speaker was providing a discrimination experience to the participants. Some European American respondents felt they would have been more comfortable with someone who was more approachable. The discrimination experience was interpreted to mean that the presenter was hostile, angry, and unapproachable.
CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Study

For more than 30 years, educators have recognized a need to strengthen the science curriculum for all students and extend opportunities in the sciences to a wider circle of society's members by including the now under-represented and under-served minority status populations: people of color, women, and people with disabilities (Anderson, 1989; Berryman, 1985; Mullis & Jenkins, 1986). The evidence of exclusion that these groups face is well documented (Anderson, 1989; Pearson & Betchel, 1989; Harding, 1993; Matyas, 1991). In spite of this recognition and some slight gains, white men and some Asian men continue to maintain a monopoly over the science arena (Leggen, 1987).

The purpose of this research was to examine the effects of a science ethnicity awareness workshop on educators' sensitivity to their attitudes and behaviors toward ethnicity. A questionnaire was developed, pretested, and used to examine the attitudes and behaviors of the participants. The intent was to determine if an ethnicity component addition to a science workshop could be an effective tool in helping educators learn to exhibit attitudes and behaviors that encourage minority status children to participate in science careers. The independent variable was whether or not participants had experienced a workshop entitled “Kindergarten Through Third Grade Science Activity-Based Workshop; Emphasizing Ethnicity and Gender.”

In 1992, Purposive Sampling was used to pick the subjects from the accessible population. The 1992 treatment group and the 1992 control group participated in an activity-based science workshop that had the exact same science
component, but only the treatment group had the ethnicity and gender components. The workshops were conducted within a week of each other.

An ethnicity focused questionnaire with a Lickert-scale format was given twice, immediately before the workshops began and four months later when the elementary schools were in session. Factors affecting the participation of minority status groups in the science arena included in the questionnaire were teacher expectations, appreciation and respect for diverse cultures, appropriate role models, and teaching strategies and techniques. The subject's change scores were examined by using a t-test for mean differences, with change scores obtained by subtracting pretest from the posttest for both treatment and control groups. Ancillary quantitative analysis was also done with two other science ethnicity workshops, 1989 and 1993, to examine for possible similarities to the 1992 treatment group. For each workshop, the subjects' pretest responses were compared to the posttest scores. The workshops were examined using a mean differences test for correlated samples. Additional 1992 science ethnicity ancillary data were examined and consisted of daily and final workshop written evaluations. The analysis procedure consisted of identifying themes and common patterns.

The analysis of the mean differences for the change scores for the 1992 groups produced three significant differences. The ancillary data mean difference analysis produced three significant mean differences for the 1989 science ethnicity group, eight for the 1992 group, and 11 for the 1993 group. The ancillary qualitative analysis for the 1992 science ethnicity treatment group was supportive of subject attitude and behavior changes.
Conclusion

A conclusion that the researcher desires to present as possible goes beyond what is supported by the major research question data. This conclusion is based more on the coupling of two types of ancillary data with the major research hypothesis data. The researcher has concluded that teachers, as represented by this study, are very receptive to the inclusion of ethnicity issues with the teaching of science.

There exists the possibility that two factors may have influenced the subjects' responses to either the pre- or post- questionnaire. With the 1992 science ethnicity workshop, the subjects' desire to participate could have reflected a selection bias. That is, a self selection bias because of the desire to become more knowledgeable, or change behavior relative to ethnicity issues. This possibility was not considered until the ancillary data for the 1992 science ethnicity control group were examined. The one questionnaire item that was significant when examining the 1992 control group pre post mean differences was: “I enhance my curriculum by using the resources that promote the inclusion of minority participation in the sciences.” The posttest mean was significantly higher than the pretest mean. This change, the researcher concluded, most likely was the result of each respondent being told of a forthcoming gift for completing the post questionnaire. The gift mentioned when soliciting completion of the questionnaire “was material and resources that promoted the inclusion of minority participation in science.”

The second factor that may have influenced subject response was the previously mentioned possible self selective bias coupled with a limited scoring format. That is, a predisposition by the 1992 science ethnicity treatment group, to
indicate a high pretest questionnaire response to ethnicity items on the questionnaire, thus leaving little room to indicate a higher response on the posttest questionnaire.

While the researcher feels strongly about these two social desirability influences, concrete support appears to exist for the second conclusion. The ancillary qualitative data collected for the 1992 science ethnicity treatment group were very positive. Not only were they positive about the workshop, but, more importantly, about the profound attitudinal change occurring with each individual. The teachers were not just reporting the provision of more ethnicity materials and information, but also taking the more difficult task of changing one's attitude and taking the difficult task of examining and utilizing their student's ethnicity. These conclusions are heartening when looking in relation to the review of literature in Chapter II.

The demographic data of the science/ethnicity workshops of 1989, 1992, and 1993 show the percentages of people of color among participants below the national population average of 5% (Irving, 1988). Of the 69 educators surveyed, only two were African American and one American Indian. The rest were European American. The sample contained no educators of Asian, Latina or Latino heritage. As the literature revealed, the scientific work force is under-represented in people of color (Matyas, 1987; NSF, 1990) as is the teaching work force in our nation's school system (Irving, 1988; Tartakov, 1991). The Iowa school districts in this study reflected this under-representation of faculty.

In Des Moines, Iowa, where 19 of the 20 1992 Treatment Group workshop participants were employed, the percentages of children of color in the schools were (as seems typical of urban areas in the U.S.) disproportionately lower. Some
classrooms had up to 70% students of color. This supports the suggestion that even in schools where there are high percentages of children of color, there are disproportionately low numbers of faculty who are of color. It means children in these Iowa schools are being exposed to mostly Eurocentric perspectives in the sciences and in the rest of the school's curriculum.

Though all children in the Iowa schools surveyed may benefit from exposure to educators of color, children of color are more particularly adversely affected because they have greater need for the role models necessary for seeing themselves as successful professionals. The lack of modeling (vicarious experiences and verbal persuasion) is the withholding of vital tools necessary for minority status students to develop confidence in their abilities (Bandura, 1986).

This situation is confounded by teachers' lack of knowledge and appreciation of diverse cultural backgrounds. For the students of color in these schools, the loss of self-esteem embodied in seeing no teachers of their own ethnicity insures the negative consequences of the self-fulfilling prophecy. For white children in those schools, a parallel lack of esteem for people of color of authority, will be the result. Both need to be given access to diversity. While presence is a problem of ethnic representation, situations in relation to authority or power is a gender problem. The primary level teaching work force is under-represented in males, except in administrative positions, where the power and policy making reside. This deficiency is striking in this sample data. Of the 66 females in the sample only two were administrators.

Though one might suppose this over-representation of females in the teaching work-force could create gender equity in the schools for females, societal influences act to maintain a white male-dominated curriculum model (Pearson
& Betchel, 1989). Both males and females have inherited a legacy demonstrating "White males can become scientists and females can become elementary school teachers." It also says that only 5% of the people of color in this country can become teachers (Irving, 1988) and for the most part, their administrator will be male. Unfortunately, women as well as men carry the message.

Most participants indicated in their written responses that they were made aware of how their past performances in teaching could inhibit females from getting involved in white male-dominated fields. When they started the workshop, many participants believed they were not confident in their ability to be effective in the teaching of sciences. As the workshops progressed, the participants began to see how their schooling had led to their feeling unprepared concerning adequate teaching skills in science.

In spite of the subjects' lack of experiences and exposure to ethnicity and gender issues, the study results indicate that when educators are made aware of influencing factors, they are willing to make the necessary changes required in becoming more inclusive and effective in their teaching. In many ways this is supportive of the results obtained by the Office of Technological Assessment (1986).

Further analysis of qualitative data indicates that the subjects' attitudes and behaviors may change if relevant modeling for change is available and reasons to change are compelling. Bandura and others reached this same conclusion concerning modeling (Bandura, 1988; Bandura, Adams, Hardy, Howells, 1980). By demonstrating and providing materials and techniques, the subjects in this study realized the importance of modeling to themselves and to their students. There also is evidence the teachers were limited by an apparent
lack of female role models for teaching science, as well as ones with multicultural perspectives and experiences.

Most subjects reported having relatively little exposure to experiences that would help them gain perspectives about their students' backgrounds. In the beginning, many saw themselves only as "American," and "White," and not as having an ethnicity, like people of color. This attitude reinforced the notion they are "regular "Americans and those identified as "ethnic" are irregular and outside the mainstream. This perspective could allow them to see their students of color as problems. When educators see students as mainly different, it is likely that this lack of identification with them and their circumstances will have negative outcomes on the students; not being sensitive to their social, emotional and educational needs leads to lack of expectations on the part of the educator (Sears & Sherman, 1964; Shipman, 1976).

After the workshop, many subjects saw value in exploring their own and their students' heritage. The white participants came to realize they were also part of an ethnic group of European Americans who were diverse by being Irish American, Dutch American, German American, French American, English American etc., and in most cases, a mixture of European ethnicities. These realizations allowed them to become open to exploring their heritage, and other people's heritage, and is reflected in the response of an African American. This workshop participant confirmed my belief that everyone, regardless of ethnicity, can benefit from exposure to cultures unfamiliar to them and learn more about their own.

As reported by many of the subjects, lack of awareness seemed to be a central reason for not developing effective strategies and techniques to encourage
under-represented groups in the sciences. Teachers from the 1992 Treatment group reported they were influenced by the experiences in the science/ethnicity workshops. Indeed, some felt they had changed their teaching and learning styles in profound ways. This included feeling they were more appreciative of their own and their students' cultures and wanted to do more to include more voices in their classrooms that reflect our multicultural society.

The change scores suggest that educators were open to using ethnicity materials and other resources, when made aware they were important. That was strongly supported by the control group's responses on "I enhance my curriculum by using the resources that promote the inclusion of minority participation in the sciences." The workshop participants also latched on to materials and resources. This included inviting more people who could speak to their children who were in an under-represented groups in the sciences. Most often mentioned to this researcher was how much participants felt being given appropriate materials and shown how to incorporate these materials into their curriculum helped.

**Recommendations**

A question to explore is how effective can ethnicity intervention programs be in the long run? Are these effects long-lasting? What, if any, administrative or material supports need to be considered for future programs? In addressing the above questions further, it is recommended that follow-up interviews over time be done to assess if these educators who participated in the treatment science/ethnicity workshops still perceive themselves to be effective in the area where there were changes. Also to be assessed would be whether the participants
continued to view their experiences in the summer science ethnicity workshops as a major influence in their coupling ethnicity and science. It would also be interesting to know if there is carryover of the concepts of ethnicity and learning into other areas of the curriculum. In addition, I would recommend that classroom visits be made to determine whether the teachers' self-perceptions about their attitudes and behaviors are consistent. Although the primary school work force is under-represented in teachers of color and under-represented at the elementary school level by males, it would be interesting to see if ethnicity plays a part in how students or teachers respond to training in the multicultural area. The sample was too small and too homogeneous in ethnicity and gender (almost all white females) to make generalizations about the differences between males and females or people of color and white respondents.

Though I suspect that people of color are more sensitive to the inequities in the curriculum as they relate to their specific group, I doubt their knowledge about cultural groups different from their own is much more developed than their mainstream counterparts. In other words, a multicultural approach to the curriculum could benefit all teachers, regardless of their ethnicity, gender, or social class.

Throughout the literature examined, an area that was rarely addressed and yet seems central to developing programs that may have long-lasting impact, was the role of society and its expectations on ethnicity and learning. Though there is a good deal of valuable thinking and effort on the development of multicultural approaches within the school setting, the effectiveness of these approaches, if isolated from the larger society in which all participants spend the majority of their lives, will be unproductive. We need a parallel ethnicity and learning
focus in the larger society. This broader ethnicity and learning concern is a challenge to the schools and their communities to support initiatives, policies, and individuals who work to create a society that values each of its individual members enough to provide the experiences that will allow them to take advantage of the resources that will improve their own and other people’s lives. None of the intervention programs that have been brought forward in this paper will be realized unless the broader underpinnings in our full social structure can support these changes.

As an elementary school teacher for over 23 years, and university instructor of curriculum and instruction for an additional 10 years, it has been my experience that children are receptive to new ways of viewing the world. So are educators. What they want and need are the resources to help them facilitate their learning. Up to now we have largely robbed our teachers of the chance to make a significant increase in our pool of scientifically literate citizens. Elementary schools, like children of color, have been relegated to the “yellow bird” minority status of societies’ professions. Fewer resources are allocated for teachers at those levels; fewer funds for research and training; fewer hours in the day for necessary preparation and planning needed to deliver a quality science program. Expectations for teachers elementary school science programs, and, for the most part, teachers live up to those expectations. When teachers look for pearls of wisdom and talent in their students, and they find one, they are eager to keep looking. Many, like myself, actually live for the days when one is found. In a way, that is the intrinsic reward we seek when working with children.

In many cases, the tools to find the gems have been hidden, just as the science equipment was hidden from Herbert Kohl and his class of 36 Children.
Unlike Kohl, most teachers under similar circumstances find the task so hard that they stop looking. It is imperative that the tools for being effective science teachers be provided. These will be in the form of teacher training, literature, equipment, and time to take advantage of these resources.

Public school teachers must also be involved in the study and research of science education if they are to fully understand their involvement in it. Many elementary schoolteachers are not comfortable with either science or issues of ethnicity; The lack of confidence with science and ethnicity hinders progress for our nation's children, especially our children of color.

On the bases of this study and my experiences as an educator, there is no question in my mind that there is a need for educators to do more to integrate the sciences and other disciples into the curriculum in a more holistic manner. Science needs to be seen as a part of the students' daily lives and seen from multiple perspectives. In this way it would be more connected and relevant to their personal/normal unique experiences. Most science curriculums teach science, and in some cases they address science equity, but these are usually seen as separate activities. It is time for a more integral approach.

Paradoxically, on one level science is attuned to ethnicity. We are beginning to look at the rain forests and to consult the indigenous people of those areas for knowledge of medicinal plants. Some of the things that Western European science has previously considered superstitious and primitive have proved to be effective techniques for treating illnesses. These techniques have been overlooked in the past by modern science because of the ethnocentrism of western thought. The science curriculum needs to recognize the diversity of its source and include for example, such things as Arabic and Indian mathematics.
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Thank you to the rest of my family and friends, whose love, faith and reassurance helped me to see the value of my work. This list of people includes my mother, Marjorie Collins, my first and main role model; my children and their families, the major source of my inspiration, Laura Lyster-Mensh, and sons: Erik Lyster and Michael Tarr; my brothers and their families; Clement Briellard and Toussaint Streat, who have encouraged me and been models for me all my life; my Uncle Kline Wilson, Aunt Helen Wilson, Aunt Early Reed and their children; Aunt Dorothy Streat, Mom Louise Hurdle, Pop Timothy Hurdle; my cousins: Norman Glanville and Francine Howard; my parents (not just in-law), Dena and Lester Tarr, proof that education never ceases.

A special thanks to my wonderful granddaughter, Liana Olympia Lyster-Mensh, who so often offered me wonderful words of wisdom and quite a few chuckles. Her and my granddaughter Carlie Pamela Lyster’s, faces are so often with me as constant reminders of hope for the future.

The following are some special sisters and brothers who have offered direct support and assistance in my work: Irma McClaurin, Brenda Jones, Sidi Tandia, Barbara Weber, Gayle Allen, James Scott, Jacqueline Mitchell, Sandra Barnes, Bassirow Chitou, and Bette Mayes. I am also grateful and indebted to
Beverlyn Lundy Allen, who walked beside me, a true soul sister, as we strove to get to this point; and to my newest support in Ames, Karen Donaldson and her family. A special mention to Gayle Huey and Pat Carlson who made me laugh when there really wasn't anything else to do, but cry.

A very unique aspect of this endeavor for me was the fact that so many of my advisors and colleagues were also my friends. That presented challenges for me as I tried to code switch from student to faculty member and colleague. What I learned is that it wasn't worth the effort. We are all students as well as colleagues.

I have only respect and admiration for five dedicated professionals and the absolute best Ph.D. committee members anyone could wish for: Dominick Pellegrino, who was always there for me as my advisor, mentor, and colleague, who has always treated me as a professional and has offered me insights I will use the rest of my career; Theresa McCormick, a colleague and friend who has shared her insights with me for many years; Mary Sawyer, a long time friend and wise and caring influence, and George Jackson another friend and model of what can be done when one has a vision; Richard Warren, who agreed to stay on my committee after he retired and graciously offered me suggestions without making me feel like a complete lost soul in statistics.

I would like to acknowledge Myrna Whigham, Pat Shier, and Libby Laughlin, who helped create the science workshops that I have been engaged in since 1988. For technical assistance I have received, I thank Tina Marshall-Bradley, George Bradley, Eshu Bumpus, Mark Ingles, Mark Mensh, and the Research Institute for Studies in Education (RISE).
APPENDIX A.

ABSTRACT OF THE GRANT
ABSTRACT

It is recognized as a priority in countering the growing shortage of scientists, engineers, and science teachers in the United States that young minorities and women must first be interested in and then recruited into the technical fields. Various strategies to encourage entry and retention of young minorities and women have focused on the student, parent, and educator. The target audience has ranged from elementary to college age, but most projects have focused on secondary-school age levels.

Because many young people, in general, and young minorities, in particular, are "turned off" to science as early as kindergarten, this project will address the problems by focusing on kindergarten through third grade (K-3) teachers of science in the schools that mainly service ethnically distinct populations of children. Team teachers will be trained in activity-based models that will take into account ethnicity and gender. The project objectives are:

• to create an awareness of classroom interactions that may encourage or discourage students on the basis of their ethnicity and gender
• to provide a resource of activity-based science teaching materials for K-3 teachers
• to provide a model that will permit teachers to develop science activities
• to establish district-wide K-3 support groups

Leadership teams will be trained by participation in a summer training program and a fall workshop; in turn, the teams will train others by conducting similar workshops in their home school district. Ultimately through the multiplier effect this program should reach more than 500 students.

NOTE: If person responsible for grant negotiations is different from person named in Item 1, please identify by name and phone number in this space.

Name: ____________________________
Phone: ____________________________
(area code) (number) (extension)
APPENDIX B.

ADVERTISEMENT FLYER
K-3 Activity-Based Science Workshop
Emphasizing Ethnicity and Gender

Activities

During the workshop participants will

• become familiar with a classroom-tested science activity model that integrates elements from successful programs

• be presented a number of activities that combine science process with problem-solving skills

• participate in activities organized around seasonal themes

• experience life, physical, and earth science activities that can be incorporated into existing textbook programs

• examine current K-3 science resources

• develop a technique for extending and creating science activities

• establish a local support group for teaching science

• be able to return to the classroom with prepared teaching materials

• have the opportunity to "make and take" additional materials

• become aware of factors that encourage or discourage people of color and girls

• become aware of role models and contributions of diverse groups to science

Audience

All K-3 teachers and support personnel interested in learning about and implementing an activity-based model for teaching science with special emphasis on ethnic and gender concerns in the classroom. Where possible, principals are encouraged to send three- or four-member teams, consisting of a K-1 teacher, a grade 2-3 teacher, a support person (lead consultant, principal, etc.), and an additional K-3 teacher. Preference will be given to people registering as a team.

Theme

Providing classroom-tested activities, techniques, and materials for teaching K-3 science, including discussions of ethnic and gender concerns in the classrooms.

Location

King Elementary
1849 Forest Ave.
Des Moines, Iowa

Dates

July 6-9, 1992
A banquet will occur the evening of July 8. A fall follow-up meeting will also be included (date to be set).

Support

A $200 stipend will be paid to each participant on completion of the program. One university credit is available. The workshop is funded by the Education for Economic Security Act (ESSA), Title II, State Board of Regents.

Iowa State University
Activity of Departments of Curriculum and Instruction, College of Education

Planners & Presenters

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Burlington Community Schools
Burlington, Iowa

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Other Presenters

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Counselor
Office of Admissions, ISU
Connie Hargrave
Coordinator of Educational Programs
Ames Lab, ISU

Jaimie Hernandez
Program Advisor and Minority Student Advisor
Office of Minority Affairs, ISU
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APPENDIX C.

REGISTRATION FORM
K-3 Activity-Based Science Workshop
Emphasizing Ethnicity and Gender
July 6-9, 1992
Registration Form

Name_
Home Address
Home Phone_
School Name_
School Address_
School Phone_

Ethnicity (please circle one) European American African American
Hispanic American Native American
Asian American Other
Prefer not to indicate

Are you interested in obtaining one graduate credit (your expense) for this workshop? Yes No

Others wishing to participate from your school: (Each person must register individually. Since preference will be given to those participating as a team, please clip all team members registration forms together if you wish to be considered as a team.)

1. ________________________
   name__position__

2. ________________________
   name__position__

3. ________________________
   name__position__

4. ________________________
   name__position__

In the space below, please provide a statement with your reason for wanting to participate in this workshop.

Send completed form to: Carlie Collins Tarskov, Project Director
N103 Lannon Hall
Department of Curriculum and Instruction
College of Education
Iowa State University
Ames, IA. 50011

Registration Deadline: April 15, 1992
DIRECTIONS: Respond to each item according to the way you feel most accurately describes your behavior and perceptions at the present time. Circle the number that represents your actions/feelings.

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<tr>
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<th>Never</th>
<th>Seldom</th>
<th>Occasionally</th>
<th>Frequently</th>
<th>Always</th>
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</thead>
<tbody>
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<td>1</td>
<td>I display visual materials depicting images of ethnic minorities in Science.</td>
<td></td>
<td></td>
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<td>2</td>
<td>I invite people from ethnic minority backgrounds to speak to my students about science.</td>
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<td>3</td>
<td>I enjoy learning about cultures that are different from my own.</td>
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<td>4</td>
<td>I am aware of the diverse cultural backgrounds of the students in my classroom.</td>
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<td>5</td>
<td>I make it a point to learn the histories of those people that I teach.</td>
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<td>6</td>
<td>I enhance my curriculum by using the resources that promote the inclusion of minority participation in the sciences.</td>
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<tr>
<td>7</td>
<td>Cultural values are an issue with my students.</td>
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<tr>
<td>8</td>
<td>I have the same expectations for achievement in the sciences for all my students.</td>
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<td>9</td>
<td>My curriculum in the sciences encourages the participation of all students.</td>
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<td>10</td>
<td>I need to understand my own background in order to more fully understand and appreciate people who are different.</td>
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<td>11</td>
<td>Ethnicity, culture and values are a part of the science curriculum.</td>
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<td>12</td>
<td>I expect certain ethnic groups to do well in the sciences.</td>
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<td>13</td>
<td>All students have a chance to succeed in the sciences.</td>
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<tr>
<td>14</td>
<td>It is essential that minorities become more a part of the science curriculum.</td>
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<td>15</td>
<td>I make it a point to learn about the histories, values and cultures of the students with whom I come into contact.</td>
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<td>16</td>
<td>I am aware of the many contributions that minorities have made to the field of science and transmit that information to my students.</td>
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<td>17</td>
<td>Minorities have contributed much in the area of science.</td>
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<td>18</td>
<td>I encourage some ethnic groups to work hard in the science area.</td>
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<td>19</td>
<td>There are chances to teach cultural values in the sciences.</td>
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</table>
| 20| I change my teaching styles in order to meet the learning styles of my students.
21. I have explored my own unique cultural background.

22. I use the resources that my community offers me to promote minority achievement in the sciences.

23. I feel that some ethnic groups have the ability to perform at higher levels in the sciences than others.

24. I use a variety of strategies and techniques that create interactions that encourage participation in the sciences.

25. I use field trips to different communities to highlight minority achievement.

26. My expectations of students influence their status in our society.

27. Ethnicity influences one's ability to succeed in the sciences.

28. The ethnic backgrounds of people in our society are a valuable asset to the fabric of our nation.

29. It is important for my students to know about the diverse populations of people in our society.

30. I treat my students alike.
1. Age:  
   ____ 21-25 yrs.  ____ 26-30 yrs.  ____ 31-35 yrs.  ____ 36-40 yrs.  
   ____ 41-45 yrs.  ____ 46-50 yrs.  ____ 51-55 yrs.  ____ 56-60 yrs.  
   ____ 60+ yrs.  
2. Female____  Male____  
3. Ethnic background (German American, Mexican American, Irish American,  
   Dutch American, Native American, Other) _____________________________  
4. Have you always lived in Iowa? Yes____  No____  
5. Were you raised in a multicultural setting? Yes____  No____  
6. Teacher____  Administrator____  Other____  
7. Years in present position ______  
8. School Location  
   Urban____  Rural____  Population under__________  
9. Estimate the percentage of ethnic minorities in your:  
   a. school ________  
   b. class ________  
10. State the number of courses taken in ethnic studies or multicultural  
    education ________  
11. Approximate hours you have spent in workshops, seminars or lectures  
    dealing with multicultural topics or issues ________  
12. Grade level(s) you are primarily responsible for ________
APPENDIX E.

WORKSHOP AGENDA
WORKSHOP AGENDA

Timeline and Schedule of Activities

January 1, 1992 - Develop flyers for advertising
January 10, 1992 - Send recruitment materials to cooperating district
April 15, 1992 - Registration deadline
May 1, 1992 - Complete selection of teacher teams
June/July 1992 - 3 1/2 day workshop
November/December 1992 - analyze data and evaluate

Day 1

8:00-8:30 Registration and get acquainted
8:30-9:00 Administrative details
9:00-9:30 Ethnic Awareness Activities
   (Carlie Collins Tartakov)
9:30-10:00 Rationale for Ethnic Considerations in the Classroom
   (Carlie Collins Tartakov)
10:00-10:45 Stereotyping and the Self-fulfilling Prophecy in the Native American Community
   (Irma Wilson-White)
10:45-11:00 Break
11:00-12:00 The Latino American
   (Jeanette Cruz, Jamie Hernandez)
12:00-1:30 Lunch and performance of the Los Baliadores Mestezes
1:30-2:15 The African American Student in the '90's
   (Tina Marshall-Bradley)
2:15-3:15 Gender Considerations
   (Myrna Whigham)
3:15-3:30 Journal Writing
3:30-3:45 Break
3:45-5:15 K-3 Activity Based Science Activities
   (Pat Shier & Libby Laughlin)

A. Overview & Objectives
   1. Explanation of three day structure and participant's roles
   2. Discussion of workshop objective
B. What is Activity Based Science?
   1. Theoretical and experiential background sources
   2. Characteristics
      a. Developing explanations
      b. Student involvement, motivation, success and cooperation
      c. Integration of science process and math problem solving skills
      d. Question types and wait time
      e. Praise vs encouragement; risk taking and creativity
      f. Open-ended vs closure format - why question
Day 2

8:30 - 9:00  Continental Breakfast
9:00 - 9:30  Sharing Day 1 thoughts or concerns and review
            Journal Writing
9:30 - 11:15 C  Activity Pattern - Components
                1. Beginning question (estimation/prediction types)
                2. Engage in real problem situation
                3. Collect and quantify data (count/measure/compute)
                4. Construct table, chart, or graph
                5. Analyze data and generalize (pattern, rule, formula or
                   relationship)
                6. Extend to new situations/questions
11:15 - 11:30  Break
11:30 - 12:30 D  Estimation Activities
                1. Rationale for inclusion into M&S curriculum
                2. Activities; taking steps, from buttons to bottles
E  Graphing Activities
    1. Types/examples: real, pictorial, and symbolic
       Activity: Frequent Handfuls
    2. Questions to ask (analysis and interpretation)
12:30 - 1:30  Lunch and performance by Minority Theatre Workshop of Iowa
1:30 - 4:30  Part II - A Beginning
            A  Seasonal Activities
                1. Fall
                   a. A squashed Pumpkin
                   b. Catch a Falling Leaf
                   c. Better Butter
                2. Winter
                   a. Santa's Sleigh
                   b. Sun Blocking
                   c. So Slow Snow
                3. Spring
                   a. Bean Swell
                   b. Eggstra Explorations (measurements)
                   c. Huff N Puff
4:30 - 5:00  Journal Writing - reactions to Day 2
Sparks - Iowa Academy
Science Teacher Division
Day 3

8:00-9:00 Continental Breakfast
9:00-9:30 Review of journal writing
9:30-10:30 Women's programs in Science and Engineering
10:30-10:50 Connie Hargrave - Resource for Educators at ISU Lab
10:45-11:00 Break
11:00-12:00 Part III - A Topical Framework
   B. Life Science Activities
      a. Are You a Square
      b. How Far Can a Mealworm Crawl
      c. Once Upon a Pea
   C. Physical Science Activities
      a. How Tacky
      b. Fruit Float
      c. Now We're Rolling
   D. Earth Science Activities
      a. Hard As A Rock/Circle Game
      b. Body Saurus
      c. Moon Patterns
12:00-1:00 Lunch and Performance by Minority Theatre Workshop of Iowa State University
1:00-4:30 Part IV - Building Upon the Foundation
   A. Resources - review of elementary science guides and magazines
   B. Introduction to Webbing - Activity: Drops in a Line
      1. What is webbing
      2. Grade level groups select seasonal activity and create a web
      3. Use web to develop a new activity
4:30-5:00 Journal Writing - reactions to Day 3

6:30 Banquet featuring the Langston Hughes Company of Players
      Park Inn

Day 4

8:30-9:00 Continental breakfast
9:00-9:30 Review of Journal Writing
9:30-11:15 C. Make and Take colored glasses and others
   D. Team resources
11:15-12:00 Reactions (Libby Laughlin and Pat Shier)
            Administrative details (Carlie Collins Tartakov)
APPENDIX F.

STATEMENTS OF AGREEMENTS
Iowa State Board of Regents
Dwight D. Eisenhower Mathematics and Science Education Act
Higher Education Grant Program

STATEMENT OF AGREEMENT

Regarding the proposed project:

Ethnicity and Gender in Activity-Based K-3 Science Workshop

We, the undersigned, certify that:

(1) Great River A.E.A. #16 has been cooperatively involved with Iowa State University in the planning of the above titled proposed project as explained below:

A. Incorporation of locally identified instructional needs into the project.
B. Joint determination of the workshop design and target populations.
C. Utilization of local resource persons to serve as project instructors.

(2) The project meets the needs of Great River A.E.A. #16 K-3 teachers for training, retraining, or inservice training of teachers and/or other school personnel as explained below:

A. Title II EESA Needs Assessment and Supplement Assessment for the following areas of need,
   1. Additional background and content for teaching science.
   2. Instruction in the use of science materials.
   3. Response to the results of the NAEP reports in science.

B. G.R.A.E.A. #16 Technological and Educational Needs Assessment for the following instructional and curriculum needs:
   1. Develop appropriate instructional methods to meet student needs.
   2. Selection and use of materials.
   3. Develop new teaching strategies.

C. Past project participants' needs which prior training sessions have identified:
   1. A method of integrating science into other areas of the primary curriculum.
   2. Accessible materials which are classroom ready.
   3. Activities which encourage student participation.

(Continued)
(3) Great River A.E.A. #16 will participate in the execution of the proposed project as explained below:

A. Providing an in-kind contribution of 5 percent of its math/science consultant's contract time.
B. Recruiting participants from LEA's within its boundaries.
C. Providing supplemental funding necessary for past G.R.A.E.A. #16 participants to meet as a support group and to inservice additional teachers within their LEAs.

Agreed to by:

Iowa State University Representative

Typed name, Title ____________________________ Signature, Date ____________________________

Great River A.E.A. Representative

Pat Shier
Elementary Math/Science Consultant

Signature, Date 9/10/91
Iowa State Board of Regents
Dwight D. Eisenhower Mathematics and Science Education Act
Higher Education Grant Program

STATEMENT OF AGREEMENT

Regarding the proposed project:

Activity Based Primary Science Workshop

We, the undersigned, certify that:

(1) Des Moines Public Schools has been cooperatively involved with Iowa State University in the planning of the above titled proposed project as explained below:

This activity-based K-3 grade science workshop was presented at King Elementary School in Des Moines last summer. Teams of elementary teachers from eleven of our forty-two elementary schools participated. Comments from participants were very positive. They found both the ethnic and "hands-on" science components very useful. We would continue to work with Carlie Tartakov and others so that participants from other elementary schools could benefit from the workshop. The objectives of our present program have been reviewed with Carlie. We will continue to confer so that any adjustments necessary will be made to parallel our needs.

(2) The project meets the needs of Des Moines Public Schools for training, retraining, or inservice training of teachers and/or other school personnel as explained below:

There are two major reasons why this workshop is important for the teachers of Des Moines.

Approximately 18% of the student population in Des Moines is minority. There is a need to assure that teachers understand appropriate responses and presentations so that students are not discouraged from science because of their ethnicity or gender. Taking advantage of children's natural curiosity through appropriate instruction at this young age will have an impact on the enthusiasm of science in later years.

Although we introduced an activity-based science program into our elementary schools several years ago, a sizable percentage of elementary teachers are uncomfortable with the program and do not follow the prescribed objectives. We need to continue the efforts toward familiarizing our staff with instruction in activity-based science. We need to provide them with ideas for activities that they can successfully employ in the classroom. The provision for trained teachers to teach other teachers will provide the means to impact a large number of our students.
(3) Des Moines Public Schools will participate in the execution of the proposed project as explained below:

We will cooperate by advertising the program, encouraging teachers to apply, and identifying those who would most benefit from this program. We would assist in making the necessary arrangements for an appropriate site for the workshop. We would communicate so that the program offered is as meaningful as possible. We would help arrange for those involved to teach other teachers and assist in the implementation of what they learned at the workshop. We would do whatever else is necessary to make the workshop as profitable for our staff and ultimately for our students.

*Must be endorsed by cooperating partners in proposed project.
APPENDIX G.

TIME LINE
TIME LINE

The following illustrates the time period covered by this study.

Six months prior to workshop: Send recruitment materials to cooperating workshop districts

Permission from Iowa State University
Human Subjects Committee
Permission from cooperating districts

One month prior to workshop: Registration deadline

Three weeks before workshop: Complete selection of subjects
Send out follow-up reminders

Before starting workshop: Administer survey

Week of workshop: Workshop (treatment)

Three months after workshop: Follow-up session

Immediately following workshop: Administer survey

November/December: Analyze data and evaluate
APPENDIX H.

1992 CHANGE SCORE MEAN DIFFERENCE
### 1992 Change Score Mean Difference

<table>
<thead>
<tr>
<th>Item</th>
<th>X</th>
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