

## Advanced Placement Environmental Science:

### Implications of Gender and Ethnicity

Rebecca Penwell  
Brenau University

#### **INTRODUCTION**

One of the challenges of science attitude research is that many studies have been inconsistent in the characteristics (such as age, sex, gender, ethnicity, and ability level) of their study sample. This poses serious challenges for research in this area and may be a reason that many of these studies have presented conflicting ideas about students' attitudes toward science. For example, a study by Cannon and Simpson (1985) which involved 821 7<sup>th</sup> grade life science students and 11 science teachers, a study involving 673 11<sup>th</sup> grade students by Schibeci and Riley (1986), and a study by Weinburgh (1995) presenting a meta-analysis of 6,753 students found that males have more positive attitudes toward science than females and that students' attitudes toward science affect their science achievement. A study of 5<sup>th</sup>, 7<sup>th</sup>, and 10<sup>th</sup> graders by Morrell and Lederman (1998) concluded that gender does not affect students' attitude toward science. Catsambis (1995) found that a gap in the attitudes of male and female students toward science exists even when females outperform males in science classes. Therefore, female students' negative attitudes toward science develop independent of their levels of science achievement (Catsambis, 1995).

Although Black students have historically been outperformed by their White counterparts, they have retained more positive attitudes toward science in high school (Pearson & Bechtel, 1989). Bachman and O'Malley (1984) reported that Black students

may appear to have more positive attitudes toward science because they are more likely than White students to choose responses at the positive end of a Likert-type scale (as cited in Pearson and Bechtel, 1989). A 1995 study by Catsambis concluded that minority students do continue to have positive attitudes toward science. Minorities, especially Blacks, report positive attitudes toward science, though their attitudes become less positive when the questions are directed at the awareness of the philosophy and methodology of science, confidence in science, and science research (Anderson, 1989). Research has also found that advanced science students have the most positive attitudes toward science and that basic science students have the least positive attitudes toward science (Cannon & Simpson, 1985).

This paper addresses the questions:

1. What are the attitudes of the students enrolled in APES?
2. Do their attitudes differ by gender or ethnicity?
3. What are the implications of their attitudes?

### **PURPOSE**

The purpose of this study was to use a student attitude survey to determine the attitudes of students in Advanced Placement Environmental Science (APES) classes in Florida, California, and New York, as well as, to determine if gender or ethnicity affected their attitudes.

### **DATA SOURCE**

The sample was comprised of 355 students from Florida (156), California (115), and New York (84). California, Florida, and New York were selected for this study because they were the states with the highest number of schools with at least 10 students

who took the Advanced Placement Environmental Science exam in the spring of 2000. A letter explaining the study and asking for participation was sent to 50 APES teachers from 50 schools in each of the three states. To encourage more participation, follow-up postcards were sent one month later to those teachers who had not responded. Fifteen teachers, representing five schools in each state, agreed to participate and were sent teacher and student surveys. The final sample consisted of three schools each in California, Florida and New York, and 12 teachers and 355 students. The student sample was 60% female, 40% male 56% White, 17% Hispanic American, 16% Asian American, 8% Black, and 4% other ethnic/racial groups. The majority of the students were in 12<sup>th</sup> grade (52%), followed by 46% in 11<sup>th</sup> grade, 2% in 10<sup>th</sup> grade, and 1% in 9<sup>th</sup> grade. The teachers were 100% White and 60% female. The entire scale contained 42 Likert type items with three subscales: class environment (13 items), teacher (25 items), and student (4 items). The response choices were Strongly Disagree (SD), Disagree (D), Agree (A), and Strongly Agree (SA).

## **METHODS**

Surveys were mailed to the teachers of three Advanced Placement Environmental Science courses in California, Florida, and New York. The teachers were asked to fill out a teacher survey and a data sheet to collect information specific to their Advanced Placement Environmental Science classes. The teachers were then asked to administer the student survey to all students in each section of their Advanced Placement Environmental Science classes. These classes are delivered based on a scope and sequence provided by the College Board, but teachers are free to choose their own textbooks, lab activities, and other learning experiences.

Using students' average scale scores on the attitude scale and each of the three attitude subscales, a two-way ANOVA was used to determine if the students' attitudes toward their APES class was dependent on gender or ethnicity. This was done by comparing the male students' average scale scores to the female students' average scale scores and by comparing the students' average scale scores for each ethnicity to all of the other ethnicities. The type I error ( $\alpha$ ) used for two-way ANOVA was 0.05.

## RESULTS

A two-way ANOVA was used to determine if gender and ethnicity had an effect on students' attitude toward APES. Results indicate students' attitudes toward Advanced Placement Environmental Science did not statistically differ for males and females for the overall student attitude scale,  $F(1, 325) = 2.525, p = 0.113$  or any of the subscales. The effect size for Omega Squared was 0.005, which indicates a very small effect size. Therefore, the non-significant effect of gender on attitude is likely attributable to the small effect size as opposed to a lack of power (see Table 1).

Results indicate that students' attitudes toward Advanced Placement Environmental Science did not significantly differ across levels of ethnicity for the student total attitude scale  $F(4, 325) = 0.977, p = 0.420$  or any of the subscales. The effect size for Omega Squared was zero, which indicates a very small effect size. Therefore, the non-significant effect of ethnicity on attitude is likely attributable to the small effect size as opposed to a lack of power (see Table 1). There was no interaction between gender and ethnicity for the student total attitude scale  $F(4, 325) = 1.133, p = 0.341$  or any of the subscales. The effect size for Omega Squared was 0.002, which indicates a very small effect size. Effect sizes will only be reported if they are significant

for the remainder of the paper. Although the differences were not significant, results indicate that females have more positive attitudes toward APES overall than do their male counterparts. Other ethnic groups in this study have more positive attitudes toward APES overall than White, Black, Asian, or Hispanic students. However, none of the ethnic groups' differences in attitudes were statistically significant.

Table 1. Two-way ANOVA for gender and ethnicity.

Scale	Levene's Test of Equal Variances		SS	Df	MS	F	P	Effect Size
Total	0.005	Gender	2.357	1	2.357	2.525	0.113	0.0045
		Ethnicity	3.649	4	0.912	0.977	0.420	-0.0003
		G X E	4.232	4	1.058	1.133	0.341	0.0016
		Total	303.359	334				

## CONCLUSIONS

On average the students agreed with most of the statements pertaining to their APES class and thus have an overall positive attitude toward APES. A study by Baker and Leary (1995) indicated that girls in grades 2, 5, 8, and 11 had a very positive attitude toward science, and Morrell and Lederman (1998) concluded that gender does not affect students' attitude toward science. Research by Cannon and Simpson (1985), Schibeci and Riley (1986), and Weinburgh (1995) reported males having more positive attitudes toward science than females.

Other research has concluded that gender differences in students' attitudes toward science decrease as students grow older or are given more self-selection in the courses they take (Steinkamp & Maehr, 1984). Therefore, gender differences in students' attitudes toward science are smaller than has been assumed. If gender differences do

exist, they usually favor males as has been generally assumed, but there have been instances when females were favored (Steinkamp & Maehr, 1984).

It is very difficult to determine from the literature whether or not these findings are indicative of attitudinal changes that may have resulted from the science education reform of the 1980's or to due to a paradigm shift in the view that science is masculine. In the 1980's girls, minorities, and other underserved populations were just beginning to experience intervention programs to encourage and support them in the pursuit of science. The current literature on gender and science attitudes is unable to address these issues due to the fact that no pre and post 1980's studies were conducted.

The current study can be supported by studies that have shown that Black students have more positive attitudes toward high school science than their White counterparts (Pearson & Bechtel, 1989), and that minority students do have positive attitudes toward science (Catsambis, 1995). A study by Bachman and O'Malley (1984) explained that Black students appear to have more positive attitudes toward science because they are more likely than White students to choose responses at the positive end of a Likert-type scale (as cited in Pearson & Bechtel, 1989).

As we research male/female and Black/White attitude gaps in science, and their subsequent gaps in environmental awareness and participation, this study bears great relevance. If we can understand why APES students do not exhibit significant differences in their attitudes toward science, this may shed some light on how to close these gaps in non-APES students. For example, do these students have positive attitudes toward science because they are advanced students, or because they enjoy science, specifically environmental science? Therefore, as educational researchers, we need to

determine which aspects of Advanced Placement Environmental Science affect students' attitudes toward science. This tool will help us to promote positive attitudes in all students.

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*About the author...*

Dr. Penwell has a B.S degree in biology and environmental science from Allegheny College, an M.S. degree in biology from Florida International University, an M.Ed. in science education and a Ph.D. in curriculum and instruction from the University of Florida. She is an assistant professor of science education at Brenau University. She teaches science content courses for teachers at the undergraduate and graduate level, science methods courses at the undergraduate, graduate and education specialist level as well as an environmental education methods course at the graduate level. She also teaches the graduate science content and methods courses in an online format. Her research interests include gender, ethnicity and attitudes toward science, program evaluation, environmental education, and science misconceptions.