THE EFFECT OF THE *FIRST* ROBOTICS COMPETITION ON HIGH SCHOOL STUDENTS' ATTITUDES TOWARD SCIENCE

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2007 *FIRST* Robotics Conference

Outline

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Problem Statement

- The purpose of this study was to measure the impact of participation in the FIRST Robotics Competition on student attitude toward science.
- Student attitude with respect to the social implication of science, perception of scientists as individuals, attitude toward scientific inquiry, affinity toward new scientific ideas, enjoyment of science classes, science related hobbies, and career interest in science related fields were examined.

Problem Statement (cont.)

- This study also attempted to examine background variables that are associated with positive experiences because of participation on a FIRST Robotics team.
- This included:
  - academic performance in science classes,
  - length of time associated with the team
  - location of their high school
  - participation in other extra curricular activities
  - age of student
  - number of years the team has been competing in FIRST Robotics.

Primary Research Questions

- Do high school students that participate on a FIRST Robotics team have more positive attitude toward the social implications of science than students who do not participate in the program?
- Do high school students that participate on a FIRST Robotics team have more positive perception of scientists than students who do not participate in the program?

Primary Research Questions (cont.)

- Do high school students that participate on a FIRST Robotics team have more positive attitude toward scientific inquiry than students who do not participate on a FIRST Robotics team?
- Do high school students that participate on a FIRST Robotics team experience greater affinity toward adoption of scientific attitudes than students who do not participate on a FIRST Robotics team?

Primary Research Questions (cont.)

- Do high school students that participate on a FIRST Robotics team experience greater enjoyment of science lessons than students who do not participate on a FIRST Robotics team?
- Do high school students that participate on a FIRST Robotics team participate in more science related hobbies than students who do not participate on a FIRST Robotics team?
- Does participation on a FIRST Robotics team increase the aspirations of students toward careers in science?

Concept of Attitude

- Experts cannot agree on a single definition.
- Attitude has been described as a non-observable psychological entity, which can only be deduced from a manifested behavior (Adolpe, 2002; Mueller, 1986).
- Thurstone initially described attitude as “the sum total of a man’s inclination and feelings, prejudices and bias, preconceived notions, ideas, fears, threats, and conviction about any specified topic” (Thurstone, 1928, p. 531).
- He later modified his definition stating attitude was the “effect for or against a psychological object” (Thurstone, 1931, p. 261).
- He recanted this definition in a 1946 commentary, stating he actually believed that attitude was more accurately described in his earlier work as “the intensity of positive or negative effect for or against a psychological object” (Thurstone, 1946, p. 39).

Concept of Attitude (cont.)

- Additional definitions of attitude include:
  - "a mental or neural state of readiness" (Allport & Hartman, 1935, p. 810),
  - a "consistency in response to social objects" (Campbell, 1950, p. 31),
  - "the covert response evoked by a value" (Linton, 1945, pp. 111-112)

Concept of Attitude (cont.)

- While an exact definition is not agreed upon, social scientists do acknowledge that attitudinal behavior is learned and can be modified.
- This theory caught the attention of educators and researchers who began to examine students' attitude in science and ways to measure selected populations (Adolphe, 2002; Billeh & Zakhariades, 1975; Fraser, 1981; Klopfer, 1971; Kozlow & Nay, 1976; Moore,1971; Sorenson and Voelker ,1972; Pearl, 1974).

Concept of Attitude (cont.)

- The development of positive attitudes toward science has long been viewed as a legitimate goal of science education and is the primary goal of FIRST.
- In a telephone interview with Dean Kamen, founder of FIRST, he emphasized that FIRST is designed to inspire youth towards fields in science and technology. It is through inspiration that Kamen sees FIRST as having the greatest impact on its predicates (Kamen, 2006).

Concept of Attitude (cont.)

- The term attitude encompasses a wide variety of affective behaviors, such as prefer, accept, appreciate, and commit.
- In most studies, the term “attitudes” is used to refer to the intrinsic values or interests of the students toward science and mathematics (Dethlefs, 2002).

Concept of Attitude (cont.)

- In 2000, Dethlefs conducted a study on the relationship of constructivist learning to students' attitudes and achievement in high school science and mathematics. His findings showed the following results:
  - Constructivist learning environments are positively associated with student attitudes in high school biology and algebra.
  - Deeper cognitive processing strategies were present when students were allowed to exercise more control in their learning activities.
  - Students' enrollment in future elective classes was predicted as a result of their attitudes.
- There is a strong relationship between cooperative group-work and students' interest in school.

TOSRA

- Test of Science Related Attitudes
- Fraser (1978) developed the survey to measure seven science related attitudes among secondary school students.
- The seven attitude scales are as follows:
  - Social Implications of Science
  - Normality of Scientists
  - Attitude of Scientific Inquiry
  - Adoption of Scientific Attitudes
  - Enjoyment of Science Lessons
  - Leisure Interest in Science
  - Career Interest in Science

TOSRA (cont.)

- TOSRA was designed to be used by educators and researchers to monitor student progress towards achieving attitudinal aims (Fraser, 1981).
- Fraser states “TORSA is likely to be most useful for examining the performance of groups or classes of students” (Frasier, 1981, p. 1).

TOSRA (cont.)

- Each scale category in TOSRA contains 10 items, for a total of 70 in the instrument.
- The five-point Likert scale is used with response categories ranging from Strongly Agree to Strongly Disagree.
- This system allows the researcher to obtain a profile of attitude scores for a particular group of students based on the scores in each category, rather than having to use only one overall score.

TOSRA (cont.)

- The Social Implications of Science scale measures the “manifestation of favorable attitudes towards science: (Fraser, 1981, p. 2).
- The Normality of Scientists scale measures the attitude toward scientists as normal people rather than eccentrics.
- The Attitude of Scientific Inquiry scale measures attitude toward scientific experimentation and inquiry as methods of obtaining information.

TOSRA (cont.)

- The Adoption of Scientific Attitudes scales measures open-mindedness, willingness to reverse opinions related to scientific investigation and inquiry.
- The remaining three scales, Enjoyment of Science Lessons, Leisure Interest in Science, and Career Interest in Science, measure attitudes reflected in their titles (Fraser, 1981).

Research Location and Design

- Eight schools sponsoring a FIRST Robotics team in the Kansas City metropolitan area agreed to participate in this study.

  Barstow School, Team 1930 (2006)

  Center High School, Team 1827 (2006)

  Mill Valley High School, Team 1810 (2006)

  Paseo Academy, Team 1763 (2006)

  Paola High School, Team 1108 (2003)

  Raytown South High School, Team 1992 (2006)

  Shawnee Mission South High School, Team 1984 (2007)

  Winnetonka High School, Team 1752 (2006)

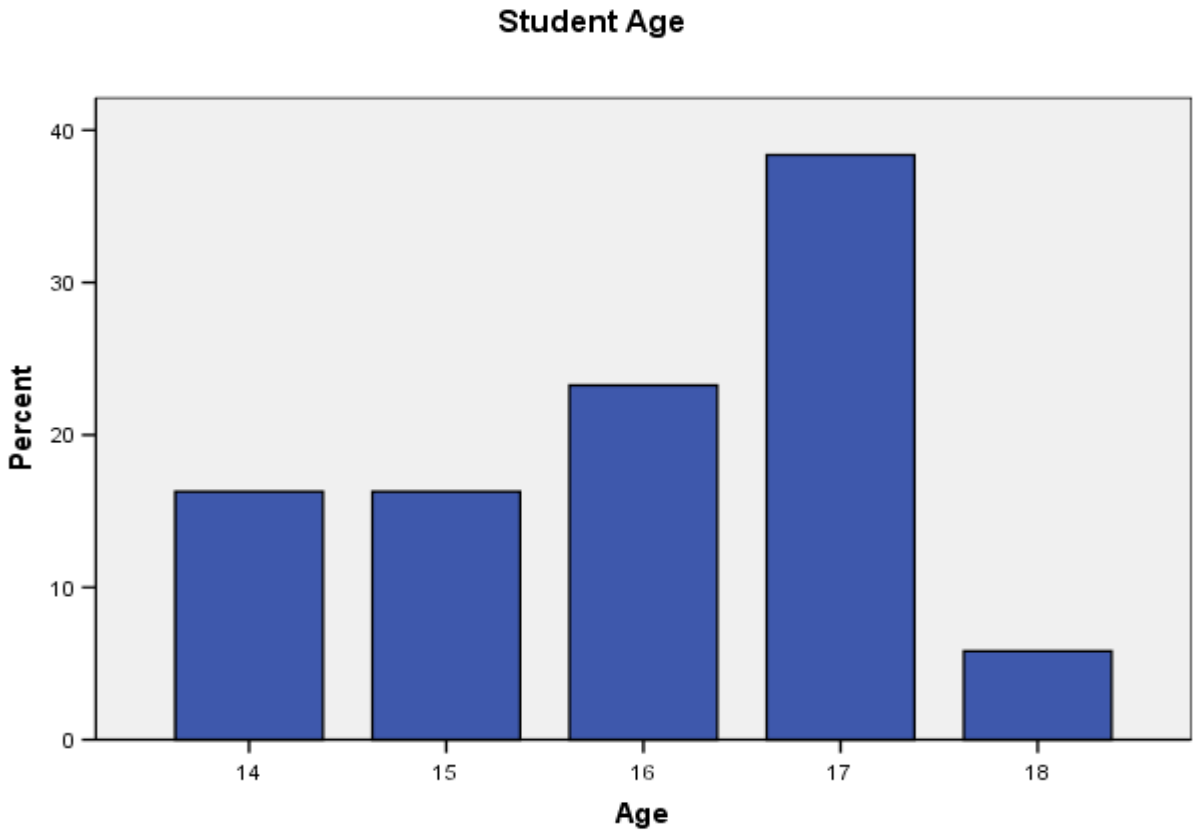
Research Location and Design (cont.)

- The study was conducted during 2006-2007 school year and the 2007 FIRST Robotics Competition Season (January – April 2007).
- The pre- surveys were administered between mid December 2006 and the first week of January 2007. This timetable was prior to the January 6th "Kick-Off" Event and the beginning of the six week build season.
- The post surveys were administered between late February and early March 2007. This timetable was immediately following the conclusion of the six-week build season for the FIRST Robotics Competition and prior to most high school's spring break.
- One focus group meeting, approximately one hour in length, of FIRST team members was held at Shawnee Mission South High School, March 27th.

Research Location and Design (cont.)

- Sample size (N) of 86 students
- Treatment group: members of FIRST teams (N=55)
- Control group: non-members of FIRST teams (N=31)

Demographics



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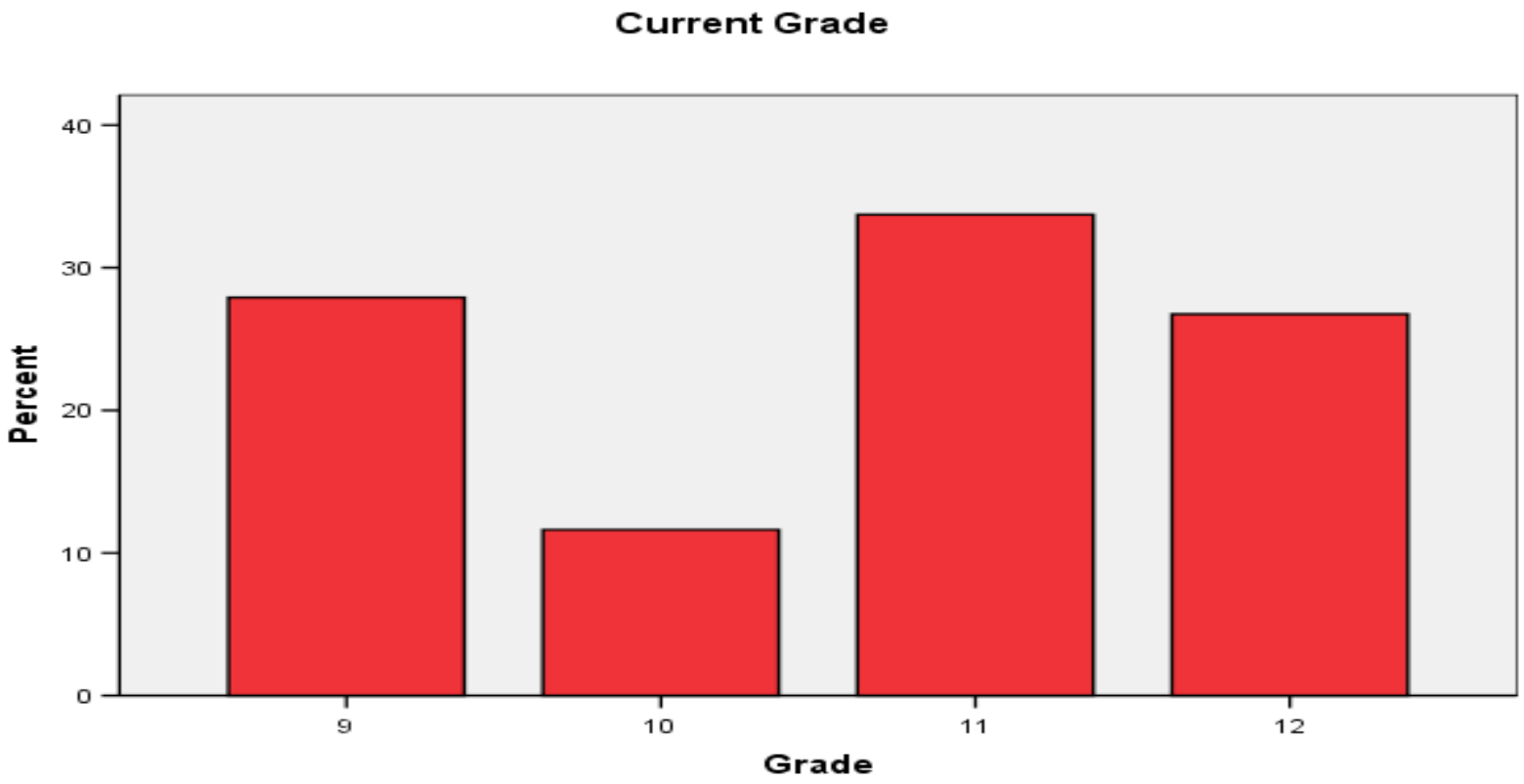

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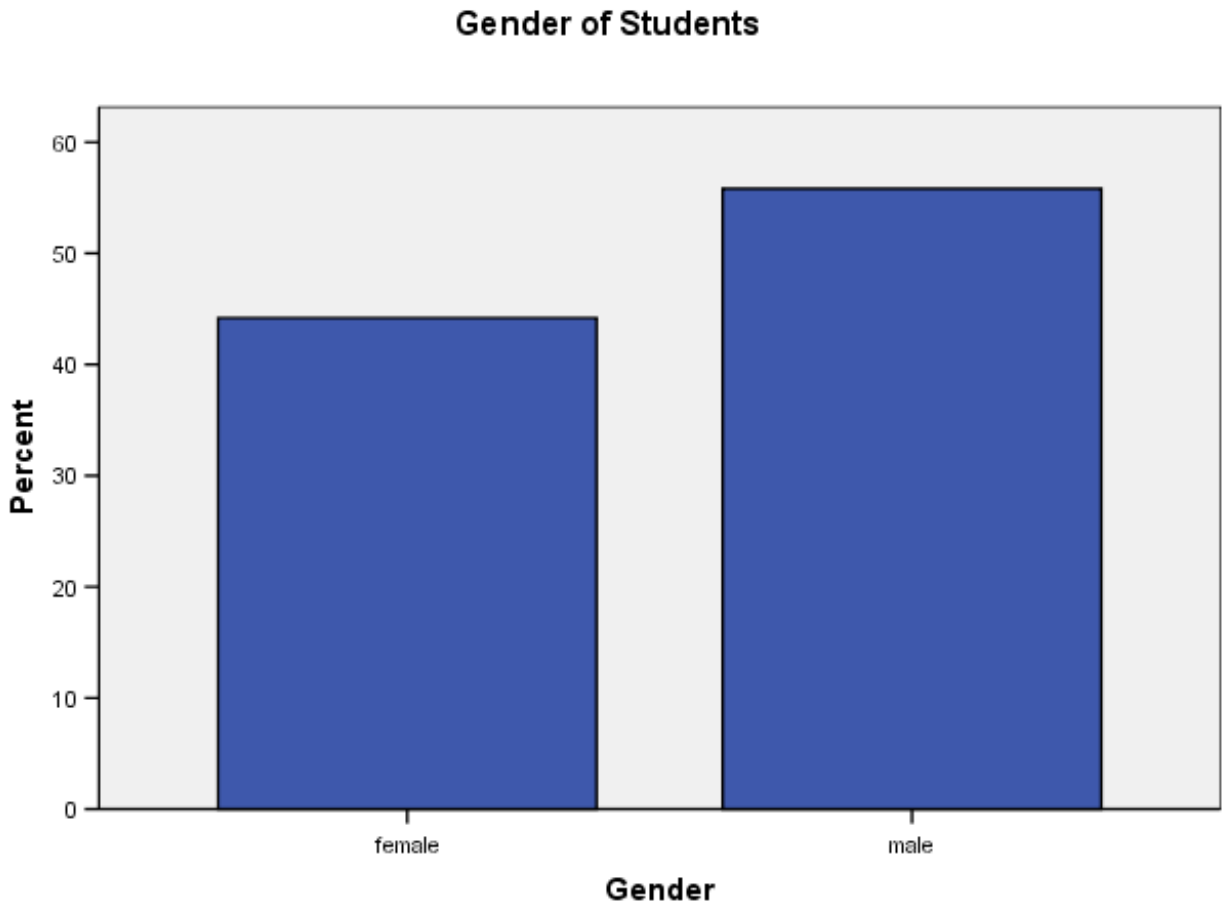

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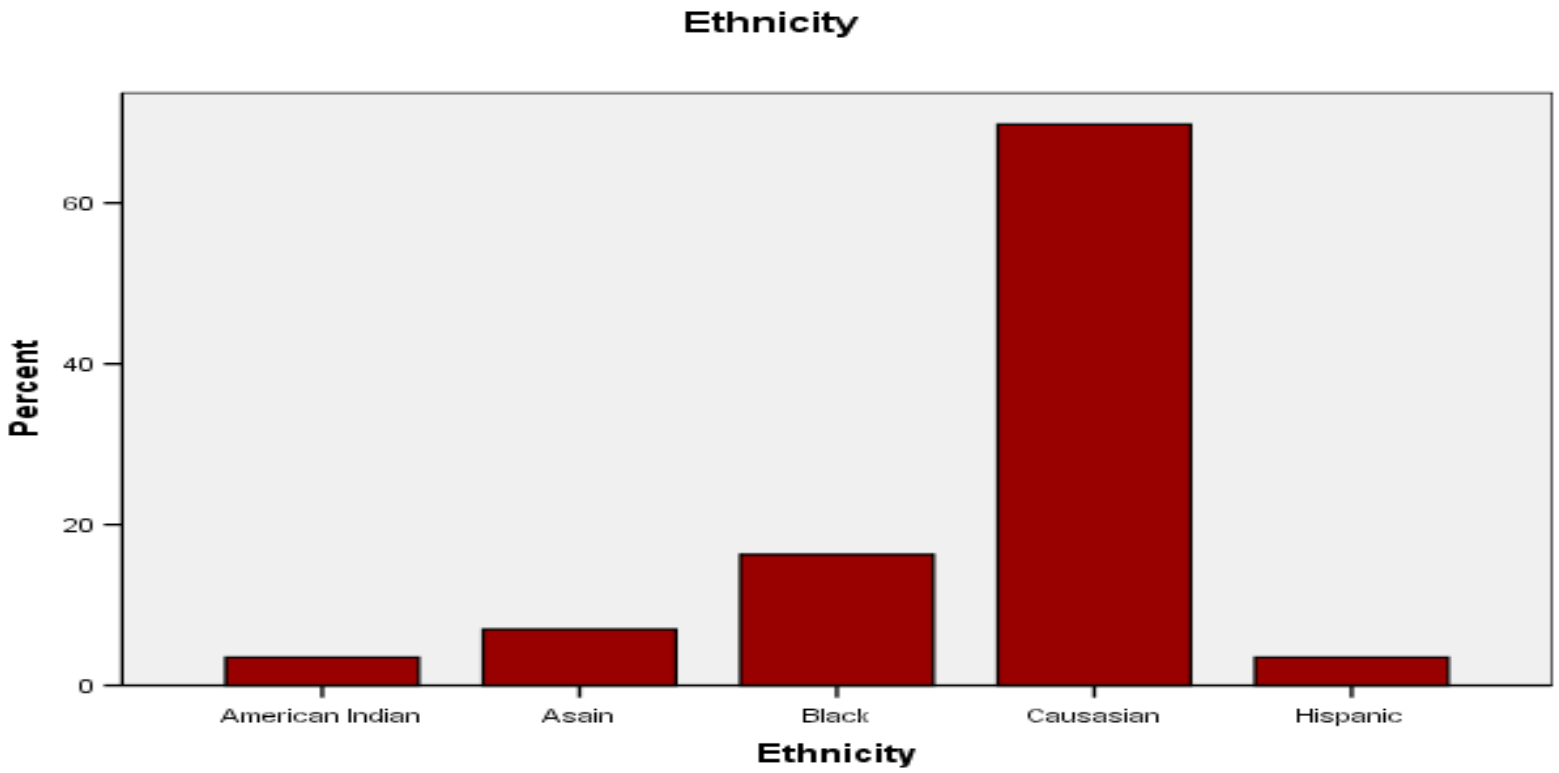

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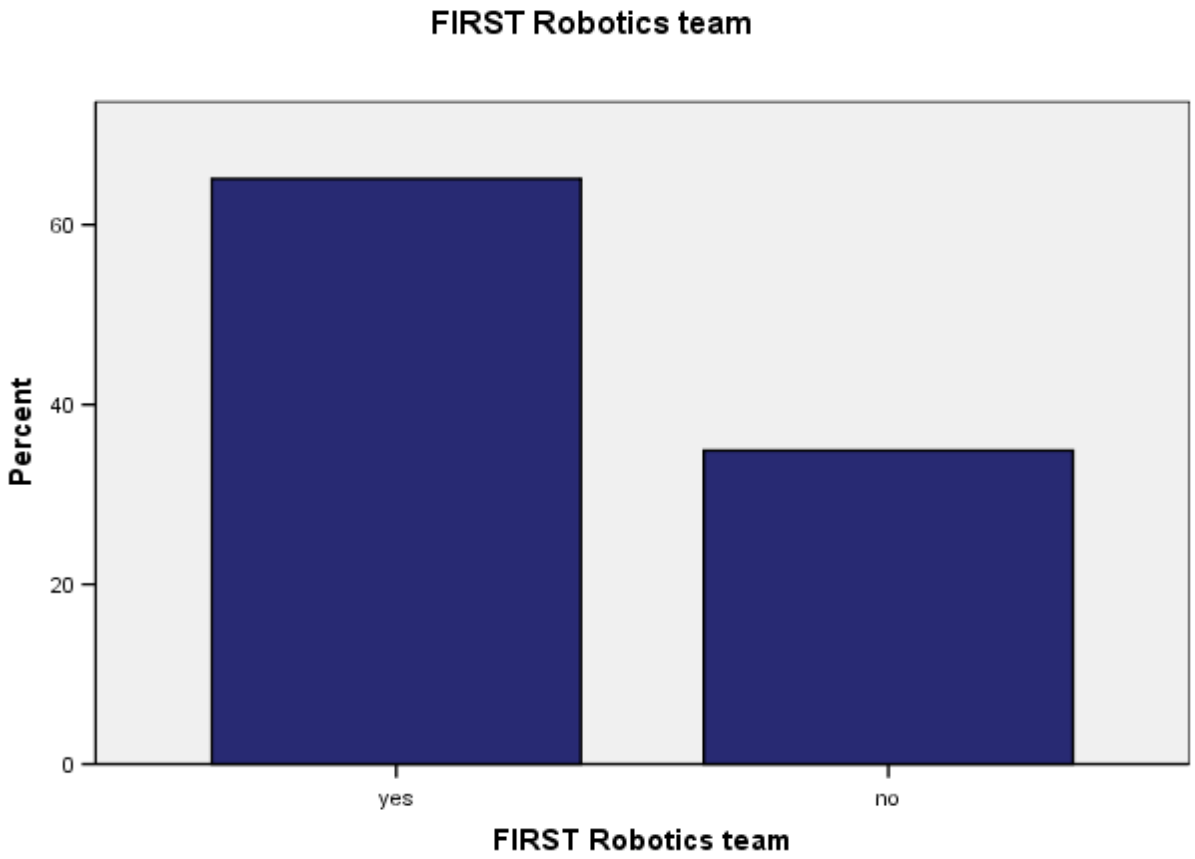

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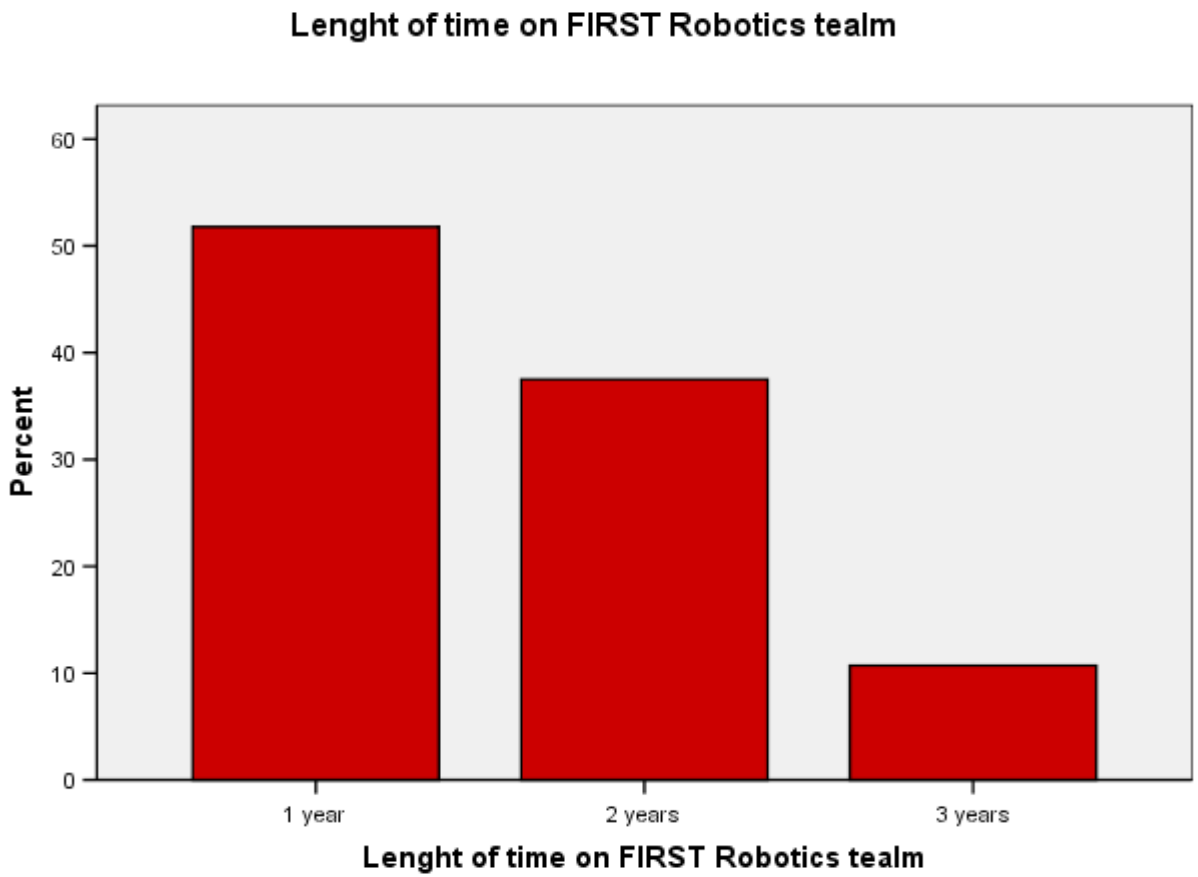
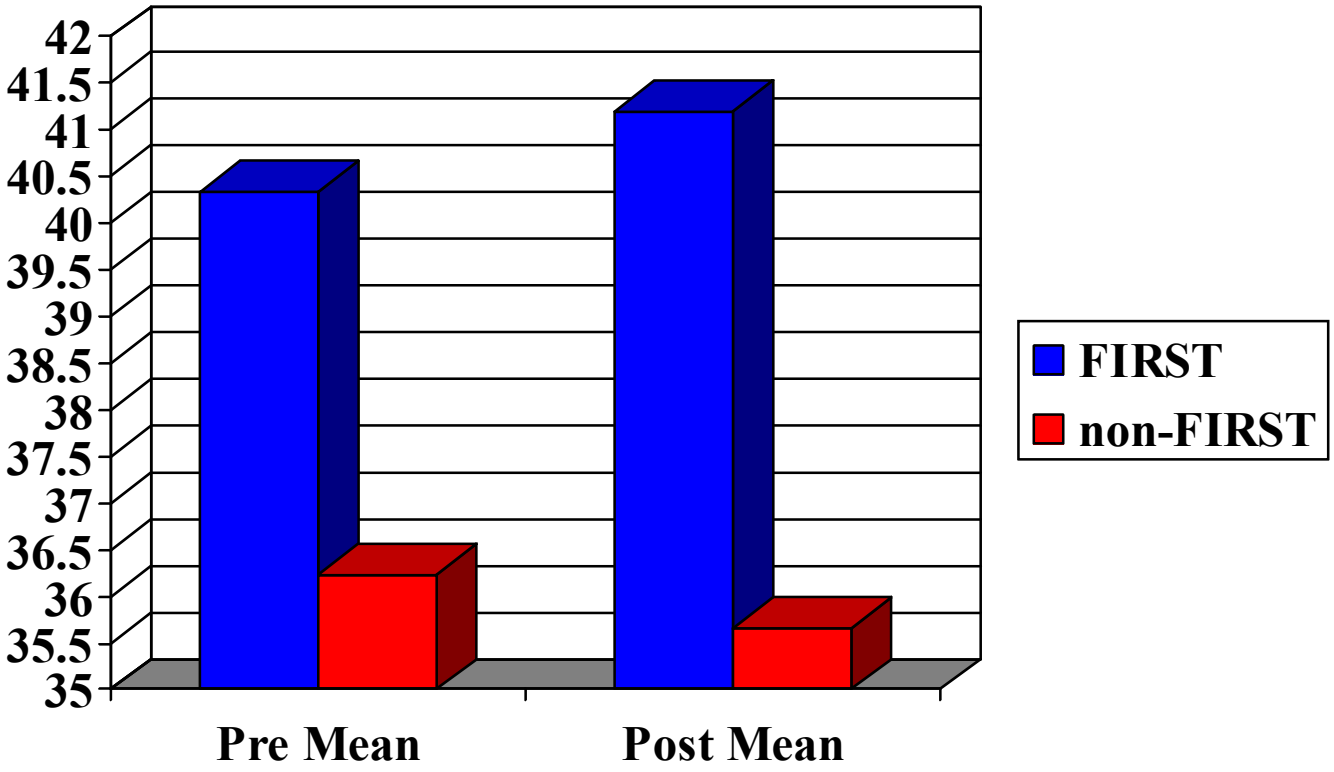


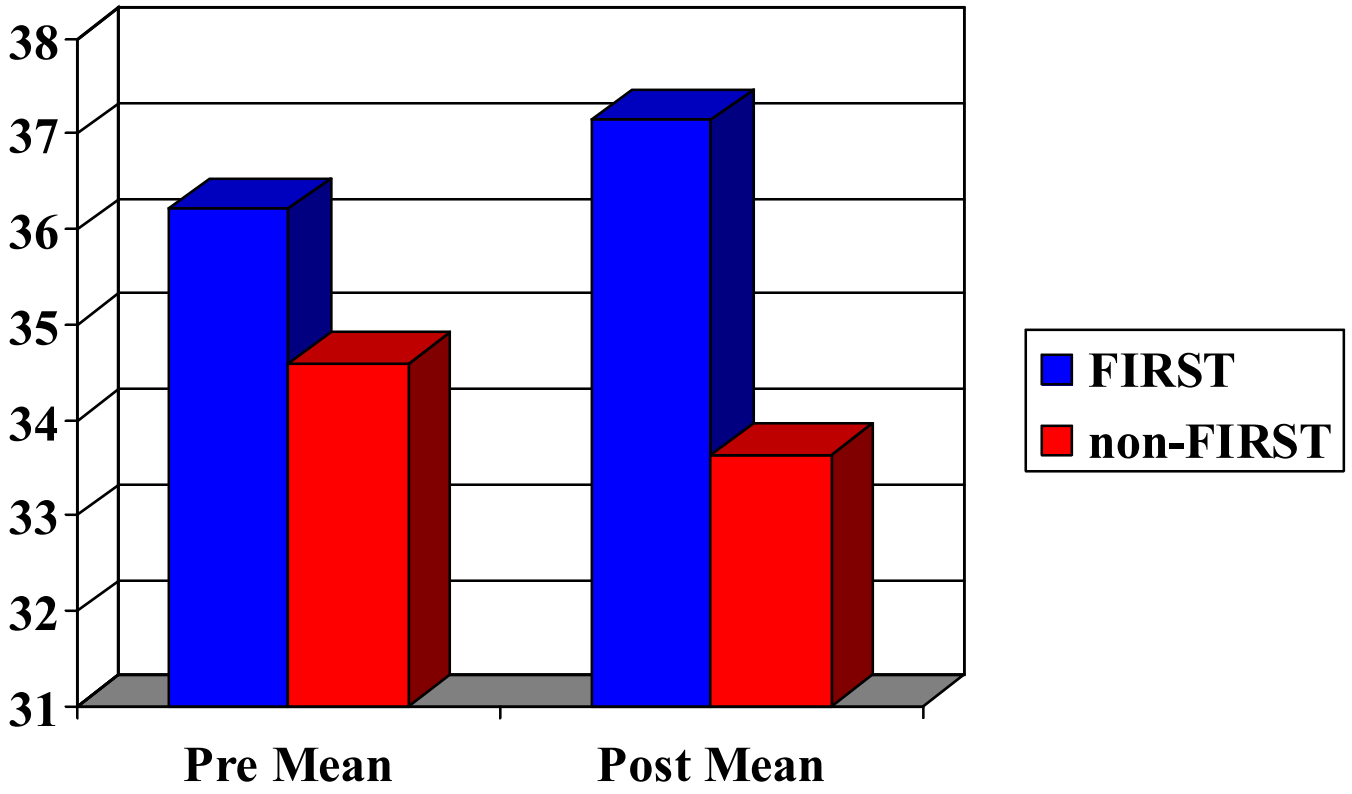
Data Analysis

- Social Implications of Science



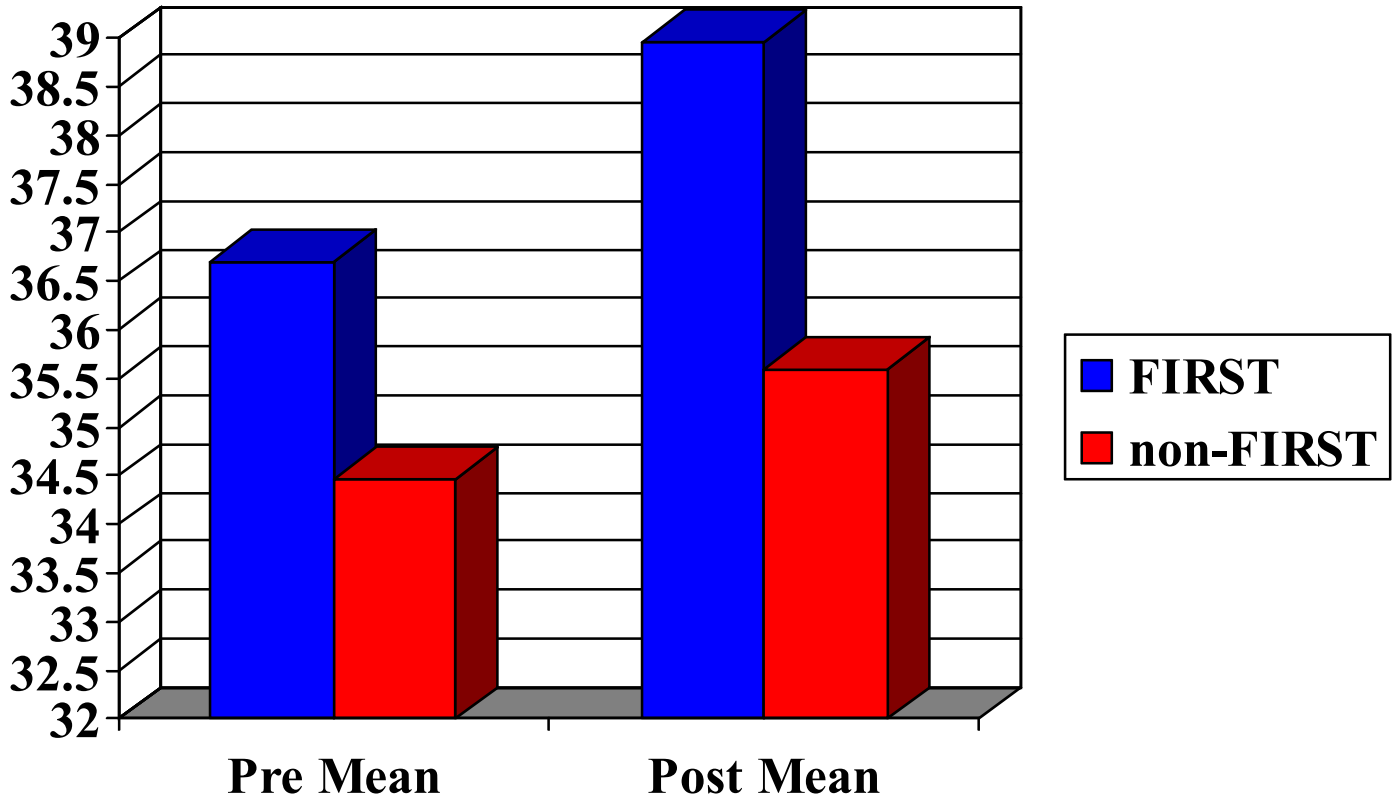
Data Analysis (cont.)

- Normality of Scientists



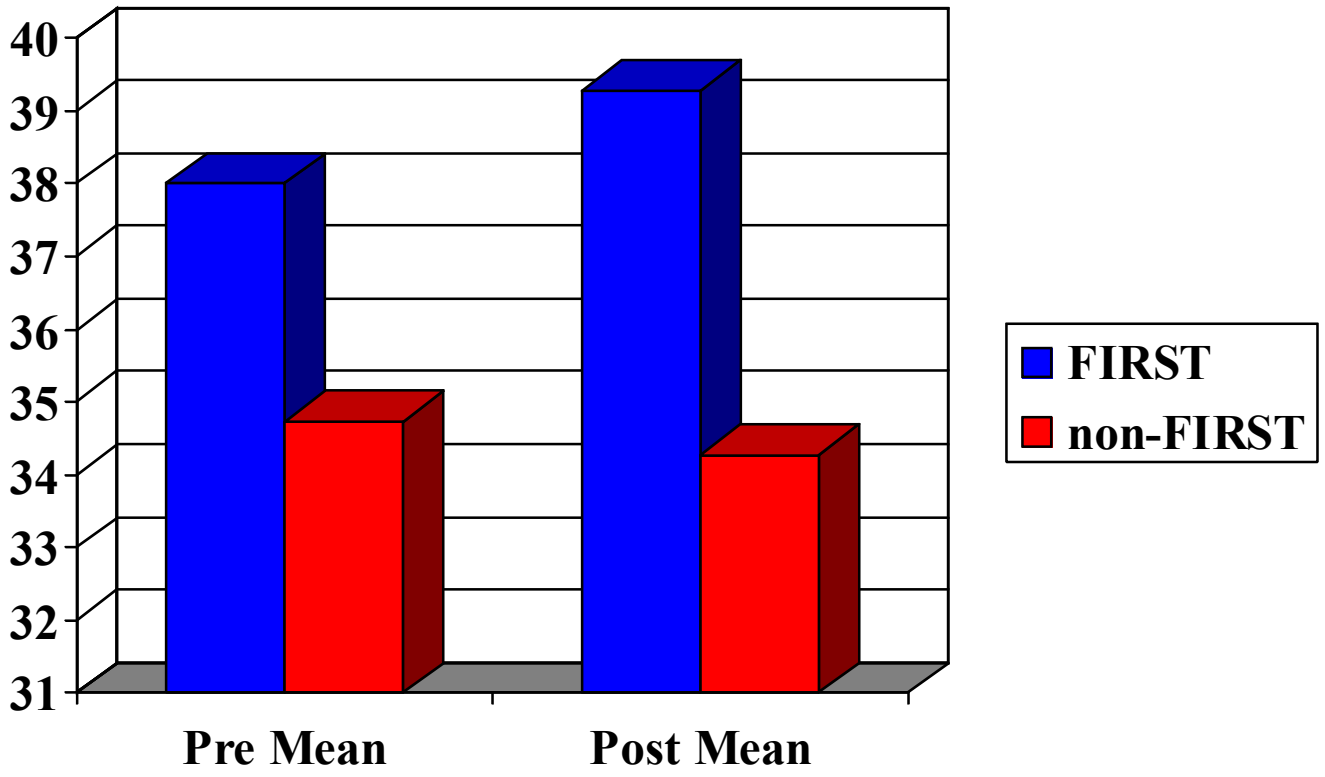
Data Analysis (cont.)

- Attitude to Scientific Inquiry



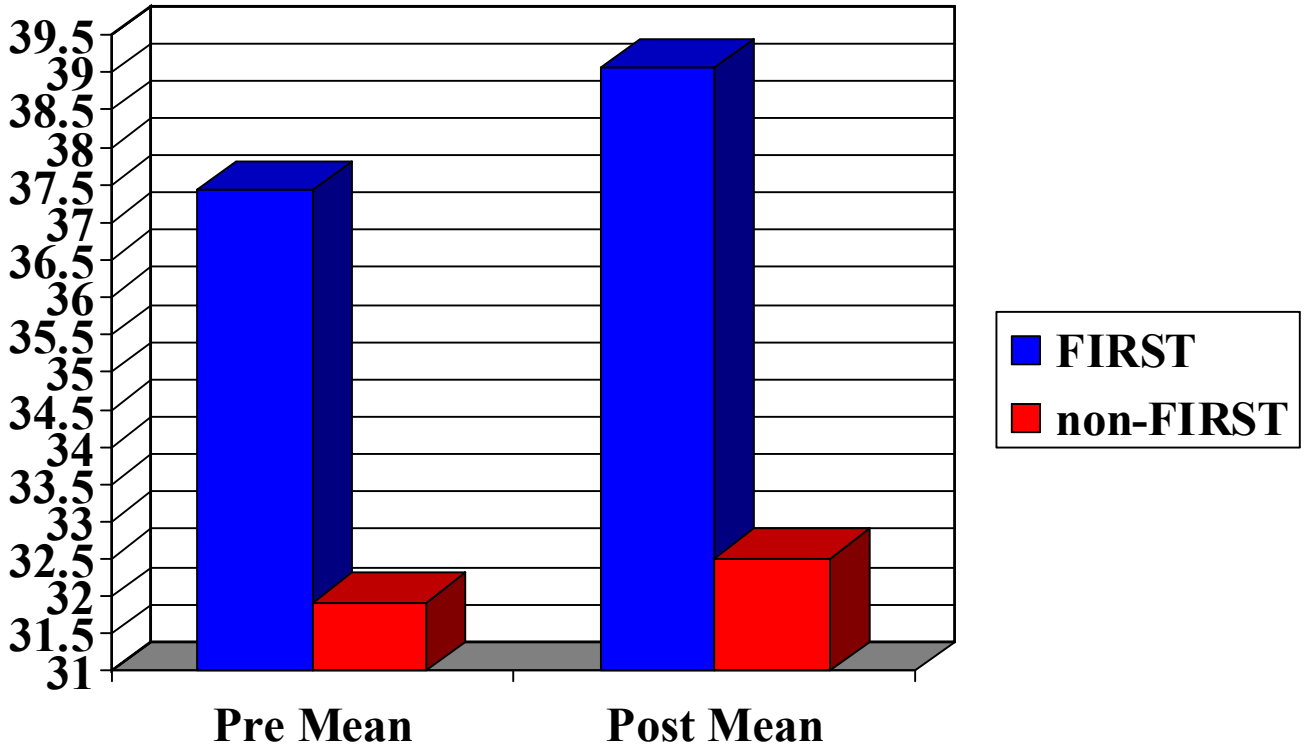
Data Analysis (cont.)

- Adoption of Scientific Attitudes



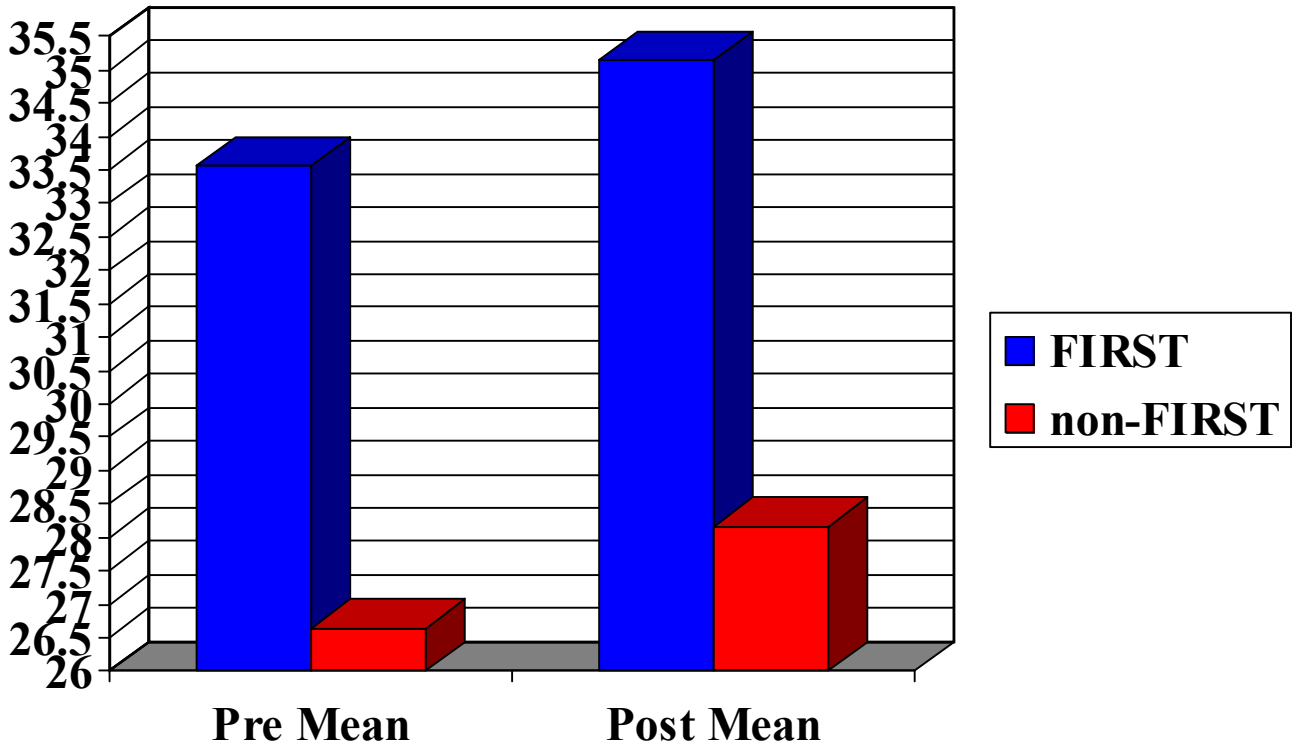
Data Analysis (cont.)

- Enjoyment of Science Lessons



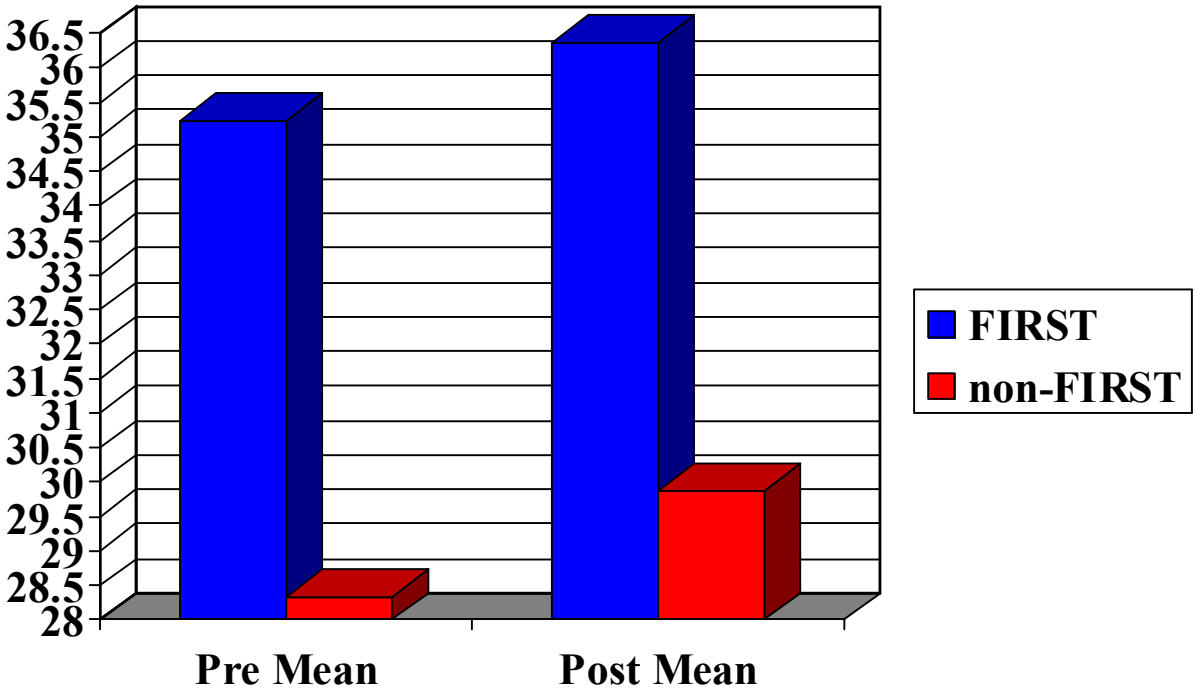
Data Analysis (cont.)

- Leisure Interest in Science

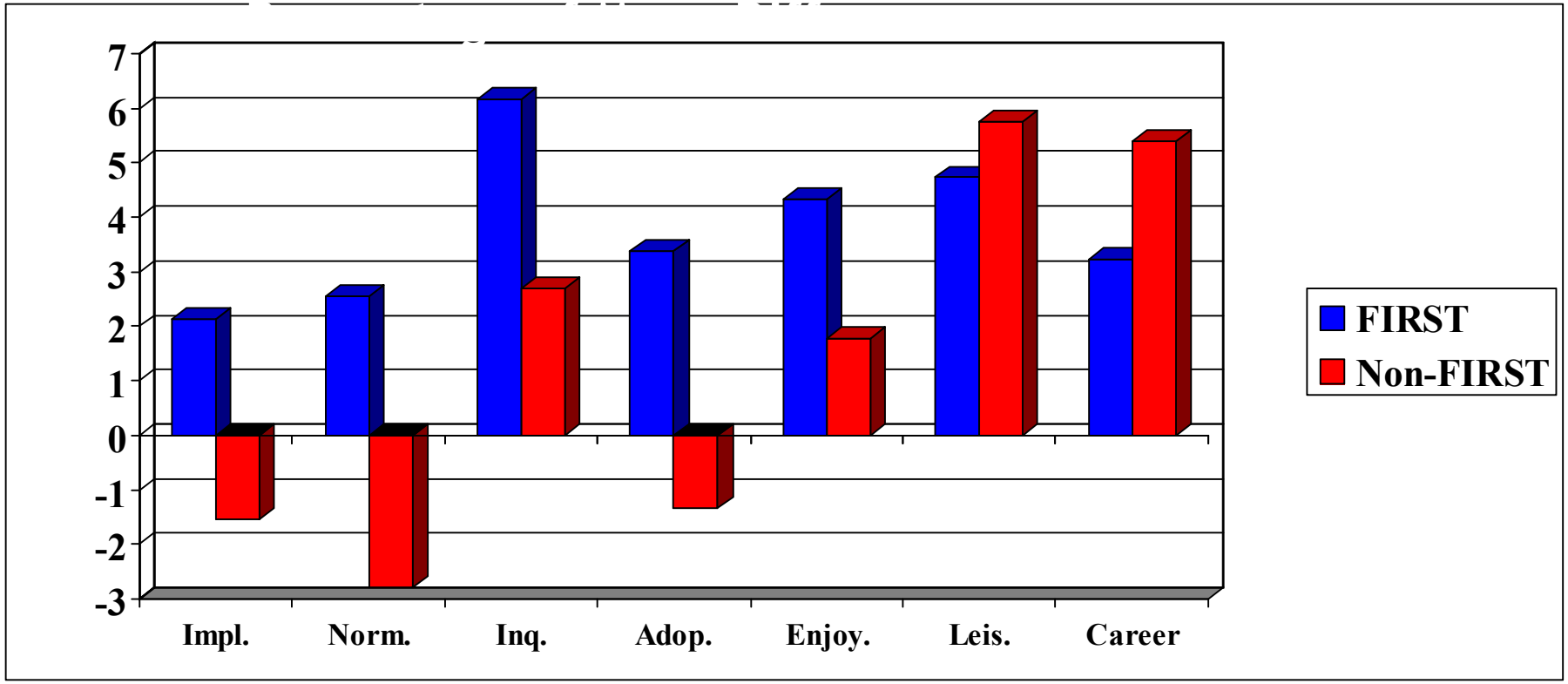


Data Analysis (cont.)

- Career Interest in Science



Percentage of Mean Differences



Results

- In all seven areas, students participating in FIRST showed gains in positive attitude toward science related areas.
- During the same period, non-FIRST students showed a decline in positive attitude toward related areas in three of the seven areas.
- Further analysis suggests that the greatest change in attitude occurs in 9^{th} and 10^{th} grade students.

Limitations and Implications

- A limitation of the study was the inability to use random sampling procedures.
- The study was limited to students attending high schools sponsoring FIRST Robotics teams and who were willing to participate in the study.
- FIRST participants may be different than other students, due to self-selecting.
- The sampling was limited due to compliance, and cooperation with the needs and desires of the participating high schools.

Future Study

- A longitudinal study should be conducted with 8th grade students prior to entering high school and following them throughout the following four years.
- A study should also be conducted asking about type of involvement on the FIRST team and assessing how that may impact attitude toward science.

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