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ABSTRACT

The purpose of this study was to update the findings of previous quantitative research related to the effects of various student characteristics on measures of science achievement, cognitive reasoning, and science attitudes using the meta-analytic approach. Furthermore, the magnitude of the relationships between the study outcomes and the methodological variables were examined. Studies carried out in 1980 through 1991 with U.S. students in grade 7 through grade 12 were included in this analysis. Of the 147 documents identified for potential inclusion in this study, 77 studies were retained for meta-analysis. Findings of this study support previous research in that significant effects were found between the study's outcome measures and gender (favoring males), and race (favoring whites). Positive relationships were found between the study's outcome measures and environmental variables which included father's education, mother's education, plans and aspirations, hours of homework, and the availability of educational items at home. Substantial positive relationships were also found between the study's outcome measures and scholastic ability, science ability, general ability, and cognitive reasoning ability. Further positive relationships were also found between the study's outcome measures and attitudinal indicators which included both attitudes toward science, and attitudes toward science learning. Exploration of the study outcomes' effect sizes associated with the methodological variables revealed significant differences across the form of publication, assignment type, method of calculating the effect size value, age levels, and grade levels. (Author)

A META-ANALYSIS OF THE RELATIONSHIP BETWEEN STUDENTS' CHARACTERISTICS AND ACHIEVEMENT AND ATTITUDES TOWARD SCIENCE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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* * * * *

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1994

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DEDICATION

To the loving memory of my dear late parents
who would have been proud

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The purpose of this study was to update the findings of previous quantitative research related to the effects of various student characteristics on measures of science achievement, cognitive reasoning, and science attitudes using the meta-analytic approach. Furthermore, the magnitude of the relationships between the study outcomes and the methodological variables was examined. Studies carried out in the years 1980 through 1991 with U.S. students in grade 7 through grade 12 were included in this analysis. Of the 147 documents identified for potential inclusion in this study, sixty-seven studies were retained for meta-analysis.

Findings of this study support previous research in that significant effects were found between the study's outcome measures and gender (favoring males), and race (favoring whites). Positive relationships were found between the study's outcome measures and environmental variables which included father's education, mother's education, plans and aspirations, hours of homework, and the availability of educational items at home. Substantial positive relationships were also found between the study's outcome measures and scholastic abilities which included language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability. Further positive relationships were also found between the study's outcome measures and attitudinal indicators which included both attitudes toward science, and attitudes toward science learning.

Exploration of the study outcomes' effect sizes associated with the methodological variables revealed significant differences across the form of publication, assignment type, method of calculating the effect size value, age levels, and grade levels.

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CHAPTER I

DESCRIPTION OF THE STUDY

Introduction

A number of research reviews have been undertaken to integrate quantitatively the studies relating variables that appear to have an important influence on students' academic achievement and attitudes toward science. Fleming and Malone (1983) examined the relationships of students' characteristics to student performance and attitudes toward science. Quantitative studies were carried out by Kahl et al. (1982), and Steinkamp and Maehr (1982) on gender differences as associated with students' achievement and attitudinal outcomes. Studies involving home environment constructs as related to student achievement were carried out by Kremer and Walberg (1981), Kahl et al. (1982), and Walberg (1986). Meta-analytic studies relating scholastic abilities to science achievement and attitudes toward science were carried and by Fleming and Malone (1983), Kahl (1982), Boulanger (1981), and Steinkamp and Maehr (1983). Quantitative synthesis of studies related to cognitive developmental levels and science achievement were conducted by Boulanger and Kremer (1981), Walberg (1986), and Kahl

(1982). Affective variables a related to achievement in science were investigated in the meta-analyses conducted by Kremer and Walberg (1981), Kahl (1982), Haladyna and Shaughnessy (1982), Willson (1983), Steinkamp and Maehr (1983), and Walberg (1986).

During the last 12 years, a great corpus of educational research has provided data on student characteristics that directly enhance student attitudes and acquisition of knowledge. While our understanding of how those characteristics influence students' performance has increased dramatically, the impressive accumulation of findings seem to have gone unnoticed by many educators as well as by the general public.

Previous research has identified certain variables that affect students' achievement and attitudes related to science. Students' gender, scholastic abilities, and attitudinal indicators are among the variables that influence students' academic achievement and foster positive attitudes towards science. However, research since 1980 has not been quantitatively synthesized to estimate the effect sizes associated with such measures, and to determine whether effect sizes reported in previous meta-analytic studies have continued to be obtained or have changed.

Need for the Study

In science education, more is known than can be expressed by separate studies regarding the relationship between student characteristics and their achievement and attitudes towards science. Meta-analysis is a quantitative synthesis of the findings of related studies which provides a means of displaying and interpreting data from a multitude of studies. The results of numerous studies on a particular topic can be integrated into a form that is understandable to the educational researcher and practitioner who may be in a position to apply the results.

The accumulated findings of many studies demand more sophisticated techniques of measurement and statistical analysis. Data from different studies should be regarded as complex data points, no more comprehensible without the full use of statistical analysis than hundreds of data points in a single study (Glass et al., 1981). According to Gage (1982), meta-analysis yields more valid and more positive conclusions about what has been found in primary research than do qualitative summaries.

Meta-analysis was chosen as the analytic approach for this study because it provides quantitative synthesis of the findings of related studies. This has the advantage of summarizing each study in a manner which provides a more concise means of displaying and interpreting data than is possible through qualitative approach. Use of the technique offers a rigorous, objective alternative to the narrative and subjective discussions of groups of research studies which are indicative of attempts to make sense of the rapidly expanding research literature (Glass et al.,1981).

A meta-analysis is conducted on a group of studies that are related through sharing a common conceptual hypothesis or common operational definitions of independent or dependent variables, and describes the degree of overlap between experimental conditions on a normal curve. When used to examine a complete survey of studies from a specific research area, the procedures of meta-analysis allow the characterization of the tendencies of the research and yield information about the magnitude of any differences between conditions. The use of meta-analysis has increased substantially during the past 20 years and many books and articles describing this procedure have been published (Glass, McGaw, and Smith, 1981; Hedges & Olkin, 1985; Hunter, Schmidt, & Jackson, 1982; Hedges, Shymansky & Woodworth. 1989; and Rosenthal, 1984, 1991).

Quantitative syntheses of studies provide science educators, including teachers, with information regarding the variables that influ9ence students' achievement and attitudes toward science and help improve science education in schools. Moreover, when designing a study, researchers should take into account the variables that relate to students' science achievement and their attitudes toward science.

Previous meta-analytic studies have identified related variables and their effect sizes in studies through 1979. This study identifies variables and their effect sizes for 1980-1991, and compares these values with those obtained before. This information will help practitioners and researchers to know if the studies yielded consistent results or if changes have occurred. In some cases, variables are identified for 1980-1991 for which no data or only a small number of studies were available in previous meta-analysis; this information provides practitioners and researchers with data they probably have not had.

Purpose of the Study

This study was designed to synthesize quantitatively the collective research pertaining to the overall assessment and evaluation of the relationship of student characteristics to their science content achievement, cognitive reasoning performance, and attitudes related to science using meta-analysis techniques. The purpose of the present research was to update the findings of previous quantitative research related to student characteristics on their achievement and attitudes in science, and to determine the magnitude of the relationship between the study outcomes and both the methodological and student variables. Qualitative comparisons between the findings of this study and earlier meta-analysis studies conducted prior to 1980 are reported. A substantial amount of literature has accumulated in this area of science education during the last ten years, but no comprehensive quantitative integrative research review on the collective related studies has appeared since that date.

Research was included in this review if the study had an outcome within the following categories: science achievement as expressed as either test score or class grade, cognitive reasoning ability, attitudes related to science, and attitudes related to science learning. Variables affecting these outcomes of interest included the following: (1) the student characteristics of gender and race; (2) environmental variables which include father's education, mother's education, availability of educational items at home, plans and aspirations, and hours of homework per week; (3) scholastic abilities which include language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability; and (4) affective variables which include both attitudes toward science and attitudes toward science learning.

Research Questions

This study sought answers to the following research questions:

Research Question 1.

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when the following student characteristics are examined in a meta-analytic fashion:

- gender, and
- race?

Research Question 2.

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning, when the following environmental variables are examined in a meta-analytic fashion:

- father's education,
- mother's education,
- availability of educational materials at ! ne,
- plans and aspirations, and
- number of hours of homework per week?

Research Question 3.

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when prior scholastic abilities, listed below, are examined in a meta-analytic fashion:

- language ability,
- mathematics ability.
- science ability,
- general ability, and
- cognitive reasoning ability?

Research Question 4.

Are there significant effects on science test scores, science grades, logical reasoning ability, attitudes toward science, and attitudes towards science learning when the effects of attitudinal indicators, listed below, are examined in a meta-analytic fashion:

- attitudes toward science, and
- attitudes towards science learning?

Research Question 5.

Are there significant mediating effects on the above relationships when examined in a meta-analytic manner attributable to the study methodological variables listed below:

- form of publication,
- length of study,
- assignment of students,
- type of Study,

- internal validity,
- design rating,
- method of calculating effect size,
- socioeconomic status,
- disciplinary focus of the study,
- age levels, and
- grade levels?

Research Question 6.

Given the results of the above analyses, are there indications that the current effects and relationships observed among the above variables differ qualitatively from such effects and relationships observed in meta-analytic studies reported in the literature prior to 1979?

Assumptions

1. A reasonably comprehensive sample of studies was obtained for this study.
2. The recording of the characteristics and outcomes of primary empirical studies in quantitative terms renders the integration of diverse findings possible through statistical analyses.
3. An average effect size can be calculated for a certain outcome variable from all studies with the same independent variable and this mean effect size can be compared to the mean effect size on the same outcome variable for studies having a different independent variable (Anderson et al. 1983).

Delimitations

1. Only studies involving outcome criteria related to students' achievement in science, their cognitive reasoning abilities, and their attitudes related to science, were included in the study.

2. The studies included addressed students' characteristics with regard to:

   - student characteristics which included gender and race;
   - environmental variables which included father's education, mother's education, the availability of educational items at home, plans and aspirations, and hours of homework per week;
   - scholastic abilities which included language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability; and
   - affective variables including attitudes toward science and attitudes toward science learning.

3. The studies reviewed included only those in which data were collected in the years 1980-1991 in the U.S. with students in grade 7 through grade 12.

4. Qualitative studies were not included in the analysis.

5. Studies were deleted that did not present sufficient empirical data for obtaining or calculating effect sizes.

6. If the same data were analyzed and reported in more than one publication, only the most complete study was coded.

7. Analysis was conducted only when six or more studies were available for a particular relationship.

Definition of Terms:

Outcome Variables

Science Test Scores

Result of any national or international standardized test or any teacher or researcher developed test instrument that measured science achievement in any science content area taught at the middle or high school level.

Science Grades

Grades achieved by students in science classes.

Cognitive Reasoning Ability

Result of any construct designed to measure students' Piagetian formal reasoning abilities whether it was control of variables, conservational reasoning, combinatorial reasoning, correlational reasoning, probabilistic reasoning etc. Examples would include the Lawson Test of Formal Reasoning, Group Assessment of Logical Thinking (GALT), or Piagetian Logical Operations Test (PLOT).

Attitudes Toward Science

Findings of any measure, whether standardized or local, that assessed students' attitudes toward science content area, science careers, scientists, or the impact of science on society.

Attitudes Toward Science Learning

Result of any measure, whether standardized or local, that assessed students' attitudes toward science or interests in science curriculum, instruction, and/or learning.

Independent Variables

The independent studies examined in this study included: gender, race, father's education, mother's education, facilities at home, plans and aspirations, hours of homework, language ability, mathematics ability, science ability, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning. Definitions of several of the independent variables are presented as follows:

Gender

Measure of students' gender whether all males, all females, or a mixture of both males and females.

Race

Measure of students' race whether all white, all black, or a mixture of both whites and blacks.

Father's Education

Measures of father's education found in reviewed studies included an indication of the length of schooling: whether some high-school completed, high school completed, some college completed, graduated from college, or holds a graduate or professional degree.

Mother's Education

Measures of mother's education found in reviewed studies included an indication of the length of schooling: whether some high-school completed, high school completed, some college completed, graduated from college, or holds a graduate or professional degree.

Availability of Facilities at Home

Measure of the amount of educational books, journals, encyclopedias, or other science equipment at home.

Language Ability

Language skills measured by a national or local instrument that measured language ability, word knowledge, reading, grammar, spelling, or verbal aptitude.

Mathematics Ability

Scores obtained from a national or local test instrument that measured mathematics ability, computation skills, algebra, quantitative skills, arithmetic skills, and mathematical concepts.

General Ability

Measure of general, verbal, or mathematical intelligence; verbal, mathematical scholastic Aptitude Tests (SAT); language ability or achievement; and mathematical ability or achievement.

Plans and Aspirations

Measure of parental aspiration for the child whether they were college plans, occupational plans, or educational aspirations.

Hours of Homework Per Week

Measure of the hours of homework per week that the student spent at home.

Methodological Variables

Form of Publication

Source from which the study was coded. Sources included journals, books, doctoral dissertations, and papers.

Length of Study

Length of the study: whether it was less than one month, one to three months, three to six months, more than six months, or a status study.

Assignment of Students

Method of assignment of students to treatments, whether it was random, self-selected, intact groups, or representative sample.

Type of Study

Basic study type as correlational, quasi-experimental, experimental, or other.

Internal Validity

Judgement of study validity as low, medium, or high, based on an assessment of the threats to generalizability identified by Campbell and Stanley (1963) namely testing, instrumentation, regression, selection, maturation, selection-maturation, and history.

Design Rating

Judgement of study design quality as low, medium, or high, made by taking into account the following characteristics: adequacy of sample size, presence of random assignment of subjects, adequacy of length of study, appropriateness of variables, and quality of instrumentation.

Method of Calculating Effect Size

Method employed to generate the effect size for the study. Methods can be either direct use of an r-value reported in the study, conversion from a t-value, conversion from an F-value, conversion from a p-value, or conversion from a D-value.

Community Type

Community identification whether it was urban, suburban, rural or mixed.

Socioeconomic Status

Measure of parent's income, average income of a school district, average income of the area where students live, the percentage of students on the federal lunch program, or any measure considering several of these factors.

Disciplinary Focus of the Study

Science discipline was coded as one of the following: biology, chemistry, physics, earth science, or, if it included a mix of two or more of the mentioned science, or if not specified, it was coded general science.

Age Levels

Grouping based on the mean age of the sample: 11 to 13, 14 to 16, or 17 to 19.

Grade Levels

Sample grade level whether it was seventh, eighth, ninth, tenth, eleventh, or twelfth, and either 7th-9th or 10th-12th grade levels.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The proliferation of information in the social and behavioral sciences during the past twenty years has made it increasingly difficult for scholars and practitioners to accurately synthesize the volume of studies produced in many areas of research. In 1976, Glass and others introduced a set of statistical techniques which could be used to provide a general measure of a treatment's effectiveness, explain variations in the outcomes of different studies testing the same hypothesis, and summarize and quantify the treatment effects of a body of studies testing the same hypothesis. He called the techniques meta-analysis and defined it generally as "the statistical analysis of summary findings of many empirical studies" (Glass, McGaw, & Smith, 1981, p.21).

This chapter is structured in two parts. The first part is devoted to introducing the process of meta-analysis, and reviewing several different approaches to meta-analysis. The second part considers literature related to the factors affecting the achievement of students in science, their cognitive reasoning ability, and their science attitudes.

Overview of Meta-Analytic Process

Meta-analysis is a quantitative synthesis of the findings of related studies which has the advantage of summarizing each study while providing more concise means of displaying and interpreting data than a qualitative approach. It connotes a rigorous alternative to the causal, narrative discussions of research studies which is often employed to make sense of the rapidly expanding research literature (Glass et al., 1981).

Meta-analysis is a quantitative cumulation and analysis of descriptive statistics across studies (Hunter, Schmidt, & Jackson, 1982). In other words, previous studies serve as the unit of analysis, and the findings of these studies serve as data points on which to perform the statistical procedures. In this respect then, it is incumbent upon the investigator to locate a sufficiently large representative sample of studies on a given topic, and then quantify or code the various characteristics of each study that may have affected its results.

The procedure for integrating studies can be summarized as follows; (1) collecting all studies, published and unpublished, measuring a particular relationship, (2) coding each study characteristic which might influence the direction and the magnitude of an effect size, (3) computing an effect size for each comparison made in the study, (4) entering all effect sizes into analysis, (5) testing for homogeneity of the effect size using a standard statistical test, (6) testing for the influence of study characteristic using standard statistic tests, (7) averaging effect sizes, and (8) reporting the results of the aggregate studies and the influence of the study methodological variables.

According to Glass et al. (1981), meta-analysis is the statistical analysis of summary findings of many empirical studies. Glass et al. recommend including all studies that meet broad standards in terms of independent and dependent variables, avoiding any judgements of study quality. Slavin (1986) criticized the exhaustive inclusion principle suggested by Glass et al., and proposed excluding lower quality studies from a research review, and considering only the methodologically adequate studies that are high in internal and external validity. Slavin recommends that reviewers apply the "best-evidence" synthesis method for selecting studies to be included in a review (Slavin, 1986). According to Slavin, this method incorporates the best features of meta-analysis and the traditional scholarly literature review. Slavin indicates that "best-evidence" synthesis method applies consistent, well-justified, and clearly stated methodological and substantive criteria for inclusion of studies in the main review and describes individual studies and critical research issues in the depth typical of good-quality narrative reviews. The principles of inclusion of studies for a "best-evidence" synthesis must be well-thought out and well-justified. The methodological adequacy of studies must be evaluated primarily on the basis of the extent to which the study design was valued high in terms of external and internal validity.

Coding of Studies

In many ways, meta-analysis resembles survey research in that it summarizes complex sets of empirical studies. A survey like instrument, called a coding form, is used to collect data from the targeted original studies. Coding forms are information gathering tools by which the researcher identifies information from a study of importance to the meta-analysis. They are similar to questionnaires or interview forms where the researcher uses them to interview each primary study with respect to treatment, design, subjects and results.

Approaches to Generating Effect Size.

A frequently employed meta-analysis summary statistic, the effect size, measures study results on a common scale. The effect size for a study, when described in standard deviation units, is the change in performance that could be attributed to a particular treatment or differences between two compared groups. When described in correlational terms, it is a measure of the association between variables under investigation.

Studies must provide sufficient data for the determination of the effect size. The method used involves obtaining the effect size directly from reported values or calculating the effect size from other statistics or raw data.

One measure of effect size, sometimes referred to as Cohen's D (Cohen, 1977), is the difference between the means of the experimental group and control group divided by σ which is the standardized denominator of the combined experimental and control groups. (See Table 1). In contrast, Hedges (1981) advocates the pooled estimate of the standard deviation in the calculation of an effect size. Hedges derives an effect size by finding the difference between the experimental and control group means and dividing the difference by the pooled standard deviations of the two groups. Glass et al. (1981) compute effect sizes by subtracting the means of the control group from the means of the experimental group. The difference is then divided by the standard deviation of the control group. All these methods require studies that provide sufficient data for the determination of the experimental and control groups means and standard deviations. Rosenthal recommends the Pearson Product moments correlation coefficient r as an effect size estimate instead of the standardized difference between means, an approach which provides more flexibility in gathering data from the original studies.

TABLE 1

FORMULAS FOR ESTIMATING EFFECT SIZES

ES Index		Formula
Cohen'a D	=	$[M_e - M_c]$ / σ pooled
Hedges's G	=	$[M_e - M_c]$ / S pooled
Glass' Δ	=	$[M_e - M_c]$ / S control group
Pearson's r	=	$\Sigma xy / NS_xS_y$

M_e is the mean for the treatment group
M_c is the mean for the control group
σ is the standardized denominator from combined and experimental group.
S is the control group standard deviation.
Σxy is the sum of the products of the paired deviation scores.
S_xS_y are the standard deviations of the distributions.
N is the number of pairs of scores.

Cohen's D, Hedges G, and Glass's Δ effect sizes are computed similarly. They differ only in the statistic used to standardize the denominator. Cohen uses sigma as the standardized denominator de~ived from the combined experimental and control groups. Sigma (σ) is the standard deviation for a population computed using the total sample size N instead of N-1 as the devisor for the sums of squares used to compute standard deviation components. The implicit assumption is that the entire population is being used instead of a sample in whic.. case one would employ N-1 as the devisor for the sums of squares. Cohen (1977) provides formulas for converting some summary statistics to correlation coefficients. Glass uses only the standard deviation for the control group, and Hedges uses the combined standard deviation for the control and experimental groups.

Rosenthal (1984, 1991) recommends using the Pearson r as an effect size measure, and the formula given in Table 1 is the generalized formula for computing this statistic. Rosenthal believes that the Pearson r (1) is easier to statistically convert from a t-test for independent samples to correlated observations, (2) can be computed more accurately than the standardized difference between means in converting some univariate statistics, (3) is easily converted to use in a binomial effect size display (BESD), and (4) has a broader base for understanding as a metric for representing strength in a relationship.

However, the Pearson r is usually derived directly from the source study, if the source study actually contains Personian correlations as a measure of association for the variables being analyzed. If the source study does not include Personian correlations, the Pearson r's is derived algebraically from a univariate statistic, i.e., t-test, F-test, p-value, D-value or from any effect size measures computed using one of the other effect size measures shown in Table 1. The formulas for converting the other effect size measures into Pearson r correlations, and for converting univariate statistics into Pearson r correlations, are done through an algebraic path from the reported statistics. Table 2 indicates how data can be transformed from a t, F, or D to a product-moment correlation measure. Moreover, when nonparametric tests have been employed, a useful estimate of effect size (r) can be obtained from looking up the standard normal deviate (Z) associated with the accurately determined p level and finding r by applying the formula(s) in Table 2.

TABLE 2

ALGEBRAIC CONVERSION FORMULAS TO PEARSON PRODUCT CORRELATION MEASURE

Reported Statistic	Transformation to r_{xy}	
a) Point-biserial	$r_{xy} = r_{pb} \sqrt{n_1 n_2}/um$ u= ordinate of unit normal distribution n= total sample size (Glass & Stanley, 1970, p.171)	$r_{xy} = 1.25\ (r_{pb})$ when $p = n_1/n_2$ is is between between 0.2 & 0.8
b) $t = \dfrac{X_1 - X_2}{s^2\ [1/n_1 + 1/n_2]}$	$r_{pb} = \dfrac{t^2}{t_2 + [n_1 + n_2 - 2]}$ (Glass & Stanley, 1970, p.318)	Conversion from t statistic to a point-biserial correlation. then convert r_{pb} to r_{xy} via a above
c) $F = MS_b/MS_w$ for $J = 2$	$\sqrt{F} = [t]$ then proceed via b) above	Conversion of F statistic to a t statistic and proceed as in item b) above.
d) Cohen's D	$r_{xy} = D/\sqrt{[D^2 + 1/pq]}$ (Cohen, 1977, p.24)	Conversion to Pearson's r from Cohen's D used with unequal ns.
	$r_{xy} = D/\sqrt{[D^2 + 4]}$ (Cohen, 1977, p. 23)	Conversion to r from Cohen's D, used w/ equal ns.
e) Standard deviate (Z)	$r = \sqrt{Z^2/N}$ $r = Z/\sqrt{N}$	Conversion to r from standard deviate Z

Adapted from Glass et al. (1981, p. 149-150)

Adjusting Effect Size Estimates

The Fisher and Hedges Adjustments

As already indicated, Rosenthal (1984, 1991) recommends using the correlation coefficient r as an effect size estimator. As the population value of r gets farther and farther from zero the distribution of r's sampled from that population becomes more and more skewed. This fact complicates the combination of r's. Fisher (1928) addressed this complication and devised a transformation z_r that is distributed normally. The relationship between r and z_r is given by

$$z_r = 1/2 \log_e [(1+r)/(1-r)] \quad (2.1)$$

Fisher (1928, p.172) noted that there was a small bias in Z_r, that can be corrected by dividing the r-population by 2[N-1]. This first approximation bias is to be removed from the obtained z_r which is associated with a corrected r-value. Since we now have a more accurate estimate of the population value of r, the bias calculation can be repeated to obtain a still more accurate correction for bias. Only when N is very small while at the same time the r-population (the actual population value of r) is very substantial is the bias of any consequence.

There are analogous biases in other effect size estimates, such as Glass Δ, Hedge's g and Cohen's d; Hedges (1981) has provided both approximate correction factors. Hedge's unbiased estimator g is given by

$$g= J(m)g \qquad (2.2)$$

where g is the effect size estimate computed as (M1-M2)/S (with S computed from both the experimental and control group) and c(m) is given approximately by

$$c(m) =1-3/[4m-1] \qquad (2.3)$$

where m is the df computed for the experimental and control groups.

<u>The Hunter, Schmidt, and Jackson Adjustments</u>

In addition to the adjustments suggested by Fisher and by Hedges for small sample sizes, Hunter, Schmidt, & Jackson (1982) have suggested that effect sizes be corrected for the unreliability of the two variables being correlated and for the restriction of the range of the variables involved. These corrections can be useful aids to understanding the results of an analysis. Adjustments for unreliability and for restriction of range are applied at the level of the individual study.

Hunter et al. (1982) also suggest adjustments for sampling error at the level of the meta-analytic set of studies. For example, the effect sizes obtained from each of a set of studies could be correlated with some feature of the study such as the year in which it was conducted, or the average age of the subjects involved in each study.

The Glass, McGaw, and Smith Adjustments

Studies included in meta-analysis differ in the precision of the statistical procedures employed in their analysis. Thus repeated measures designs, analysis of covariance designs, and designs employing blocking will tend to produce larger effect sizes and more significant test statistics than would the analogous unblocked posttest only designs. Glass, McGaw, and Smith (1981) have shown how we might convert the results of various designs onto a common scale of effect size (e.g Δ or g) based on the unblocked posttest only. These adjustments can often be quite usefully employed. Glass et al. (1981) provide adjustment procedures that can be used on nonparametric tests of significance. When nonparametric tests have been employed, a useful estimate of effect size r can be obtained from looking up the standard normal deviate Z, associated with the determined p level, using a table of Z values and then finding r from:

$$r = \sqrt{Z^2/N} = Z/\sqrt{N} \qquad (2.4)$$

Averaging Effect Sizes

Two major ways are involved in evaluating the results of research studies - in terms of their effect sizes and in terms of their statistical significance. In other words, when combining a set of studies we are at least as interested in the combined estimate of the effect size as we are in the combined probability.

There are at least two ways to average effect sizes. The simplest way is to compute a simple average of the effect size estimates. The more accurate way is to compute a weighted average which takes into account some aspects of the study. Hedges (1981) suggests weighing the effect sizes by the variance of the independent samples of the study effect sizes. Rosenthhal (1984, 1991) suggests weighing by sample size. The procedure is to transform the r correlation into the Fisher Z statistic by applying the formula $Z = 1/2 \log_e [(1+r)/(1-r)]$, or referring to a table that facilitates this conversion (Wert, Neidt, & Ahmann, 1954, p.425-426). The sample sizes associated with each of the effect sizes are also determined. The formula given by Rosenthal for computing the weighted mean Fisher Z , which is subsequently converted to a mean r correlation coefficient, is:

$$Z = \frac{SUM_{j=1 \text{ to } K} (N_j - 3) Z_j}{SUM_{j=1-K} (N_j - 3)} \qquad (2.5)$$

where: Z_j = Fisher Z transformation of r for any effect size j.
N_j = sample size associated with each study j
K = number of studies pooled

Consistency of Effect Sizes

When the results from many different studies are merged, there is always a concern about the construct validity of the merged studies. Statistical techniques which measure the consistency of the study effects across studies can be used in tandem with the researchers' conceptual knowledge of the field of study to ascertain whether or not the body of studies share a common underlying effect size, In this manner a meta-analytic researcher can determine if the body of research included in the meta-analysis is measuring the same phenomenon. Hedges (1981) explains that it can be misleading to combine estimates of effect sizes across studies if the studies do not share a common underlying effect size. Hedges and Olkin (1989) and Rosenthal (1984, 1991) developed tests of homogeneity for effect sizes.

The test of homogeneity attempts to explain the variability in differences among effect sizes by determining if the effect size variance is significantly different from what would be expected from sampling error. If there is no significant difference, the researcher can reasonably assume that the underlying population of effect sizes is measuring the same phenomena. If there is significant variation, the researcher needs to examine the distribution of studies to determine the source of variation.

To test the homogeneity of effect sizes, Pearson r correlations are derived for each effect size. The transformed Fisher Z of the r correlation value and the sample size associated with each of the effect sizes are determined. The homogeneity of the set of effect sizes (r) can then be obtained from a Chi square using the following formula (Rosenthal, 1984, 1991):

$$X^2 = \mathrm{SUM}_{j=1\text{-}K}\ (N_j - 3)(Z_j - Z^2) \qquad (2.6)$$

$$\text{with df} = K-1$$

where: Z_j = Fisher Z transformation of r for an effect size j.
N_j = sample size associated with each study j
K = number of studies pooled
Z = weighted mean Fisher Z

The resulting Chi square value with K-1 degrees of freedom (where K = the number of effect sizes) is used with the Chi square critical values table to determine if the variance of effect sizes is significantly greater than a null hypothesis of no relationship.

If the null hypothesis is not rejected, it is assumed that the distribution of effect sizes share a common underlying effect size. If the null hypothesis is rejected, the effect sizes are heterogeneous and the researcher will need to examine the distribution of effect sizes to determine the source of systematic variance among the effect sizes. Snedecor (1946) devised a measure of the deviation of the sample from the hypothetical population ratio donated by X^2 (Chi-Square). That is, he showed how a X^2 test could be employed to assess the heterogeneity of a set of correlation coefficients, and help us judge whether the correlations differed significantly from each other.

Averaging Significance Levels

Rosenthal (1984, 1991) identifies seven basic methods for combining the probabilities obtained from two or more studies testing essentially the same directional hypothesis as follows: (1) adding logarithms of the associated probability values, (2) adding the probability values, (3) adding t's, (4) adding Z-scores associated with probability values, (5) adding weighted Z-scores associated with probability values, (6) testing for the mean probability value, (7) testing for the mean Z-score associated with the probability values, (8) counting the number of positive and negative probability values, and (9) blocking by incorporating study statistics into an overall ANOVA.

The simplest and most versatile method of testing for significance - the procedure applied in this study - is the method of adding Z's called the Stouffer method by (Mosteler and Bush 1954), which involves obtaining the standard normal deviate Z corresponding to the p values. The standard normal deviate Z associated with the p value is obtained and summed, and then divided by the square root of the number of studies being combined (Adcock,1960; Cochran, 1945: Stouffer, Suchman, Devinnery, Star & Williams, 1949, p.45, in Rosenthal 1984, 1991).

$$Z = SUM_{j=1-K}\ Z/\sqrt{K} \qquad (2.7)$$

K = number of studies pooled.
Z = standard normal deviate.

The variance of the sum of independent normal deviates is the sum of their variances. Hence, this sum is equal to the number of studies, since each study has unit variance.

In this study an estimate of the standard normal deviate (Z) was derived from the r correlation coefficient value by multiplying the r correlation coefficient value by the square root of N. This procedure will yield a generally conservative approximation to Z according to the following equation:

$$Z = r\sqrt{N} \tag{2.8}$$

Where N is the sample size of the study associated with each particular effect size.

The reason for including six or more studies in the analysis is justified by Snedecor (1946) who includes six correlations in his classic textbook Statistical Methods Applied to Experiments in Agriculture and Biology, as an example of how to combine correlation coefficients. Rosenthal (1984, 1991) points to the fact that subsequent editions involved in comparing and combing the results of a series of studies have retained the same example, and advocated six as the minimum number of studies to combine.

Meta-Analytic Approach Chosen for this Study:

Rosenthal's Approach

The meta-analytic method adopted for this study is Rosenthal's approach. As already mentioned, Rosenthal emphasized the r correlation value as an effect size estimate. One of the reasons is that the r value does not require any special adjustment when generated from t-tests for independent samples to correlated observations. Another reason is that r value can be computed accurately from the information provided by the author of the original study. A third reason has to do with the simplicity of its interpretation in practical terms. Moreover, the r value can be adjusted for sample size, and the research results averaged in terms of their effect sizes and in terms of their statistical significance.

Rosenthal's approach applies the more progressive quantitative methods for synthesizing study results that avoid the problems of earlier analysis. Rosenthal (1984) indicates: "the intuitive approach of simply averaging study results has been shown to be conceptually problematic." (Rosenthal. 1984, p.125). Additionally, these new methods provide an explanation of the study results, given by different statistical models. Thus the reviewer can ask not only whether significant differences exist between the variables, but also whether, after moderator variables are considered, any "unexplained" variations remain.

Overview of Related Literature

The following review includes the findings of meta-analysis reviews as well national and international studies. The literature review is divided into four sections. Section One surveys the studies that dealt with science achievement as related to: (1) student characteristics which included gender and race; Section Two (2) environmental variables which include father's education, mother's education, availability of educational items at home, plans and aspiraions, and hours of homework per week variables; Section Three (3) scholastic abilities, which include language ability, mathematics ability, science ability, general ability and cognitive reasoning ability; Section Four (4) affective variables such as attitudes toward science, and attitudes toward science learning.

Study Outcomes and Student Characteristics

Science Achievement and Gender

The past decade has seen considerable growth in the attention given to gender-related differences in learning, particularly in science. A primary stimulus has been the under-representation of women in traditionally male-dominated areas of study and work space. A number of meta-analyses have been carried out which examined the relationship between gender and science achievement.

In a meta-analysis project conducted at the University of Colorado, and funded by the National Science Foundation, Fleming and Malone (1983) examined the relationship of student characteristics to student performance in science. Their findings indicate that males tended to score higher than females on measures of science achievement with a mean correlation r= 0.09 based on 49 studies. When these findings were broken down by grade levels, several interesting trends became apparent. At the middle school levels, males outperformed females in science achievement, with a mean correlation r= 0.14, based on 11 studies. At the high school level, this difference decreased, with males scoring higher than females on science achievement with a mean correlation of 0.10 based on 18 studies. A breakdown of subject areas also shows interesting results for the effect of gender on the combined cognitive level. Physical science, general science, and chemistry values showed that males scored higher than females with effect sizes r= 0.30, r= 0.29, and r= 0.16, respectively.

Using a meta-analysis technique, Kahl et al. (1982) examined gender-related trends in pre-college science achievement. The analysis revealed that overall gender differences were small with males generally outperforming females. But, when these achievement differences were broken down by grade levels, some differences were considerably larger. The results revealed a mean coorelation r= 0.23 (22 studies) at the junior high school, and a mean correlation r= 0.12 (37 studies) and at the senior high school. At the secondary level, Kahl reported gender-related differences favoring males for cognitive outcomes associated with selected science disciplines. There appeared to be little difference between the performance levels of males and females in biology and earth science. However, males had a decided advantage in other disciplines. The results revealed gender-related differences in general science achievement with a mean correlation r= 0.29 (10 studies); a mean correlation r= 0.33 in physical science achievement (8 studies); a mean correlation r= 0.22 in physics achievement (3 studies), and a mean correlation r= 0.16 in chemistry achievement (8 studies).

In a meta-analysis review, Steinkamp and Maehr (1984) examined the magnitude and direction of gender differences in school age boys' and girls' science achievement. A comprehensive review of journal articles/reports, large-scale national/international studies, and standardized testing procedures appearing in the literature since 1965 provided 406 comparisons for science achievement and 207 comparisons for motivation. The results showed that boys consistently achieved higher than girls. Journal articles revealed a mean effect size r= 0.21 based on 93 studies; standardized tests indicated an effect size r= 0.43, based on 70 studies; while in large-scale studies, a mean effect size r= 0.48 was reported, based on 28 studies.

Becker (1989) reviewed the quantitative synthesis of correlational research on science affect, ability, and achievement conducted by Steinkamp and Maehr (1983). Their findings were reassessed by employing a meta-analysis approach which used tests for fitting categorical models to effect sizes. The reexamination focused on explanations of the reported differences in science achievement between males and females as well as on the role of measurement variables in the size of the gender differences. The size of gender differences depended in part on the science subject matter being tested and also on the type of measure used in the studies. Mean gender differences for two of the subject-matter groups were significantly greater than zero. The effects for studies of biology and physics both showed advantages for males, of g= 0.14 and g= 0.35 standard deviations, respectively. There were no significant differences between males and females on either geology or chemistry, although a mean effect size of g= -0.12 standard deviations, in favor of females was obtained for studies of chemistry, and a mean effect size of g= 0.07, in favor of males. was obtained for general science. General-Science studies were further subdivided according to the school grade and the subjects. Results revealed a mean effect-size of g= 0.29, at the junior high level, and a mean effect size of g= 0.17, at the senior high level, favoring males. Further analysis of gender differences in general science by type of measure revealed a mean effect size of g= -0.07, favoring females, for standardized tests; a mean effect size of g= 0.35, favoring males, for locally-made tests; and a mean effect-size of g= 0.08, favoring males, for tests made specifically for the studies.

Keeves and Kotte (in Keeves, 1992) summarized the results of the first 1970-1971 IEA study with regard to gender-related differences in science achievement. Keeves indicates that science achievement differences between the males and females in the United States increases with age from 10-year-olds to 14-year-olds to the terminal secondary level. In addition, these differences are generally greater in physics than in chemistry and greater again in biology. For the 14-year-old level, an effect size of r= 0.18 was reported for biology, favoring males, an effect size of r= 0.28, favoring males, was also reported for chemistry, and an effect size of r= 0.56 was reported for physics, with a total effect size of r= 0.44. At the terminal secondary school level, an effect size of r= 0.36 was reported in biology, an effect size of r= 0.94 in chemistry, and an effect size of r= 0.62 in physics, with an effect size r= 0.56 for the total achievement in science.

To summarize the results of the meta-analysis studies for sex-related differences in science achievement, we come to the conclusion that males outperform females. When broken down by grade levels, the differences are larger, favoring males, at the middle and high school levels. Differences in cognitive outcomes, favoring males, are associated with selected science disciplines such as physics and chemistry. (See Table 3)

TABLE 3

EFFECT SIZES: GENDER EFFECTS
ON MEASURES OF SCIENCE ACHIEVEMENT

	E.S.	N	Discipline	Grade Level
Fleming & Malone (1983)	0.09	49		
(reported as r)	0.14	11		Junior
	0.10	18		Senior
	0.30		Physics	
	0.29		General	
	0.16		Chemistry	
Kahl (1982)	0.29	10	General Science	
(reported as r)	0.02	13	Biology	
	0.07	3	Earth Science	
	0.33	8	Physical Science	
	0.16	8	Chemistry	
	0.22	3	Physics	
	0.23	22		Junior
	0.12	37		Senior
Steinkamp & Maehr	0.21	93	Journals	
(1984)	0.43	70	Standard Tests	
(reported as r)	0.48	28	Large Studies	
Becker (1989)	0.14		Biology	
(reported as g)	-0.12		Chemistry	
	0.35		Physics	
	0.07		General Science	
	0.29		" "	Junior
	0.17		" "	Senior
	-0.07		" "	Standardized
	0.35		" "	Local
	0.08		" "	Study-made
Keeves & Kotte	0.18		Biology	Junior
(1992)	0.28		Chemistry	"
(reported as r)	0.56		Physics	"
	0.44		Total	"
	0.36		Biology	Senior
	0.94		Chemistry	"
	0.62		Physics	"
	0.56		All	"

Science achievement in the United States has been studied by three major educational organizations. The International Association for the Evaluation of Educational Achievement (IEA) sponsored the First and Second International Science Studies. The National Science Foundation (NSF) supported three different studies between 1969 and 1976. The National Assessment of Educational Progress (NAEP) conducted three assessments in science, with data collected in 1969-70, 1972-73, and 1976-77.

The most extensive data on the differences between the sexes in science achievement test scores have come from the cross-cultural survey of science achievement conducted by the International Association for the Evaluation of Educational Achievement (IEA). The first international science study was carried out in 1970-71 and involved 19 countries. The major report on findings from the IEA's First International Science Study is Science Education in Nineteen Countries (Comber & Keeves, 1973). The following were among the major findings of the study:

1. Home background was a good predictor of science achievement.

2. Boys did better in science than girls, especially in the physical sciences. Boys also showed a consistently more favorable attitude toward science.

3. In Grades 9 and 12 there was a relationship between the opportunity to learn and science achievement.

Comber and Keeves (1973) stated that boys achieved better than girls in science (one-fourth of a standard deviation) from a study of 19 countries. They also reported that sex accounted for two percent of variance in science achievement.

Since the early 1960s, research concerning the effects of the National Association for Educational Progress (NAEP) science assessment has been conducted for sex differences in science learning and its determinants.

In a summary of the NAEP assessments, Weiss et al. (1989) in the Research Horizon Project concluded the following:

> - Based on data collected by NAEP since 1969-70, science proficiency of 9-, 13-, and 17-year-olds in 1986 remains at or below what it was in 1969. While science proficiency for 17-year-olds showed significant improvement from 1982 to 1986, the gains were insufficient to bring scores back up to the level of students in the 1970 assessment.
>
> - Male-female differences in science proficiency varied though females generally remained well below their male counterparts. While 9- and 13-year-old males improved their performance from 1977 to 1986, females at the same ages exhibited no significant change.
>
> (Weiss et al. (1989), p.9)

A number of important reviews concerning the effects of sex on science achievement appeared in the 1980s. Haertel, Walberg, Junker, and Pascarella (1981) examined data from the 1976-1977 National Association for Educational Progress (NAEP) science assessment, to explore sex differences in science learning with controls for ethnicity and parental socioeconomic status. The sample was composed of 2,350 13-year olds, and a significant sex-specific trend in science motivation was detected. For males, increased motivation was found with higher levels of socioeconomic status.

Another study conducted by Pascarella et al. (1981) examined the 1976-1977 NAEP assessments in science on national samples of 2,350 13-year-old, and 2,944 17-year-old students. A mean correlation, favoring males, was revealed between sex-related difference and science achievement of r= 0.13 for the 13-year-old sample, and a mean correlation of r= 0.14 for the 17-year-olds.

Zerega, Haertel, Tsai and Walberg (1986) analyzed the 1976 Science Assessment of the National Assessment of Educational Progress (NAEP) data in order to explore the size and influence of differences between boys and girls in science learning during late adolescence. Analysis of the data showed significant sex differences in late adolescent science achievement. Male students scored significantly higher on science achievement and motivation, and perceived their classroom environment more positively than did females.

Schibeci and Riley (1986) investigated the influence of students' background and achievement in science. The data analyzed came from Booklet 4 given to a total of 3,135 individual 17-year-olds during the 1976-1977 National Assessment of educational Progress (NAEP) survey.

The influence of sex on student attitudes and achievement was examined. The results indicate a substantial correlation between sex-related differences and science achievement with a correlation r= 0.25 in favor of males.

Linn et al. (1987) analyzed the data from the 1976-1977 NAEP Science Assessment for seventeen-year-olds to explain gender differerces in achievement and attitudes towards science. Females were more likely to use the "I don't know" response, especially for items with physical science content or masculine themes.

Earlier studies of sex differences in science achievement were carried out by Walberg (1967) using samples of Harvard Project Physics students in grades 11 and 12. In "Dimensions of Scientific Interest in Boys and Girls Studying Physics" (Walberg, 1967), the Reed Science Activity Inventory was administered to a national sample of physics students, 725 boys and 332 girls. Five dimensions of reported science activities were analyzed. Girls reported more activity than did boys in three dimensions: Academic, Nature Study, and Applied Life. It was noted that the girls in physics or in the Harvard Project Physics sample were select, since they scored one standard deviation above the national average of high-school students on cognitive measures. Walberg, in summarizing his results, indicated that cultural stereotyping of female roles may be responsible for the differences.

Walberg's findings also led him to suggest that boys might be more attracted to activities involving physical manipulation, while girls would be stimulated by discussion of science applications.

Butts (1981), in a review of literature pertaining to students of various ages, indicated that, in general, no science achievement differences could be attributed to gender. He indicated that in 1979 nine of 13 studies published which examined the relationship of achievement and attitudes toward science suggest "that students of higher aptitude or ability tend to do significantly better on measures of science achievement than do students of lower ability or aptitude" (p.272). Butts reported similar findings for studies conducted at all grade level. In most of these studies IQ or some similar measure of general ability was used as the aptitude/ability indicator.

Reyes and Padilla (1985), in their review of the literature regarding sex differences in science and mathematics, reported four general findings of recent research: (1) females believed that science is just for males, (2) females preferred the life sciences while males preferred the physical sciences (females, however, seemed to do better than males in chemistry), (3) gender differences in achievement were at their maximum during the middle school years, and (4) in the last six years the difference between male and female motivation toward science widened. These authors contended, like others, that differences in spatial visualization skills, i.e., the ability to mentally manipulate three dimensional objects, could explain male superiority in science achievement.

Cognitive Reasoning Ability and Gender

In a meta-analysis research, Tohidi (1982) reviewed the studies undertaken in the time period of 1965-1981 in order to determine the magnitude and direction of gender-related differences in Piagetian-type logical operations. Seventy studies were identified with a mean effect size of r= 0.32. In the United States and Canada, a mean effect size of r=0.27 was revealed based on 81 effect sizes. These difference tend to favor males in different domains of Piagetian logical operations.

Attitudes Related to Science and Gender

Using a meta-analysis technique, Kahl et al. (1982) examined sex-related trends in pre-college attitudes toward science. The sex-related trends in attitudes toward science, across grade levels, revealed a mean correlation of r= 0.08 (25 studies) at the junior high level, and a mean correlation of r= 0.07 (45 studies) at the senior high school level in favor of males.

Fleming and Malone (1983) examined the relationship of student characteristics to their attitudes toward science. Gender-related differences in students' attitudes toward science, tended to favor boys with an effect size r= 0.07, based on 37 studies. When broken down by grade level, considerable differences in attitudes were apparent. At the middle school level, females had more positive attitudes toward science, with a mean effect size r= - 0.11, based on 7 studies. This trend reversed among high school students, where males outscored females on science attitude measures, with a mean effect size of r= 0.12 based on 15 studies.

Steinkamp and Maehr (1984) examined the magnitude and direction of gender differences in school-age boys' and girls' motivational orientation. With regard to students' motivational orientation toward science achievement in the United States, the differences between the sexes tended to favor males. Journal articles revealed a mean effect size of r= 0.10 (74 studies); standardized tests had an effect size of r= 0.16 (3 studies); while in large-scale studies, a mean effect size of r= 0.29 was reported (14 studies). To confirm the findings of earlier reviewers, they found that sex differences appeared to be greater in the United States than in other countries, and greater for students at upper socio-economic status (SES) levels. (See Table 4)

TABLE 4

EFFECT SIZES: GENDER EFFECTS
ON MEASURES OF SCIENCE ATTITUDES

Author	E.S.	N	Grade
Fleming and Malone	0.07	37	
(1983)	-0.11	7	Junior
(reported as r)	0.12	15	Senior
Kahl (1982)	0.08	25	Junior
(reported as r)	0.07	45	Senior

Science Achievement and Race

Much has been written about racial differences or ethnic background differences or "minority differences," as they are sometimes called, as they pertain to school achievement. The effect of race on science achievement and attitudes toward science has received the same degree of attention for being an essential factor. However, race has rarely been singly examined as an influence on science achievement, rather, it is usually embedded with a group of variables whose effects on science achievement are being investigated. It also has been historically associated with SES and gender measures of one kind or another.

In the meta-analysis project carried out by Fleming and Malone (1983), the relationships between student characteristics and student outcomes in science were examined. Their findings implicated race as an important factor in science achievement. Anglo/Black comparisons on science achievement revealed an effect size of r= 0.16 (15 studies), in favor of Anglos. Anglo/Black racial differences in science achievement remain fairly constant with an effect size of r= 0.20, based on 5 studies, at the middle school level, and an effect size of r= 0.15, based on 4 studies, at the high school level. When broken down by grade level, Anglo/Black differences in science achievement remain fairly constant with an effect size of r= 0.20, based on 5 studies, at the middle school level, and an effect size of r= 0.15, based on 4 studies, at the high school level.

In a meta-analysis study, racial differences in science achievement were analyzed by Kahl (1982). When broken down by grade levels, White/Black racial differences revealed a mean correlation of r= 0.19 (12 studies), at the junior high level, and a mean correlation of r= 0.15 (10 studies) at the senior high level.

The effect size comparisons for race were found to be larger than gender effects, which indicated that race was a mo_e powerful influence on science achievement than gender for all three ethnic groups.

To summarize the results of the meta-analysis studies, we come to the conclusion that Anglo/Black differences on science achievement is fairly large. The trends in science achievement across grade levels among the Anglo/Black racial groups remain fairly constant across the middle and high school levels. (See Table 5)

TABLE 5

EFFECT SIZES: RACE EFFECTS
ON MEASURES OF SCIENCE ACHIEVEMENT

Author	E.S.	N	Grade
	(White/Black)		
Kahl (1982)	0.19	12	Junior
(reported as r)	0.15	10	Senior
	(White/Black)		
Fleming & Malone	0.20	5	Middle School
(reported as r)	0.15	4	High School

For a review of the effects of race or ethnic background on science achievement and attitudes, a discussion of the findings of the national assessment studies is discussed.

Pascarella et al. (1981) examined Package 4 of the 1976-1977 National Assessment of Educational Progress (NAEP) data. The analyzed sample included 2,350 13-year-old and 2,944 17-year-old. Racial differences revealed a mean correlation r of 0.37 for the 13-year-old sample, and a mean correlation r of 0.35 for the 17-year-old sample in favor of Whites.

Schibeci and Riley (1986) investigated the influence of race on science achievement. The data analyzed came from Booklet 4 given to 17-year-olds during the 1976-1977 National Assessment of Educational Progress (NAEP) survey. Racial background was reported to have an influence on science achievement, with Whites scoring higher. Racial differences and science achievement revealed a mean correlation of 0.30 in favor of Whites as compared to other racial groups.

In the data summary of trends in academic achievement in science of the nation's 9-, 13-, and 17-year-olds, as assessed by the National Assessment of Educational Progress (NAEP) 1970-1990 results, Mullis et al. (1991) indicated that the performance of the students was as follows:

> - From 1970 to 1977, the average proficiency in science of White 9- and 13- year-olds declined. During the same period the average proficiency of 9- and 13-year-old Black students remained the same.
>
> - Between 1977 and 1990, the average science proficiency of 9- and 13-year-olds increased in all three racial/ethnic groups.
>
> - There was a decline in average science performance for White and Black 17-year-olds from 1969 to 1982.
>
> - The average science proficiency of 17-year-olds in all three racial/ethnic groups increased from 1982 to 1990.
>
> - For Black students, average performance in science of 9-year-olds in 1990 was above that in 1970, but for 13-and 17-year-olds there was no difference from 1970 to 1990.
>
> (p. 25-27)

Another study was carried out by Kahle (1982) who directed her concern toward minority achievement scores on 1969-1973 NAEP assessment. When the results of the NAEP survey of science attitudes were compared with science scores, black students were shown to exhibit positive science attitudes and interests. She found that although the majority of student scores dropped more significantly from 13 to 17 years, the minority students' attitudes toward science still remained high relative to the white student population. Her explanation for this difference is the poverty level in which many minority students live. Their lack of exposure to science leaves them with more enthusiasm for the subject than white students exhibit, but also less confident about their own capabilities and future use of science. Along with poverty, segregation, teacher expectations, and classroom practices are mentioned as key components of these results. Kahle pointed out that many minority students lack educational opportunities due to the "tracking" structure of the present system. These students are often placed in tracks where the lowest science courses are taught and where prerequisite classes are a limiting factor.

Study Outcomes and Environmental Variables

Measures of environmental variables include home environment constructs, parental education, parental occupation, presence of science-related educational items at home, or parental involvement in school homework. Often the term socioeconomic status (SES) is used as a substitute for home environment. Accurate measurement of socioeconomic status (SES) is critical to research in and about schools, but it is difficult to find widely accepted standard definitions (White, 1982). According to St. John (1970), the four most commonly used indices of SES are parental occupation, parental education, parental income, and family possessions.

White (1982) maintained that there was a major concern raised by readings of the literature about the strength of the relationship between SES and academic achievement. Possible explanations for a large part of the variation may lie in the many and varied ways in which SES is defined as a variable in educational research.

Science Achievement and Environmental Variables

There have been several reviews of research and meta-analyses in which home background has been analyzed for its effect on achievement. The home environment is characterized by many different measures. In fact, much of the difficulty in comparing various studies using the home environment as a measure is a lack of uniformity in the definition of the scale. While these indices would be expected to be highly correlated, they do not measure the same construct. Variables have generally yielded mean correlations of r= 0.25 to r= 0.42 and accounted for a total of about 10 to 18 percent of the explained variance. As already mentioned, most studies have tended to include both parents' education and occupation in their studies. Some have included expectations or other home variables.

Several meta-analysis studies analyzed the effects of home environment constructs on science achievement. In a meta-analysis study, Kremer and Walberg (1981) analyzed 26 studies covering the years 1964 to 1979, on the social and psychological influences on science learning. They defined the home environment construct as any characteristics of the student's environment over which a parent or guardian exerted direct control. As examples of this construct, they cited parent occupation as a measure of SES, presence of science-related equipment and documents in the home, or parental involvement in school work. Nine of the 13 socioeconomic (SES) studies considered in their review showed a positive relationship between parents' education and science learning. They reported a mean correlation between socioeconomic status and science learning of $r= 0.25$ (three studies). If parents' education, parents' expectation for student achievement, and science equipment at home are included in the analysis, the mean correlation between science achievement and home background was $r= 0.30$ (10 studies); about 10 percent of variance in science achievement was explained by home background.

In a meta-analysis, Fleming and Malone (1983) analyzed the relationship between socioeconomic status and science achievement. The variable socioeconomic included in most studies is based either on father's income, average income of a school district, average income of the area where students live, or measures considering several of these factors. The correlation between socioeconomic status and science achievement was r= 0.25 (21 studies). When broken down across grade levels, the correlation between SES and science achievement revealed mean correlations of r= 0.26 (5 studies) at the middle school level, and r= 0.30 (6 studies) at the high school level. A mean correlation between home environment and science achievement was found to be r= 0.23 based on seven studies. Kahl et al. (1982) reported a mean correlation between socioeconomic status and science achievement of r= 0.29 (13 studies) at the junior high level, and a mean correlation of r= 0.28 (14 studies) at the senior high level.

Walberg (1986) reported a median correlation between home environment and learning in science of r= 0.32 based on three studies. In the same study, Walberg (1986) demonstrated that home had the second highest standardized regression weight ($p<.01$) and socioeconomic status had the highest standardized regression weight ($p<.05$).

In a quantitative synthesis, Iverson and Walberg (1982) analyzed the correlation of home environment and academic learning in eight countries over a 19-year-period. They indicated that the substantive meaning of SES in its relationship to home environment and school learning is unclear and will remain a confounding effect until researchers specify and include it in their analyses.

Correlations of ability, motivation, and achievement with indices of parent stimulation of the student in the home, based on 18 studies, are considerably higher than those with indices of socioeconomic status; specifically the median of 92 simple correlations of home environment and learning is r= 0.37 and of 62 multiple regression-weighted composites is r= 0.44. The analysis suggests that academic ability and achievement are more closely linked to the measures of sociopsychological environment and intellectual stimulation in the home than they are to parental socioeconomic status indicators such as occupation and amount of education. (See Table 6)

Results of the above mentioned meta-analytic studies revealed means of correlation with science achievement that range from r= 0.25 to r= 0.32, which account for 10 percent of the variance explained by measures of socioeconomic status. In summary, students of higher socioeconomic status whose parents had high education scored higher in science achievement. Parents can highly influence their children's initial performance and interest in science by providing relevant books and materials, being involved with their children's homework, and conducting science activities outside school. Parents who themselves have had higher educational backgrounds have the knowledge to assist and to influence their children.

TABLE 6

EFFECT SIZES: EFFECTS OF ENVIRONMENTAL VARIABLES ON MEASURES OF SCIENCE ACHIEVEMENT

Author	Environmental Variables E.S.	N	Grade
Fleming & Malone (reported as r)	0.25	21	
	0.26	5	Middle
	0.30	6	High School
Kahl (1982) (reported as r)	0.29	13	Junior
	0.28	14	Senior
Kremer & Walberg (reported as r)	0.30	10	
	0.25	3	
Iverson & Walberg (1982) (reported as r)	0.37	92	
	0.44	62	
Walberg (1986)	0.32	3	
	(Home Environment)		
Kremer & Walberg (1980) (reported as r)	0.24	13	
	(Home Environment)		
Fleming & Malone (1983) (reported as r)	0.23	7	

In constructing a model of educational productivity in high school science, Walberg, Pascarella, Haertal, Junker, and Boulanger (1982) used 1974 NAEP data collected on 3,049 17-year-old students. Walberg's (1978) Productivity Model draws on the general education empirical literature and provisionally identifies the primary factors influencing general school learning. The constructs are ability, motivation, and age or developmental level; quality and quantity of instruction; and home, peer, and classroom social environments. Socioeconomic status was operationally defined as the highest amount of either parent's education (3 categories: no college, some college, or college graduate). They regressed the science achievement scores of the students on indices of their SES, motivation, quality of instruction, social psychological environment, homework, and home conditions.

Pascarella, Walberg, Junker, and Haertel (1981) analyzed the data provided by NAEP 1976-1977, Package Four, for correlations between father's and mother's level of education, which were included under the following categories: no college, some college, and college graduate. Home variables addressed the questions "Is there an encyclopedia in your home?", and "Does your family get a newspaper regularly?" A total of 2,350 13-year-old and 2,944 17-year-old students were included the analyses. These samples were composed of an almost equal number of boys and girls. The majority of the students were white, although Blacks and other racial groups were represented. Most parents of students in the two samples were blue-collar workers or farmers. The relationship between mother's education and science achievement revealed a correlation of r= 0.26 for 17-year-olds, and a correlation of r= 0.20 for 13-year-olds. Father's education and science achievement revealed a correlation of r= 0.27 for 17-year-olds, and r= 0.21 for 13-year-olds. Home environment revealed a mean correlation with science achievement of r= 0.34 for 17-year-olds, and r= 0.35 for 13-year-olds.

Schibeci and Riley (1986) investigated the influence of home environment and parents' education on student achievement in science. The data analyzed came from Booklet Four given to 17-year-olds during the 1976-1977 National Assessment of Educational Progress (NAEP) survey. Home environment was scored on four items; example, "Is there an encyclopedia in your home?" Parents' education was rated by the highest level of education reported by the respondents. Homework was rated by the time spent on homework. The results revealed a substantial influence due to the three mentioned variables, with a correlation with science achievement of r= 0.30 for home environment, a mean correlation of r= 0.38 for parents' education, and a mean correlation of r= 0.20 for homework. These results coincide with the findings of Zerega et al. (1986) from the 1976

Science Assessment of the National Assessment of Educational Progress (NAEP), which concluded that increased parental education is associated significantly with higher levels of almost all productivity factors.

The results of a previous National Assessment of Educational Progress (NAEP) survey (Sauls, 1976) showed the same pattern; students whose parents had post-high school education achieved higher than those students whose parents did not have post-high school education. Students whose parents had professional occupations achieved higher than those whose parents had non-professional occupations. Pascarella et al. (1981) NAEP data in Package Four, on 2,350 13-year-old and 2,944 17-year-old students revealed that most parents of students in the two samples were blue-collar workers or farmers, somewhat fewer were classified as professional-managerial, clerical, or skilled labor. Parents of approximately 16 percent of both student samples were on welfare or not regularly employed. With regard to 17-year-old students, the results revealed a mean correlation of r= 0.27 between father's education and science achievement, and a mean correlation of r= 0.26 between mother's education and science achievement. As for 13-year-old students, the results revealed a mean correlation of r= 0.21 between father's education and science achievement, and a mean correlation of r= 0.20 between mother's education and science achievement. Home environment revealed a mean correlation with science achievement of r =0.35 for the 17-year-olds and the 13-year-olds. Walker (1976) analyzed the six International Association of Educational Progress (IEA) studies and found that home background accounted for 11 percent of the variance. Keeves and Saha (in Keeves, 1992) analyzed the 1970-1971 IEA assessment results in the United States for the relationship between home background measures and science achievement test scores. The results revealed a correlation of r= 0.29 between science achievement and father's education, a correlation of r= 0.25 between mother's education and science achievement, and a correlation of r= 0.25 between science achievement and the availability of books at home.

Study Outcomes and Scholastic Abilities

Scholastic abilities include mathematics ability, language ability, general ability, science ability (prior knowledge), and cognitive reasoning ability.

Reviews of research and meta-analysis have been carried out that include these variables related to science achievement, cognitive reasoning ability, and attitudes related to science.

Science Achievement and Language Ability

There have been several reviews of research and meta-analyses in which language ability has been related to science achievement.

Thorndike (1973) stated that in the international evaluation of reading comprehension, the correlation between science achievement and reading comprehension was r= 0.52. According to Thorndike, language ability accounted for about 16 to 25 percent of variance in science achievement. Thorndike's results are very similar to the results obtained in more recent research of the 1970's and 1980's. Fleming and Malone (1983) found a mean correlation between science achievement and language ability of r= 0.41 (5 studies). They also reported a mean correlation of r= 0.62 (4 studies), at the middle school level, and a mean correlation of r= 0.47 (4 studies) at the high school level.

Kahl (1982) reported a mean correlation between science achievement and language/verbal ability of r= 0.59 (3 studies), at the junior high level; and a mean correlation of r =0.47 (8 studies), at the senior high level. Kahl also reported that science achievement and reading ability had a mean correlation of r =0.62 (5 studies), at the junior high level, and a mean correlation of r =0.43 (5 studies), at the senior high level. (See Table 7)

The relationship between language ability and science achievement appears to be consistent over time. A substantial correlation is reported which ranges from r= 0.41 to r= 0.62. Language ability generally explains about 25 percent of the variance in science achievement.

TABLE 7

EFFECT SIZES: LANGUAGE ABILITY EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Source	Science Achievement E.S.	N	Grade
	(Reading Ability)		
Thorndike (1973) (reported as r)	0.52		
	(Language Ability)		
Fleming & Malone (1983) (reported as r)	0.41	5	
	(Reading Ability)		
Fleming & Malone (1983) (reported as r)	0.62	4	Middle
	0.47	4	Senior
	(Language/Verbal)		
Kahl (1982) (reported as r)	0.59	3	Junior
	0.47	8	Senior
	(Reading)		
Kahl (1982) (reported as r)	0.62	5	Junior
	0.43	5	Senior

Science Achievement and Mathematics Ability

Boulanger (1981) reported a correlation between quantitative ability and science achievement of r= 0.51 (9 studies). Fleming and Malone (1982) conducted a meta-analysis related to student characteristics and outcomes in science using 302 studies covering the years from 1960 to 1981. They reported a mean correlations between science achievement and mathematics ability of r= 0.43 (7 studies) at the high school level. Kahl (1982) reported a mean correlation between science achievement and mathematics ability of r= 0.52 (three studies) at the junior high level, and mean correlation of

r= 0.45 (15 studies) at the senior high level. (See Table 8)

These studies indicate that mathematics ability is strongly related to science achievement and accounts for about 16 to 25 percent of variance in science achievement.

TABLE 8

EFFECT SIZES: MATHEMATICS ABILITY EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Source	E.S.	N	Grade
Kahl (1982) (reported as r)	0.52	3	junior
	0.45	15	senior
(Mathematics Ability)			
Fleming and Malone (1983) (reported as r)	0.42	13	high school
(Arithmetic Ability)			
Fleming & Malone (1983) (reported as r)	0.77	3	
(Quantitative Ability)			
Boulanger (1981) (reported as r)	0.51	9	

Science Achievement and Science Ability

There have been several reviews of research and meta-analyses in which prior learning has been analyzed for its effect on achievement. Results have generally yielded correlations of r= 0.40 to r= 0.50 and accounted for 16 to 25 percent of the explained variance in achievement for upper grades and lower correlations for lower grades. In general, more variance was explained as grade level increased. When home background and scholastic ability were analyzed, prior knowledge contributed less to the explained variance.

Fleming and Malone (1983) showed that when data were broken down by age level, at age ten, prior knowledge added a mean of zero percent (18 studies) to the explained variance after home background was removed. At age 14 (21 studies) and 12th grade (18 studies), prior knowledge added three and nine percent, respectively, to the explained variance after home background was removed. After taking out the variance explained by home background, prior knowledge explains less variance. Variance due to prior knowledge decreases substantially for lower grades when home background is included in the analyses.

In general, high correlations are obtained from prior knowledge tests related to course tests. Lower positive correlations are obtained from correlations with previous course background or tests not highly related to the correlated test. Overall, prior knowledge accounted for about 16 to 25 percent of variance in science achievement.

Science Achievement and General Ability

Earlier studies revealed significant relationship between general ability as measured by an intelligence quotient testing tool and students' achievement in science. In his book, Educational Achievement in Relation to Intelligence, St. John (1970) identified eight studies on intelligence test scores and teacher's marks in natural science in higher grades, with a mean correlation of r= 0.46.

Flanagan et al. (1964) in the Project Talent study identified an a priori IQ composite consisting of reading comprehension, abstract reasoning, and mathematics test scores. The mean correlation of the IQ composite with physical science and biological science test scores for grades 9-12 was r= 0.51.

Boulanger (1981) reported the results of a meta-analytic study on students' ability and science achievement with students from the sixth to twelfth grades. The studies covered a period of 16 years. Ability was defined as any cognitive measure that predicts science learning. The student ability variables were described as general ability, prior achievement, and quantitative-spatial reasoning, while the outcome variables were described as factual, product, process, and attitudinal learning. Combining the correlations that produced the best overall estimate of the relationship of ability to student science outcomes produced a mean correlation of r= 0.48 with a standard deviation of r= 0.15 based on 62 correlations, and accounted for about 23 percent of the variance for science learning. The mean correlations between general ability and science achievement was r= 0.49 (34 studies), between prior achievement and science learning was r= 0.46 (19 studies), and between quantitative-spatial ability and science learning was r= 0.51 (9 studies).

In Fleming and Malone's (1983) meta-analysis of science achievement, a mean correlation between science achievement and general ability (IQ) of r= 0.42 (27 studies) was reported. When broken down by grade levels, the relationship between general ability and science achievement is rather high at the middle school level with a mean correlation of r= 0.59 (5 studies). This correlation decreases during the high school level with a mean correlation of r= 0.47 (14 studies). The correlation between measures of general ability and science achievement revealed a correlation value of r= 0.43, based on 42 studies.

Kahl (1982) reported a mean correlation between science achievement and IQ of r= 0.43 based on 14 studies at the junior high level, and a mean correlation of r= 0.46 based on 19 studies at the senior high level.

A meta-analysis study was carried by Steinkamp and Maehr (1983) who synthesized quantitatively the correlations between affect, ability, and achievement in science. Retrieved from 66 articles and reports, the data base consisted of 255 correlations. The relationships between achievement and cognitive ability were significantly positive with a mean correlation of r= 0.36 for boys and a mean correlation of r= 0.32 for girls. It was revealed that higher levels of cognitive ability are associated with higher levels of achievement in science.

Walberg (1986) synthesized the research on teaching and reported a mean correlation of ability with learning in science of r= 0.48 based on 10 studies.

Reviews of research and meta-analyses usually indicate a mean correlation of general ability with science achievement of about r= 0.40 to r= 0.50 (explaining about 16 to 25 percent of the variance). These relationships are again similar to those found for mathematics and language ability. (See Table 9)

TABLE 9

EFFECT SIZES: GENERAL ABILITY EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Author		E.S.	N	Grade
Boulanger (1981) (reported as r)		0.49	34	
Kahl (1982) (reported as r)	(IQ)	0.43	14	Junior
		0.40	19	Senior
Fleming and Malone (reported as r)	(IQ)	0.42	27	
		0.59	5	Middle
		0.47	14	High
		0.43	42	
Walberg (1986) (reported as r)		0.48	10	

Attitudes toward Science and General Ability

Fleming and Malone (1983) reported a mean correlation between general ability and attitude toward science of .15 based on 13 studies. Further analysis across grade levels showed a marked increase from middle school to high school levels. This trend of relationship revealed a mean correlation of r= 0.12 (5 studies) at the middle school level, and a mean correlation of r= 0.21 (3 studies) at the high school level. Breakdown by subject areas revealed a mean correlation of r= 0.24 in general science (n=3), and a correlation of r= 0.22 in life science (n=4).

Boulanger (1981) reported the results of a meta-analysis study on students' ability and their attitudes toward science. The findings indicate a mean correlation of ability and attitudes toward science of r= 0.27 with a standard deviation of 0.07, based on five studies. (See Table 10)

TABLE 10

EFFECT SIZES: SCIENCE ABILITY EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Source	E.S.	N	Discipline	Grade
Fleming & Malone (reported as r)	0.15	13		
	0.12	5		middle
	0.21	3		senior
	0.24	3	General Science	
	0.22	4	Life Science	
Steinkamp and Maehr (reported as r)	0.36			Boys
	0.32			Girls
Boulanger (1981) (reported as r)	0.27	5		

Science Achievement and Cognitive Development

Cognitive attributes have been shown to have a very decided effect on science achievement. In particular, students' intellectual developmental levels and cognitive style have been shown to correlate with success in science.

Boulanger and Kremer (1981) conducted a quantitative synthesis of studies related to developmental level and science learning among grade 6-12 students over the 1963-1978 period. The results of the analysis revealed that the mean correlations of developmental level and cognitive achievement rose from r= 0.28 in grade seven to r= 0.63 in grade nine, and declined to r= 0.32 in grade 12. The grand mean was reported to be r= 0.40 with a standard deviation of 0.14., based on 27 studies.

Walberg (1986) reported a correlation range between Piaget's developmental level and school achievement of r= 0.02 to r= 0.71 with a median of 0.35. The mean correlation in science was r= 0.40 based on nine studies.

Kahl (1982) reported a mean correlation of r= 0.61 (one study) at the Junior high level, and a mean of r= 0.50 (one study) at the senior high level. Fleming and Malone (1983) reported a mean correlation between science achievement and cognitive level of r= 0.59 based on three studies. (See Table 11)

TABLE 11

EFFECT SIZES: COGNITIVE REASONING ABILITY EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Source	E.S.	N	Grade
Boulanger & Kremer(1981) (reported as r)	0.40	27	
	0.28		seventh
	0.63		ninth
	0.32		twelfth
Kahl (1982) (reported as r)	0.61	1	junior
	0.50	1	senior
Fleming and Malone (1983) (reported as r)	0.59	3	
Walberg (1986) (reported as r)	0.40	9	

Study Outcomes and Attitudinal Variables

Science Achievement and Attitudes Related to Science

Reviews of literature and meta-analysis concerning the relationship between such attitudinal measures as attitudes toward science, motivation, and interest in science as related to school science achievement has accumulated over the last three decades.

The attitude/motivation variable as related to achievement in science was investigated in the meta-analysis conducted by Kahl (1982). A mean correlation of r= 0.19 was obtained at the junior high level based on three studies, and a mean correlation of r= 0.34 was revealed at the senior high level based on 6 studies.

Willson (1983) carried on meta-analysis research analyzing attitudes toward science and interest in science as related to achievement in science. Forty-three studies were utilized from 21 countries, yielding 280 correlation coefficients, with grade levels ranging from kindergarten through college. The mean for all coefficients was r= 0.16, with differences between junior high, senior high subjects. As for attitudes towards science measures at the junior high level, 18 coefficients were examined, with an average correlation of r= 0.14. At the senior high level, 120 coefficients yielded an average correlation of r= 0.15.

With regard to the relationship between the measures of interest in science and science achievement, different correlations were obtained. At the junior high level, 33 correlation coefficients yielded a mean correlation of r= 0.23. At the senior high level, 13 correlation coefficients were examined, with an average correlation of r= 0.19. Willson concluded that achievement in science is more highly related to interest in science than to attitudes toward science. In a comprehensive meta-analytic review of the literature, Steinkamp and Maehr (1983) synthesized quantitatively the correlations among affect, ability, and achievement in science; and between these variables and gender. Retrieved from 66 articles and reports, the data base consisted of 255 correlations. It was found that sex differences in both affect and achievement were smaller than was generally assumed, but they did occur, and, with few exceptions, they tended to favor males. The results revealed a correlation of r= 0.19 for males, and r= 0.18 for females. These results are similar to those of Willson (1983) who reported a mean correlation of r= 0.14 in his meta-analysis of studies in which affect and achievement were specific to science.

Haladyna and Shaughnessy (1982) reported on a meta-analysis of research findings related to affective factors and their relationship to science achievement. Various types of attitude research were analyzed including science interests and attitudes toward science. The analysis was limited to 49 studies conducted in the United States between 1960 and 1980 that measured elementary and secondary students's attitudes toward science. Their analysis revealed a consistently low order relationship between science attitudes and science achievement. The variance in achievement accounted for by the affective measures ranged from r= 0.01 to r= 12.2 percent, with a 2.4 percent median, which is equivalent to a mean correlation r of 0.15. (See Table 12)

TABLE 12

EFFECT SIZES:ATTITUDES TOWARD SCIENCE EFFECTS ON MEASURES OF SCIENCE ACHIEVEMENT

Author	E.S.	N		Grade
Haladyna & Sheghnessy (1982) (reported as r)	0.15	49		
Willson (1983) (reported as r)	0.16	43		
	0.14	18		junior
	0.15	120		senior
Steinkamp & Maehr (1983) (reported as r)		(Affect)		
	0.19		(males)	
	0.18		(females)	
Fleming and Malone (1983) (reported as r)	0.23	7		
Willson (1983) (reported as r)		(Affect)		
	0.23	33		junior
	0.19	13		senior

In summary, the mean correlations for attitudes toward science and achievement in science are consistent with the varied meta-analysis studies. The correlations range from r= 0.14 to r= 0.23, which account for 2 to 11 percent oi the variance in science achievement due to attitudes and interests.

The relation between the affective characteristics and students' achievement was investigated in the first International Study of Educational Achievement (IEA). Bloom (1976) analyzed the IEA data from 17 countries in six subject areas and found that the relationship between attitudes and achievement was greatest in science. Students' attitudes accounted for 25 percent of the variance in science achievement. In the United States, the mean correlation between science interest and science achievement was lower at the primary grade levels than at later school levels. The results revealed a mean correlation of r= 0.35 between science interest and science achievement at the eighth grade level and a mean correlation of r= 0.43 at the 12th grade level.

The NAEP surveys of nine and thirteen year old students in 1978 and 1982 showed a decline in attitudes between these two age groups (Hueftle, Rakow and Welch, 1983).

Napier and Riley (1985) used the data collected in the 1976-1977 NAEP survey to re-analyze the hypothesis that there are affective determinants of science achievement. A total of 3135 individual 17-year-olds who responded to the tests in Booklet 4 were used in the study. The highest correlate to achievement was student motivation with a correlation of r= 0.26, which accounted for 7 percent of the variance in cognitive achievement.

Schibeci and Riley (1986) analyzed the data from Booklet 4 given to 17-year-olds during the 1976-1977 NAEP survey, the same sample examined by Napier and Riley (1985). The relationship between motivation and enjoyment in science as related to science achievement was investigated. The results revealed a correlation of r= 0.22 between enjoyment in science as related to science achievement, which confirms the results obtained by Napier and Riley.

CHAPTER III

METHODS AND PROCEDURES

Introduction

This chapter is devoted to explaining how this study was conducted, focusing on the meta-analytic techniques employed. In general, meta-analytic procedures involved analyzing the literature to determine the effects of student characteristics, environmental variables, scholastic abilities, and attitudinal measures as related to science test scores, grades, measures of cognitive reasoning ability, and student attitudes toward science, and attitudes toward science learning. The target population for this study was students in the U.S. in grades 7-12.

Meta-analysis is a systematic approach to selecting and integrating research studies measuring the same phenomena. It involves a series of statistical techniques applied to a body of studies, and entails (1) identifying a common conceptual topic shared among studies in a research domain, (2) operationally defining the conditions under which studies will be included and excluded, (3) systematically searching the literature base for common studies, (4) identifying important study characteristics which may influence study outcomes and developing a coding scheme to capture this material, (5) analyzing and extracting comparable statistical information from research studies, and finally, (6) reporting the findings in a way which accurately summarizes the literature.

This chapter contains five sections: (1) defining the parameters of the meta-analysis, (2) locating studies, (3) developing a coding sheet and collecting data, (4) calculating effect sizes, and (5) analyzing the data.

Defining the Parameters of the Meta-Analysis:

Studies were included in the analysis if they

(1) were on the secondary school level (grades 7-12);

(2) focused on science teaching and learning;

(2) reported data on at least one of the following outcome variables: science test scores, science grades, cognitive reasoning ability, attitudes toward science, or attitudes toward science learning;

(3) included usable information on at least one independent variable of interest: student characteristics which included gender and race; environmental variables which included father's education, mother's education, and availability of educational items at home; plans and aspirations, and hours of homework per week; scholastic abilities, which included language ability,

mathematics ability, science ability, general ability, a cognitive reasoning ability; or attitudinal measures which included attitudes toward science and attitudes toward science learning.

The analysis included studies in which data were collected between 1980-1991, and was limited to studies conducted in the United States. This decision was based on the fact that the methods and conditions present in American education, instructional methods, environmental conditions, and status of teachers and students, vary from this country to other countries. Moreover, academic achievement and attitudes in many respects are determined by cultural factors interacting with the educational setting, and the inclusion of non-U.S. studies could be a source of complication. In this respect, the analysis was forced to exclude a large number of investigations which were conducted in other countries.

Only studies which were conducted at the secondary school level (grades 7-12) were included in the analysis. This decision was based on the fact that research relevant to the cognitive and affective domains at the secondary school level are fundamentally different from similar investigations conducted at the elementary level setting. First, from an ontogenic standpoint, many psychologists, such as Piaget, indicate that individuals progress through various stages of development. According to Inhedler and Piaget (1958), the stages of development normally prevalent during preadolescence have associated cognitive and affective characteristics that are quite distinct from those characteristics present during adolescence. Secondly, the logistics of the instructional experience in elementary school differ from those in the secondary school. In elementary schools, science is usually taught as part of a daily, or less frequent, routine, in the same classroom, by the same teacher with whom the student spends the entire day. Additionally, the elementary teacher is frequently someone who has a limited background in science and science education. Rather, they have a broad educational background as necessary for elementary certification. In the secondary schools, science is usually taught daily, as a separate subject, in a separate classroom, by a teacher who has concentrated training in one or more sciences.

A study was deemed codeable if it dealt with the above mentioned outcomes, contained appropriate independent variables, and included sufficient data to allow for meta-analytic transformation. To be included, studies had to report sufficient statistical data from which an effect size could be obtained or could be derived. This means studies had to report sample size and one or more of the following: (1) means and standard deviations for the groups under consideration, (2) relevant correlations, (3) t-tests, (4) F-tests with 1-df, or (5) probability levels.

Locating and Acquiring Studies

Standard research procedures were used to locate relevant empirical studies in the field of interest. Studies published in a journal, a book, a dissertation or a published or unpublished ERIC document were identified. Manual searches were carried out for each variable for the years 1980-1991 using the Current Index to Journals in Education, Education Index, Resources in Education, and Dissertation Abstracts Index. Journal articles were identified by scanning the table of contents of the Journal of Research in Science Teaching and the Annual Reviews of the Science Education journal for the years 1980-1991 in order to insure a complete and thorough survey. Further manual searches were conducted through reviewing bibliographies of codeable studies in order to locate more studies.

Computerized literature searches of available research were also conducted of the ERIC, Psychological Abstracts and Dissertation Abstracts electronic database. The searches were conducted on the full text data-bases using descriptors of the study outcomes, grade levels, subject matter, and student characteristics. As studies were identified, data were gathered by reading journal articles, reading the relevant ERIC documents, and reading the dissertations as they became available through the departments of science education at other universities, The Ohio State University Inter-library Loan, and the University Microfilms International (UMI) Dissertation Information Services. When research was reported as a dissertation and subsequently as a journal article or a paper, only the dissertation was coded. This was the procedure of choice as dissertations contain more complete raw data usable in meta-analysis. Concentrating on dissertations reduced the volume of published articles used in the meta-analysis, as many of them were based on dissertation research. The search conducted yielded 147 documents for potential inclusion in this study. Of the documents identified, 75 were coded and 67 were ultimately retained for further analysis. (See Appendix B)

Coding of Study Data

To provide a consistent approach to gathering data from the studies to be analyzed, a coding form was used. Coding forms are information gathering instruments which the researcher uses to identify information from a study of importance to meta-analysis. Coding forms were developed by the researcher (See Appendix A). They included spaces to record variables used to designate basic study information, methodological variables associated with the original studies, science learning outcomes, students' characteristics, environmental variables, scholastic abilities, and attitudinal measures. The forms provided for the recording of all necessary statistical data. The information gathered is described below.

Basic Study Information

The first variable in this category identified the study using a four digit code. The second variable identified the year in which the study was published. The third variable identified the length of the study, whether study duration was less than one month, one to three months, three to six months, more than six months, or a status study. The fourth variable, form of publication, was used to indicate the source from which the study data were coded. Sources included journals, books, doctoral dissertations, and papers. When a study was available from more than one source, the original or primary source was used.

Study Methodological Characteristics

Study methodological characteristics were analyzed as mediating variables. The variables were coded in an effort to identify groups of studies with like characteristics. Coding used six variables to designate aspects of study design and methodology. The first variable identified the total number of students in the study. The second variable designated the assignment of students to treatments whether random, matched, self-selected, intact groups, representative, or other. The third variable identified the basic study type as correlational, quasi-experimental, experimental, or other. Correlational studies were those that measured the size and direction of the relationship between two sets of data. Experimental studies included those that used a posttest-only control group design with random assignment of subjects to groups or used a pretest-posttest control group design, again with random assignment of subjects. Studies using a treatment versus control group design, but without random assignment to groups, were coded as quasi-experimental. Studies that used a one group pretest-posttest design or a static-comparison procedure were considered as pre-experimental and placed in the 'other' category.

The fourth variable, which rated internal validity, considered the generalizability issues identified by Campbell and Stanley (1966) namely, testing, instrumentation, regression, selection, maturation, selection/maturation interaction, history, and mortality. The internal validity was judged as high if the assignment was random, the total mortality below 15 percent and equivalent among groups, and no significant threats to validity were present in at least seven of the above mentioned categories. The internal validity was judged as medium if a study had randomization of subjects, or intact groups, had uneven mortality, and no significant threats to validity were present in at least five of the above mentioned categories. If the study did not randomize subject assignment, attempted to randomize and failed, used intact groups which were highly dissimilar, or displayed severely disproportionate mortality, and displayed threats to internal validity in at least four of the eight categories used by Campbell and Stanley (1966), the internal validity was coded as low.

The fifth variable used was study design. Study design was rated high if the study design met at least five of the following criteria:

a. The sample size was adequate.
b. The subjects were randomly assigned.
c. The length of the study was adequate.
d. The variables were appropriately identified.
e. The study applied an appropriate instrument.
f. The internal and external reliability were reasonable.
g. Confounding variables were not present or were adequately controlled for.

The study design was rated medium if the study met three or four of the above mentioned criteria. The study design was rated low if the study met fewer than three of the above criteria.

The sixth variable involved the method employed to generate effect sizes for the study. Methods were direct use of an r-value reported in the study, conversion from a t-value, conversion from an F-value, conversion from a p-value, or conversion from a D-value. The seventh variable identified students' socioeconomic status whether low, medium, high, or mixed sample. The eighth variable designated the students' community type whether urban, suburban, or rural community. If the community included two or more of the mentioned types, it was coded as mixed community. The ninth variable identified the science discipline whether biology, chemistry, physics, or earth science. If the discipline included a mix of two or more of the mentioned sciences, or if not specified, it was coded general science. The tenth variable used was age level. Age was coded on the basis of the mean age of the sample whether it was between 11-13 years-old, 14-16, or 17-19 years-old. The eleventh variable identified students' grade level. Grade level was coded according to the sample's grade level whether it was seventh, eighth, ninth, tenth, eleventh, or twelfth, and either 7th-9th and 10th-12th grade levels.

Study Variables

The following variables were identified as either present or absent in the study so the studies could be appropriately grouped for meta-analysis. These variables included the science learning outcomes, student characteristics, environmental variables, scholastics abilities, and attitudinal measures.

Science Learning Outcomes

The science learning outcomes coded were science achievement tests, science grades, logical reasoning ability, attitudes toward science, and attitudes toward science learning.

Variables Affecting Study Outcomes

Student Characteristics

Student characteristics coded were the presence of gender and race as independent or correlated variables.

Gender

Gender was coded if the study explored outcomes related to gender.

Race

Race was coded if the study explored outcomes related to race.

Environmental Variables

The environmental variables which were identified in the coding process were father's education, mother's education, availability of educational materials at home, plans and aspirations, and hours of homework per week. In all instances, the coding process sought to identify studies which employed valid measures of these variables either as independent variables in measures of group effects or as variables which were correlated with science learning outcomes.

Father's Education

Father education was coded according to the years of schooling that students' paternal parents had whether some high-school completed, high school completed, some college completed, graduated from college, or holds a graduate or professional degree.

Mother's Education

Mother's education was coded according to the years schooling that students' mother had whether some high-school completed, high school completed, some college completed, graduated from college, or holds a graduate or professional degree.

Availability of Educational Materials at Home

Availability of educational materials at home variable was coded according to the amount of educational books, journals, encyclopedias, or other science equipment at home.

Plans and Aspirations

Plans and aspirations variable was coded according to the amount of parental aspiration for the child whether they were college plans, occupational plans, or educational aspirations.

Hours of Homework Per Week

Hours of homework was coded according to the hours of homework per week that the student spent at home.

Scholastic Abilities

Scholastic abilities variables which were identified in the coding process were language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability. In all instances the coding process sought to identify studies which employed valid measures of these variables either as independent variables in measures of group effects or as variables which have correlated with science learning outcomes.

Language Ability

Language ability was coded according to the language skills measured by a national or local instrument that measured language ability, word knowledge, reading,grammar, spelling, or verbal aptitude.

Mathematics Ability

Mathematics ability was coded according to the mathematical skills obtained from a national or local test instrument that measures mathematics ability, computation skills, algebra, quantitative skills, arithmetic skills, and mathematical concepts.

General Ability

General ability consisted of a number of measures of general, verbal, or mathematical intelligence; verbal, mathematical scholastic Aptitude Tests (SAT); language ability or achievement; and mathematical ability or achievement.

Cognitive Reasoning Ability

Cognitive reasoning ability was coded according to the students' Piagetian formal reasoning abilities whether they were control of variables, conservational reasoning, combinatorial reasoning, correlational reasoning, probabilistic reasoning, etc. (e.g., Lawson Test of Formal

Reasoning (Lawson, 1978); The Group Assessment of Logical Thinking, GALT (Roadrangka, Yeany, & Padilla, 1982); Piagetian Logical Operations Test, PLOT (Staver & Gabel, 1980), etc.).

Attitudinal Meas. :es

The attitudinal measures which were identified in the coding process were attitudes toward science and attitudes toward science learning. In all these instances the coding process sought to identify studies which employed valid measures of these variables either as independent variables in measures of group effects or as variables which have correlated with science learning outcomes.

Attitudes Toward Science

Attitudes toward science was coded according to students' attitudes towards science content area, science careers, scientists, or the impact of science on society.

Attitudes Toward Science Learning

Attitudes toward science learning was coded according to students' attitudes toward science or interests in science curriculum, or instruction and learning.

Execution of Coding Process

The procedure for coding the variables of each of the studies screened for synthesis involved using a specially prepared scheme developed to reflect information related to the study form characteristics, study design, and variables' outcomes.

Once the decision was made to include a study, all of the study outcomes, factors affecting those outcomes, and possible mediating variables addressed by that study were coded. Studies were coded more than once when multiple outcome variables included, grade levels, ability levels, and/or when the study identified multiple disciplinary areas. Subsets of data within studies were merged if the outcome variables were consistent and no significant differences were identified across grade levels, ability levels, age levels, or disciplinary focus of the studies. On the other hand, if significant differences existed between the outcomes across the grade levels, age levels, or disciplinary areas, the subsets of data within studies were coded separately.

The corpus of studies was coded twice by the researcher, and verified by two members of the research committee in order to reliably reflect definitional or coding refinements that were made as the coding procedure progressed. Questions were resolved by checking the original documents.

Retention of Studies for Meta-Analysis

Reasons for rejecting studies in this meta-analysis included the following:

- data needed for the calculation of effect size(s) were incomplete or erroneous,
- the active language of the subjects was not English,
- the study was conducted on elementary or college level students,
- the study was conducted outside the Unite States,
- the study was conducted outside the 1980-1991 time span,
- the outcome variables were not associated with the student outcomes and characteristics under investigation,
- the study was rated low on internal validity, and/or
- the study was rated low on design.

See Appendix C for a list of the studies withheld from analysis.

Difficulties Encountered

The goal of meta-analysis is to combine information from several studies. One difficulty, however, was the great variety of measures used for assessing a specific outcome. Initially, an effort was made to differentiate between the science achievement outcomes assessed by national or international tests or any teacher or researcher developed test instrument, and the science achievement outcomes assessed by classroom grades. Therefore, science achievement had two outcomes, one assessed by test scores, and the other outcome assessed by classroom grades. In regard to the students' cognitive reasoning ability outcome, several criteria measures were carried out to assess this variable. To name some, the Group Assessment of Logical Thinking (GALT), Piagetian Logical Operations Thinking (PLOT), and Lawson's Test of Formal Reasoning Ability, etc. A panel of the dissertation committee members reached a consensus to collapse the outcomes assessed by those measures since they all relate to the variables that measure students' Piagetian formal reasoning abilities whether it is combinatorial, correlational, proportional, relational, etc. An effort was made to differentiate between the outcomes measured by the instruments that assessed students' attitudes toward science, and students' attitudes toward science learning. It was agreed that the result of any measure that assessed students' attitudes toward science outcomes, the content area of science, science careers, scientists, or the impact of science on society to be considered an attitude toward science outcome; and the result of any measure that assesses students' attitudes toward science or interest in science curriculum, or instruction and learning to be considered as attitude toward science learning outcome.

Furthermore, it is worth mentioning that in experimental, quasi-experimental, or other types of studies, the posttest was considered an outcome (the dependent variable), and the pretest or any correlated student variable was considered a predictor (an independent variable).

Obtaining and Calculating Effect Sizes

In this research analysis, the Pearson product moment correlation coefficient "r" was used as an effect size estimate and will be designated r_{es} for clarity. The r_{es} was computed to determine the strength of relationships between the study outcomes as they related to the variables associated with the methodological aspects of the original studies, and the student outcome variables.

As already mentioned, Rosenthal (1984, 1991) recommends using the r_{es} for the following reasons: (1) many studies are reported in r_{es} values, (2) it is easier to statistically convert from a t-test or F-test for independent samples to the r statistic, (3) r_{es} can be computed more accurately than the standardized difference between the means when converting some univariate statistics, and (4) r_{es} has a broader base of understanding as a metric for representing strength in a relationship. In correlational studies, the correlation coefficient measure the relationships between the study outcomes and student variables coded. However, in experimental, quasi-experimental and other studies that used one group pretest-posttest designs or static-comparisons procedure, the Pearson r was derived algebraically from a univariate statistic, i.e., t-test, F-test, p value, or D-value. The formulas for converting the other statistics measures into Pearson r correlations, and for converting univariate statistics into Pearson r correlations, are developed algebraically and applied to the reported statistics.(Glass et al. 1981, Cohen, 1977, Rosenthal, 1984, 1991).

Most of the effect sizes were obtained directly from the studies by using the reported r and sample sizes to generate r_{es}. For some studies that included other statistical values from which r could be derived, r_{es} values were converted algebraically. If the study did not provide an r or an appropriate statistic or data to calculate an r, r_{es} could not be determined and the study was not used.

Finally, before accepting the reported r or derived r as an effect size, the Pearson correlation coefficient was adjusted for sample size. This was done because the r distribution deviates from the standard normal at the extremes. Fisher (1928) devised a transformation to correct for this deviation. Initially, the r correlation was transformed into the Fisher z_r statistic through applying the formula (3.1):

$$z_r = 1/2 \log_e [(1+r)/(1-r)] \qquad (3.1)$$

The estimated bias to z_r was calculated by dividing the r-population by 2(N-1). The bias was then removed from the obtained z_r which is associated with a corrected r. This procedure was repeated to obtain a still more accurate correction for bias. Repetition led to a more corrected Z_r which is associated with a more corrected value of r. The corrected r, then, was identified as r_{es} . In this meta-analysis procedure, all the analyses were carried out using a corrected effect size r_{es}.

Analysis of Data

The coded information of each study, including the values of the effect sizes that could be calculated for the different outcome variables, constituted the input for the meta-analysis. Eight lines of data were generated for each study. Data were analyzed utilizing the Statistical Analysis System (SAS) package available at the computer facilities at The Ohio State University.

Initially, an exploratory correlation analysis of the 75 coded studies was performed examining the relationship of outcome variables with study methodological characteristics. The results of the analysis revealed a high positive correlation between the student outcomes and the validity and design of the coded studies. A decision was made to delete the studies with low validit· ınd design. A further run of the correlation analysis was conducted, after deleting studies with low validity and design; the results revealed a lower correlation between the student outcomes and both the validity and design of the coded studies. Therefore, only the methodologically adequate studies that were rated medium or high in validity and design were considered for the analysis. Eight studies that were rated low in validity and design were excluded from the research integration analysis. The final analysis included 67 studies rated medium or high in validity and design.

Combining Studies and Averaging Effect Sizes

In this research analysis, the results of six or more studies were combined. A procedure developed by Rosenthal (1984, 1991) was applied for computing the weighted average of the effect sizes, that takes into account the studies' sample sizes. This procedure involved transforming the effect size r_{es} correlation into a Fisher Z by applying the formula $Z = 1/2 \log_e [(1+r)/(1-r)]$, or through referring to the table that facilitated this conversion (Wert, Neidt, & Ahmann, 1954, p.425-426). The sample associated with each of the effect sizes was also determined. The Fisher Z weighted mean was then computed by applying the following formula (Rosenthal, 1984, 1991):

$$\text{Weighted Mean: } Z = \frac{SUM_{j=1-K}\ (N_j - 3)Z_j}{SUM_{j=1-K}\ (N_j - 3)} \quad (3.2)$$

where: Z_j = Fisher Z transformation for any effect size j.
N_j = sample size associated with each study j
K = number of studies

Finally, Fisher's Z weighted mean was subsequently converted to the mean effect size $r_{es\text{-}mean}$.

Consistency of Effect Sizes

In order to determine if the body of research included in the meta-analysis was exhibiting a consistent magnitude of effect, the test of homogeneity of effect sizes, which measures the consistency of the study effects across studies, was applied. The test involved transforming the effect size r_{es} into a Fisher z_r. The homogeneity of the set of effect sizes (r) was then obtained as a Chi square statistic by applying the following formula (Rosenthal, 1984, 1991):

$$X^2 = SUM_{j=1-K} [N_j - 3][Z_j - Z]^2 \quad (3.3)$$

with df = K-1

where: Z_j = Fisher Z transformation of r for any effect size j.
N_j = sample size associated with each study j
K = the number of studies in the meta-analysis
Z = weighted mean Fisher Z

The resulting Chi square value with K-1 degrees of freedom (where K = the number of effect sizes) was used with the Chi square critical values table to determine if the variance of effect sizes was significantly greater than a null hypothesis of no variability.

If the null hypothesis was not rejected, it was assumed that the distribution of effect sizes share a common underlying effect size. If the null hypothesis was rejected, the effect sizes were heterogeneous and the researcher had to examine the distribution of effect sizes to determine the source of systematic variance among the effect sizes.

Averaging Significance Levels

In this study "the method of adding Z's" called the Stouffer method by (Mostteler and Bush, 1954) was applied when combining the probabilities obtained from the studies testing the same directional hypothesis. This method involved obtaining the standard normal deviate Z corresponding to the p values, summed, and then divided by the square root of the number of studies being combined.

$$Z = \frac{SUM_{j=1-k} \; Z_j}{\sqrt{K}} \qquad (3.4)$$

K = the number of studies combined

In this study an estimate of the standard normal deviate (Z) was derived from the r_{**} correlation coefficient value by multiplying the r_{**} value by the square root of the sample size of the study associated with each particular effect size according to the following equation:

$$Z = r_{**} \sqrt{N}. \qquad (3.5)$$

Results of the meta-analysis procedures undertaken are presented in the following chapter.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

The results of this study are organized into four sections: (1) a presentation of the frequency of studies available for meta-analysis given the outcomes and student variables examined in this study. The study outcomes are: science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning, while the student variables are: student characteristics which includes gender and race, environmental variables which include the following: father's education, mother's education, facilities at home, plans and aspirations, and hours of homework per week; (2) an examination of the effects of student variables on various outcomes, (3) a breakdown of studies being analyzed by study methodological variables, and (4) an examination of the effects observed in subgroups of studies defined by the methodological variables associated with each study.

From the original 75 studies coded using the meta-analysis technique, 67 studies were retained in the analysis. Eight studies were dropped from the analysis based on their low design and validity ratings. The outcome values were determined by calculating the Pearson Correlation Coefficient values (effect sizes) for the different outcome variables as they related to the study methodological variables, and student characteristics. The coded information of each study that included the values of the effect sizes calculated for the different outcome variables, constituted the input for the analysis.

Only studies in which data were collected during the years 1980-1991 were included in this analysis. Table 13 presents the years of publication and the frequency of the coded studies within each year. The frequency of the coded documents ranged from three studies published in 1983 to eight studies published in 1984, 1986, and 1990.

TABLE 13

FREQUENCY OF STUDIES ACCORDING TO THE YEAR OF PUBLICATION

Date	Frequency	Percent
1981	4	6.0
1982	7	10.0
1983	3	4.5
1984	8	11.9
1985	7	10.4
1986	8	11.9
1987	4	6.0
1988	6	9.0
1989	3	4.5
1990	8	11.9
1991	5	7.5
1992	4	6.0
Total	67	

<u>Frequency of Studies Available for Meta-Analysis for the Outcome Measures and Student Variables</u>

Analyses were carried out for the variables that included six or more studies. Variables with fewer than six coded studies were dropped from the analysis. Table 14 presents the frequency of the studies available for meta-analysis given the student variables and the following outcome measures: science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning. The term student variables refers to student characteristics which included gender, race; environmental variables which included father's education, mother's education, the availability of cultural items at home; plans and aspirations, and hours of homework per week; scholastic abilities, which included language ability, general ability, and cognitive reasoning ability; or attitudinal measures which included attitudes toward science and attitudes toward science learning.

TABLE 14

FREQUENCY OF STUDIES ACROSS THE
OUTCOME MEASURES AND STUDENTS' VARIABLES

Student Variables	Science Test Scores	Science Grades	Cognitive Reasoning	Attitudes toward Science	Attitudes toward Science Learning
Gender	25*	9*	6*	5	8*
Race	9*	5	0	0	3
Father Ed	9*	2	1	3	3
Mother Ed	9*	2	1	3	3
Facil	12*	0	0	2	3
Plans	14*	0	0	3	2
Homewk	10*	0	0	0	2
Lang	19*	12*	5	1	5
Math	13*	16*	5	3	2
Scien	9*	4	19*	11*	14*
General	9*	5	7*	2	1
Cogtv	13*	12*	0	1	3
AttSc	8*	5	1	0	0
AttLr	15*	7*	3	0	0

* Analysis was conducted when the number of studies available was ≥6.

Results Related to Research Question 1: Student Characteristics Effects

In the examination of results related to research question 1, the relationship of student characteristics with study outcomes, sufficient numbers of studies existed to examine the relationships between:

- science test scores and grades,
- science grades and gender,
- cognitive reasoning and gender,
- attitudes toward science learning and gender, and
- science test scores and race.

An insufficient number of studies existed to explore other relationships in a meta-analytic fashion. Results for the meta-analyses conducted follow. Data tables related to relationships which could not be explored are provided in Appendix D.

Students' Science Test Scores and Gender

An examination of the relationship of students' science test scores and gender yielded a mean effect size of ($r_{..}$) of 0.15 based on 25 studies (Z=39.10, p_{pooled}<.001). A test for heterogeneity of this effect yielded a X^2 of 258.08 (p<.001), indicating that heterogeneity existed. (See Table 15)

TABLE 15

EFFECT SIZES: GENDER EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code		Sample Size	r	r_{es}
008		1958	0.21	0.21
019		130	0.06	0.06
022	(a)	82	0.09	0.09
	(b)	421	0.19	0.19
024		152	0.03	0.03
026	(a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	(d)	625	0.15	0.15
	(e)	625	0.32	0.32
	(f)	625	0.34	0.34
027		8479	0.20	0.20
032		2719	0.27	0.27
036		91	0.11	0.11
052		26279	0.14	0.14
055		499	0.20	0.20
058		2520	0.25	0.25
059		1729	0.24	0.24
070	(a)	7873	0.14	0.14
	(b)	7974	0.18	0.18
071	(a)	6200	0.13	0.13
	(b)	3868	0.14	0.14
072	(a)	6649	0.09	0.09
	(b)	4411	0.11	0.11
075		4172	0.05	0.05

Pooled Effect Size r_{es} = 0.15
Heterogeneity X^2 = 250.08
Z for Effect Size observed Z = 39.10
Probability associated with Z = $p<.001$

Students' Science Grades and Gender Variable

An examination of the relationship of students' science grades and gender revealed a mean effect size r_{es} of 0.13, based on nine studies ($Z = 7.66$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 15.50 ($p<.001$), indicating that heterogeneity existed. (See Table 16)

TABLE 16

EFFECT SIZES: GENDER EFFECTS
ON STUDENTS' SCIENCE GRADES

Study Code	Sample Size	r	r_{es}
001	306	0.20	0.20
011	195	0.09	0.09
019	185	0.13	0.13
039	168	0.20	0.20
049	1504	0.15	0.15
051	92	0.09	0.09
064	261	0.05	0.05
069	143	-0.14	-0.14
075	4172	0.10	0.10

Pooled Effect Size	r_{es} =	0.13
Heterogeneity	X^2 =	15.50
Z for Effect Size observed	Z =	7.66
Probability associated with	Z =	p<.001

Students' Cognitive Reasoning Ability and Gender

An examination of the relationship of students' cognitive reasoning ability and the gender variable revealed a mean effect size r_{es} of 0.28, based on six studies ($Z = 8.34$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 10.72 (0<.001), indicating that homogeneity existed. (See Table 17)

TABLE 17
EFFECT SIZES: GENDER EFFECTS
ON STUDENTS' COGNITIVE REASONING

Study Code	Sample Size	r	r_{es}
011	195	0.14	0.14
036	91	0.39	0.39
037	77	0.06	0.06
045	140	0.32	0.32
051	92	0.25	0.25
055	634	0.32	0.32

Pooled Effect Size	r_{es} =	0.28
Homogeneity	X^2 =	10.72
Z for Effect Size observed	Z =	8.34
Probability associated with Z	=	p<.001

Students' Attitudes Toward Science Learning and Gender

An examination of the relationship of students' attitudes toward science learning and the gender variable revealed a mean effect size r_{es} of 0.07, based on eight studies (Z=6.92, p<.001). A test for heterogeneity for this effect yielded a X^2 of 42.80 (p<.001), indicating that heterogeneity existed. (See Table 18)

TABLE 18

EFFECT SIZES: GENDER EFFECTS ON STUDENTS' ATTITUDES TOWARD SCIENCE LEARNING

Study Code	Sample Size	r	r_{es}
008	1958	0.10	0.10
019	185	0.02	0.02
032	2719	0.09	0.09
039	168	-0.02	-0.02
049	1504	-0.06	-0.06
054	3663	0.12	0.12
073	509	0.09	0.09
075	4172	0.06	0.06

Pooled Effect Size	r_{es} =	0.07
Heterogeneity	X^2 =	42.80
Z for Effect Size observed	Z =	6.92
Probability associated with	Z =	p<.001

Students' Science Test Scores and Race

An examination of the relationship of students' science test scores and the race variable exhibited a mean effect size r_{es} of 0.37, based on nine studies (Z= 81.56, p<.001). A test for heterogeneity of this effect yielded a X^2 of 427.31 (p<.001), indicating that heterogeneity existed. (See Table 19)

TABLE 19

EFFECT SIZES: RACE EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code		Sample Size	r	r_{es}
019		130	0.43	0.43
052		26279	0.36	0.36
070	(a)	7322	0.38	0.38
	(b)	7496	0.44	0.44
071	(a)	3300	0.40	0.40
	(b)	5129	0.45	0.45
072	(a)	5425	0.35	0.35
	(b)	3905	0.37	0.37
075		4172	0.11	0.11

Pooled Effect Size r_{es} = 0.37
Heterogeneity X^2 = 427.31
Z for effect size observed Z = 81.56
Probability associated with Z = p<.001

Results Related to Research Question 2: Environmental Variables

In the examination of results related to research question 2, the relationship of environmental variables with study outcomes, sufficient numbers of studies existed to examine the relationship of:

- science test scores and father's education,
- science test scores and mother's education,
- science test scores and facilities at home,
- science test scores and plans and aspirations, and
- science test scores and hours of homework.

An insufficient number of studies existed to explore other relationships in a meta-analytic fashion. Results for the meta-analyses conducted follow. Data tables related to relationships which could not be explored are provided in Appendix D.

Students' Science Test Scores and Father's Education

An examination of the relationship of students' science test scores and the father's education variable revealed a mean effect size r_{es} of 0.21, based on nine studies (Z=28.14, p<.001). A test for heterogeneity of this effect yielded a X^2 of 85.75 (p<.001), indicating that heterogeneity existed. (See Table 20)

TABLE 20

EFFECT SIZES: FATHER'S EDUCATION EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code		Sample Size	r	r_{es}
019		130	0.42	0.42
031	(a)	2822	0.16	0.16
	(b)	3258	0.18	0.18
	(c)	3100	0.26	0.26
032	(a)	2719	0.18	0.18
	(b)	1958	0.28	0.28
033		2443	0.12	0.12
055		495	0.19	0.19
056		2520	0.30	0.30

Pooled Effect Size	r_{es}=	0.21
Heterogeneity	X^2=	85 75
Z for effect size observed	Z =	28.14
Probability associated with	Z =	p<.001

Students' Science Test Scores and Mother's Education

An examination of the relationship of students' science test scores and the mother's education variable revealed a mean effect size r_{es} of 0.18, based on nine studies ($Z=24.44$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 85.04 ($p<.001$), indicating that heterogeneity existed. (See Table 21)

TABLE 21

EFFECT SIZES: MOTHER'S EDUCATION EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
008	1958	0.27	0.27
019	130	0.32	0.31
031 (a)	2822	0.13	0.13
(b)	3258	0.14	0.14
(c)	3100	0.23	0.22
032	2719	0.12	0.12
033	2443	0.11	0.11
055	498	0.19	0.19
056	2520	0.27	0.27

Pooled Effect Size	$r_{es}=$	0.18
Heterogeneity	$X^2=$	85.04
Z for Effect Size observed	$Z =$	24.44
Probability associated with	$Z =$	$p<.0^{r}1$

__Students' Science Test Scores and Availability of Facilities at Home__

An examination of the relationship of students' science test scores and the availability of facilities at home variable exhibited a mean effect size r_{es} of 0.25, based on 12 studies (Z=43.42, p<.001). A test for heterogeneity of this effect yielded a X^2 of 112.12 (p<.001), indicating that heterogeneity existed. (See Table 22)

TABLE 22

EFFECT SIZES: FACILITIES AT HOME EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	538	0.10	0.10
(b)	487	0.21	0.21
(c)	644	0.21	0.21
008	1958	0.34	0.34
031 (a)	2822	0.17	0.17
(b)	3258	0.18	0.18
(c)	3100	0.27	0.27
032	2719	0.22	0.22
033	2443	0.23	0.23
035	233	0.41	0.41
052	26279	0.26	0.26
056	2520	0.34	0.34

Pooled Effect Size	r_{es} =	0.25
Heterogeneity	X^2 =	112.12
Z for Effect Size observed	Z =	39.10
Probability associated with Z	=	p<.001

Students' Science Test Scores and Plans and Aspirations

An examination of the relationship of students' science test scores and the plans and aspirations variable exhibited a mean effect size r_{es} of 0.28, based on 14 studies (Z=47.95, p<.001). A test for heterogeneity of this effect yielded a X^2 of 589.31 (p<.001), indicating that heterogeneity existed. (See Table 23)

TABLE 23

EFFECT SIZES: PLANS AND ASPIRATIONS EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	504	0.05	0.05
(b)	488	0.09	0.09
(c)	648	0.23	0.23
027	8479	0.41	0.40
031 (a)	3259	0.15	0.15
(b)	2822	0.16	0.16
(c)	2505	0.21	0.21
(d)	3100	0.27	0.27
032 (a)	2719	0.17	0.16
(b)	1958	0.36	0.36
033	2443	0.15	0.15
035	233	0.31	0.31
052	26279	0.32	0.32
059	1729	0.05	0.05

Pooled Effect Size	r_{es} =	0.28
Heterogeneity	X^2 =	589.31
Z for Effect Size observed	Z =	47.95
Probability associated with Z	=	p<.001

Students' Science Test Scores and Hours of Homework

An examination of the relationship of students' science test scores and the hours of homework variable revealed a mean effect size r_{es} of 0.19, based on 25 studies (Z=24.53, p<.001). A test for heterogeneity of this effect yielded a X^2 of 201.98 (p<.001), indicating that heterogeneity existed. (See Table 24)

TABLE 24

EFFECT SIZES: HOURS OF HOMEWORK EFFECTS
ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	540	-0.17	-0.17
(b)	488	-0.11	-0.11
(c)	645	0.14	0.14
031 (a)	3258	0.06	0.06
(b)	2822	0.18	0.18
(c)	2505	0.19	0.19
(d)	3100	0.20	0.20
032	1958	0.26	0.26
035	233	0.11	0.11
052	26279	0.21	0.21

Pooled Effect Size	r_{es}=	0.19
Heterogeneity	X^2=	201.98
Z for Effect Size observed	Z =	24.53
Probability associated with	Z =	p<.001

Results Related to Research Question 3: Scholastic Abilities Effects

In the examination of results related to research question 2, the relationship of environmental variables with study outcomes, sufficient numbers of studies existed to examine the relationship of:

- science test scores and language ability,
- science grades and language ability,
- science test scores and mathematics ability,
- science grades and mathematics ability,
- science test scores and science ability,
- cognitive reasoning and science ability,
- attitudes toward science and science ability,
- attitudes toward science learning and science ability,
- science test scores and general ability,
- cognitive reasoning and general ability,
- science test scores and cognitive reasoning,and
- science grades and cognitive reasoning.

An insufficient number of studies existed to explore other relationships in a meta-analytic fashion. Results for the meta-analyses conducted follow. Data tables related to relationships which could not be explored are provided in Appendix D.

Students' Science Test Scores and Language Ability

An examination of the relationship of students' science test scores and the language ability variable revealed a mean effect size r_{es} of 0.43, based on 19 studies (Z=53.51, p<.001). A test for heterogeneity of this effect yielded a X^2 of 296.97 (p<.001), indicating that heterogeneity existed. (See Table 25).

TABLE 25

EFFECT SIZES: LANGUAGE ABILITY EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	541	0.22	0.22
(b)	478	0.25	0.25
(c)	642	0.42	0.42
008	1958	0.45	0.45
021	80	0.70	0.70
022 (a)	424	0.48	0.48
(b)	421	0.58	0.58
(c)	82	0.59	0.59
024	152	0.51	0.51
031 (a)	3258	0.34	0.34
(b)	2822	0.47	0.47
(c)	3100	0.53	0.53
032	2719	0.37	0.37
033	2443	0.37	0.37
035	233	0.68	0.68
040 (a)	226	0.62	0.62
(b)	217	0.51	0.51
043	72	0.67	0.67
068	128	0.73	0.73

Pooled Effect Size	r_{es} = 0.43
Heterogeneity	X^2 = 296.97
Z for Effect Size observed	Z = 53.51
Probability associated with Z	Z = p<.001

Students' Science Grades and Language Ability

An examination of the relationship of students' science grades and the language ability variable revealed a mean effect size r_{es} of 0.41, based on 12 studies (Z=19.64, p<.001). A test for heterogeneity of this effect yielded a X^2 of 108.00 (p<.001), indicating that heterogeneity existed. (See Table 26)

TABLE 26

EFFECT SIZES: LANGUAGE ABILITY EFFECTS ON STUDENTS' SCIENCE GRADES

Study Code		Sample Size	r	r_{es}
001		306	0.70	0.70
003		312	0.36	0.35
006	(a)	75	0.14	0.14
	(b)	215	0.23	0.23
	(c)	185	0.35	0.35
	(d)	55	0.77	0.37
016		145	0.23	0.23
017		352	0.29	0.29
018	(a)	546	0.41	0.41
	(b)	174	0.46	0.46
	(c)	314	0.58	0.58
020		171	0.25	0.25

Pooled Effect Size r_{es} = 0.41
Heterogeneity X^2 = 108.00
Z for Effect Size observed Z = 19.64
Probability associated with Z = p<.001

Students' Science Test Scores and Mathematics Ability

An examination of the relationship of students' science test scores and mathematics ability variable exhibited a mean effect size r_{es} of 0.55, based on 13 studies (Z=46.37, p<.001). A test for heterogeneity of this effect yielded a X^2 of 77.06 (p<.001), indicating that heterogeneity existed. (See Table 27)

TABLE 27

EFFECT SIZES: MATHEMATICS ABILITY EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	489	0.40	0.40
(b)	648	0.57	0.57
(c)	542	0.58	0.58
022 (a)	424	0.55	0.55
(b)	82	0.60	0.60
(c)	421	0.67	0.67
031 (a)	473	0.45	0.45
(b)	3100	0.57	0.57
(c)	2822	0.59	0.59
040 (a)	226	0.41	0.41
(b)	217	0.45	0.45
043	72	0.73	0.73
068	128	0.70	0.70

Pooled Effect Size	r_{es} =	0.55
Heterogeneity	X^2 =	77.06
Z for Effect Size observed	Z =	46.37
Probability associated with	Z =	p<.001

Students' Science Grades and Mathematics Ability

An examination of the relationship of students' science grades and mathematics ability variable exhibited a mean effect size r_{es} of 0.42, based on 16 studies (Z=23.33, p<.001). A test for heterogeneity of this effect yielded a X^2 of 136.95 (p<.001), indicating that heterogeneity existed. (See Table 28)

TABLE 28

EFFECT SIZES: MATHEMATICS ABILITY EFFECTS ON STUDENTS' SCIENCE GRADES

Study Code		Sample Size	r	r_{es}
001		306	0.66	0.66
003		312	0.42	0.42
006	(a)	75	0.09	0.09
	(b)	215	).32	0.32
	(c)	185	0.39	0.39
	(d)	55	0.37	0.37
011		195	0.49	0.49
016		154	0.30	0.30
017		499	0.31	0.31
018	(a)	116	0.44	0.43
	(b)	238	0.53	0.53
	(c)	545	0.28	0.27
020		171	0.49	0.49
038		126	0.53	0.53
064		261	0.67	0.67
069		143	0.09	0.09

Pooled Effect Size	r_{es} = 0.42
Heterogeneity	X^2 = 136.95
Z for Effect Size observed	Z = 23.33
Probability associated with Z	= p<.001

Students' Science Test Scores and Science Ability

An examination of the relationship of students' science test scores and science ability variable revealed a mean effect size r_{es} of 0.55, based on 9 studies (Z=33.65, p<.001). A test for heterogeneity of this effect yielded a X^2 of 152.63 (p<.001), indicating that heterogeneity existed. (See Table 29)

TABLE 29

EFFECT SIZES: SCIENCE ABILITY EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	478	0.29	0.29
(b)	541	0.42	0.42
(c)	648	0.45	0.45
019	185	0.72	0.72
022 (a)	424	0.53	0.53
(b)	421	0.67	0.67
030	65	0.68	0.67
033	2443	0.63	0.63
044	83	0.27	0.27

Pooled Effect Size r_{es} = 0.56
Heterogeneity X^2 = 152.63
Z for Effect Size observed Z = 33.65
Probability associated with Z = p<.001

<u>Students' Cognitive Reasoning Ability and Science Ability</u>

An examination of the relationship of students' cognitive reasoning ability and the science ability variable revealed a mean effect size r_{es} = 0.45, based on 19 studies (Z=20.88, p<.001). A test for heterogeneity for this effect yielded a X^2 of 109.55 (p<.001), indicating that heterogeneity existed. (See Table 30)

TABLE 30

EFFECT SIZES: SCIENCE ABILITY EFFECTS
ON STUDENTS' COGNITIVE REASONING

Study Code	Sample Size	r	r_{es}
005 (a)	33	0.39	0.38
(b)	39	0.54	0.54
(c)	35	0.70	0.69
011	195	0.42	0.42
015	84	0.47	0.47
016	170	0.13	0.13
017	335	0.29	0.29
020	171	0.30	0.30
021	95	0.65	0.65
029	122	0.59	0.59
030	65	0.54	0.54
038	126	0.42	0.42
042	140	0.39	0.39
043	72	0.69	0.69
044	83	0.48	0.48
051	92	0.30	0.30
053	84	0.22	0.22
055	500	0.64	0.63
060	131	0.41	0.41

Pooled Effect Size r_{es} = 0.45
Heterogeneity X^2 = 109.55
Z for Effect Size observed Z = 20.88
Probability associated with Z = p<.001

Students' Attitudes Toward Science and Science Ability

An examination of the relationship of students' attitudes toward science and the science ability variable revealed a mean effect size r_{es} of 0.26, based on 11 studies (Z=19.33, p<.001). A test for heterogeneity of this effect yielded a X^2 of 43.03 (p<.001), indicating that heterogeneity existed. (See Table 31)

TABLE 31

EFFECT SIZES: SCIENCE ABILITY EFFECTS ON STUDENTS' ATTITUDES TOWARD SCIENCE

Study Code	Sample Size	r	r_{es}
004 (a)	488	0.11	0.11
(b)	540	0.18	0.18
(c)	644	0.28	0.28
010	321	0.36	0.36
013	4000	0.24	0.24
016	170	0.10	0.10
033	2443	0.33	0.33
038	126	0.28	0.28
040 (a)	226	0.17	0.17
(b)	217	0.19	0.19
047	97	0.26	0.26

Pooled Effect Size r_{es} = 0.26
Heterogeneity X^2 = 43.03
Z for Effect Size observed Z = 19.33
Probability associated with Z = p<.001

Students' Attitudes Toward Science Learning and Science Ability

An examination of the relationship of students' attitudes toward science learning and the science ability variable revealed a mean effect size r_{es} of 0.21, based on 14 studies (Z=21.67, p<.001). A test for heterogeneity of this effect yielded a X^2 of 89.81 (p<.001), indicating that heterogeneity existed. (See Table 32)

TABLE 32

EFFECT SIZES: SCIENCE ABILITY EFFECTS ON STUDENTS' ATTITUDES TOWARD SCIENCE LEARNING

Study Code		Sample Size	r	r_{es}
003		312	0.35	0.35
004	(a)	540	0.11	0.11
	(b)	488	0.14	0.14
	(c)	644	0.26	0.26
008		1958	0.35	0.35
019		185	0.36	0.36
023		1450	0.20	0.20
032		2719	0.15	0.15
033		2443	0.34	0.33
039		168	0.14	0.14
040	(a)	226	0.12	0.12
	(b)	217	0.05	0.05
049		1504	0.20	0.20
062		550	0.16	0.16

Pooled Effect Size	r_{es} =	0.21
Heterogeneity	X^2 =	89.81
Z for Effect Size observed	Z =	21.67
Probability associated with	Z =	p<.001

Students' Science Test Scores and General Ability

An examination of the relationship of students' science test scores and the general ability variable exhibited a mean effect size r_{es} of 0.42, based on nine studies (Z = 50.80, p<.001). A test for heterogeneity of this effect yielded a X^2 of 133.94 (p<.001), indicating that heterogeneity existed. (See Table 33)

TABLE 33

EFFECT SIZES: GENERAL ABILITY EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
019	185	0.50	0.50
024	152	0.65	0.65
027	8479	0.42	0.42
031 (a)	473	0.22	0.22
(b)	2822	0.37	0.37
(c)	3100	0.38	0.38
058	2520	0.45	0.45
059	1729	0.54	0.54
068	128	0.74	0.74

Pooled Effect Size	r_{es} = 0.42
Heterogeneity	X^2 = 133.94
Z for Effect Size observed	Z = 50.80
Probability associated with	Z = p<.001

<u>Students' Cognitive Reasoning and General Ability</u>

An examination of the relationship of students' cognitive reasoning ability and the general ability variable revealed a mean effect size r_{es} of 0.55, based on seven studies (Z=14.61, p<.001). A test for heterogeneity of this effect yielded a X^2 of 132.36 (p<.001), indicating that heterogeneity existed. (See Table 34)

TABLE 34

EFFECT SIZES: GENERAL ABILITY EFFECTS
ON STUDENTS' COGNITIVE REASONING

Study Code	Sample Size	r	r_{es}
017	351	0.76	0.76
020	171	0.15	0.15
021	95	0.56	0.56
029	122	0.72	0.72
044	83	0.18	0.18
050	120	0.19	0.19
051	92	0.56	0.56

Pooled Effect Size r_{es} = 0.55
Heterogeneity X^2 = 132.36
Z for Effect Size observed Z = 14.61
Probability associated with Z = p<.001

Students' Science Test Scores and Cognitive Reasoning

An examination of the relationship of students' science test scores and cognitive reasoning ability variable revealed a mean effect size r_{es} of 0.56, based on 13 studies ($Z = 21.34$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 42.89 ($p<.001$), indicating that heterogeneity existed. (See Table 35)

TABLE 35

EFFECT SIZES: COGNITIVE REASONING ABILITY EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
005 (a)	39	0.54	0.54
(b)	35	0.70	0.69
(c)	33	0.39	0.38
021	95	0.65	0.65
030	65	0.39	0.38
042	140	0.39	0.39
043	72	0.69	0.69
044	83	0.48	0.48
053	84	0.22	0.22
055	500	0.64	0.63
065 (a)	44	0.71	0.71
(b)	152	0.61	0.61
074	725	0.55	0.55

Pooled Effect Size	r_{es} =	0.56
Heterogeneity	X^2 =	42.89
Z for Effect Size observed	Z =	21.34
Probability associated with	Z =	p<.001

Students' Science Grades and Cognitive Reasoning Ability

An examination of the relationship of students' science grades and the cognitive reasoning ability variable exhibited a mean effect size r_{es} of 0.33, based on 12 studies ($Z=14.11$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 34.44 ($p<.001$), indicating that heterogeneity existed. (See Table 36)

TABLE 36

EFFECT SIZES: COGNITIVE REASONING ABILITY EFFECTS ON STUDENTS' SCIENCE GRADES

Study Code	Sample Size	r	r_{es}
006 (a)	215	0.24	0.24
(b)	185	0.26	0.26
(c)	55	0.27	0.26
011	195	0.42	0.42
015	84	0.47	0.47
016	170	0.13	0.13
017	335	0.29	0.29
020	171	0.30	0.30
029	112	0.59	0.59
038	126	0.42	0.42
051	92	0.30	0.30
063	101	0.51	0.51

Pooled Effect Size	r_{es} =	0.33
Heterogeneity	X^2 =	34.44
Z for Effect Size observed	Z =	14.11
Probability associated with	Z =	p<.001

Results Related to Research Question 4: Attitudinal Measures Effects

In the examination of results related to research question 2, the relationship of environmental variables with study outcomes, sufficient numbers of studies existed to examine the relationship of:

- science test scores and attitudes toward science, and
- science test scores and attitudes toward science learning.

An insufficient number of studies existed to explore other relationships in a meta-analytic fashion. Results for the meta-analyses conducted follow. Data tables related to relationships which could not be explored are provided in Appendix D.

<u>Students' Science Test Scores and Attitudes Toward Science</u>

An examination of the relationship of students' science test scores and the attitudes toward science variable exhibited a mean effect size r_{es} of 0.23, based on eight studies (Z=15.31, p<.001). A test for heterogeneity of this effect yielded a X^2 of 258.08 (p<.001), indicating that heterogeneity existed. (See Table 37)

TABLE 37

EFFECT SIZES: ATTITUDES TOWARD SCIENCE EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	488	0.11	0.11
(b)	540	0.18	0.18
(c)	644	0.28	0.28
033	2443	0.33	0.33
040 (a)	217	0.19	0.19
(b)	226	0.17	0.17
059	1729	0.11	0.11
068	128	0.30	0.30

Pooled Effect Size r_{es} = 0.23
Heterogeneity X^2 = 67.27
Z for Effect Size observed Z = 15.31
Probability associated with Z = p<.001

<u>Students' Science Test Scores and Attitudes Toward Science Learning</u>

An examination of the relationship of students' science test scores and attitudes toward science learning variable exhibited a mean effect size r_{es} of 0.19, based on 15 studies ($Z=27.45$, $p<.001$). A test for heterogeneity of this effect yielded a X^2 of 200.64 ($p<.001$), indicating that heterogeneity existed. (See Table 38)

TABLE 38

EFFECT SIZES: ATTITUDES TOWARD SCIENCE LEARNING EFFECTS ON STUDENTS' SCIENCE TEST SCORES

Study Code	Sample Size	r	r_{es}
004 (a)	540	0.11	0.11
(b)	488	0.14	0.14
(c)	644	0.26	0.26
008	1958	0.35	0.35
019	150	0.30	0.30
031 (a)	2822	0.10	0.10
(b)	3258	0.10	0.10
(c)	3100	0.16	0.16
032 (a)	2719	0.15	0.15
(b)	606	0.30	0.30
033	2443	0.23	0.22
040 (a)	226	0.12	0.12
(b)	217	0.05	0.05
057 (a)	2520	0.23	0.23
(b)	1729	0.35	0.35

Pooled Effect Size r_{es} = 0.19
Heterogeneity X^2 = 200.64
Z for Effect Size observed Z = 27.45
Probability associated with Z = $p<.001$

Students' Science Grades and Attitudes Toward Science Learning

An examination of the relationship of students' science grades and the attitudes toward science learning variable exhibited a mean effect size r_{es} of 0.23, based on seven studies (Z=14.81, p<.001). A test for heterogeneity of this effect yielded a X^2 of 32.57 (p<.001), indicating that heterogeneity existed. (See Table 39)

TABLE 39

EFFECT SIZES: ATTITUDES TOWARD SCIENCE LEARNING EFFECTS ON STUDENTS' SCIENCE GRADES

Study Code	Sample Size	r	r_{es}
003	312	0.35	0.35
019	185	0.36	0.36
023	1450	0.20	0.20
039	168	0.14	0.14
049	1504	0.20	0.20
062	550	0.16	0.16
064	261	0.45	0.45

Pooled Effect Size	r_{es} =	0.23
Heterogeneity	X^2 =	32.57
Z for Effect Size observed	Z =	14.81
Probability associated with Z	=	p<.001

<u>Results Related to Research Question 5: Analysis of the Mediating Effects of Methodological Characteristics</u>

Further analysis of the effects on outcome variables, when examining subgroups created using study methodological characteristics, were carried out. Table 40 presents the frequency of the studies displaying effects for various outcome measures broken down by study characteristics. Comparisons were made among the effect sizes of the student characteristics on outcomes across the subgroups associated with each study variable. Analyses of the effect sizes were carried out if the number of studies analyzed was equal to or more than six. Due to the low number of studies available for analyses, few variables could be split out for comparisons. (See Appendix D)

TABLE 40

FREQUENCY OF STUDIES DISPLAYING EFFECTS FOR VARIOUS OUTCOME MEASURES ACROSS SOURCES OF THESE EFFECTS BROKEN DOWN BY STUDY CHARACTERISTICS

Outcome Measure	Study Characteristics	Gender	Race	Father Ed	Mother Ed	Facil
				Source of Effect		
SCIENCE TEST SCORES						
Total number of Studies		25	9	9	9	12
	Form of Publication	*	-	-	-	-
	Assignment	*	-	-	-	-
	Study Type	*	-	-	-	-
	"r" calculation	*	-	-	-	-
	Socioeconomic Status	*	-	-	-	-
	Age Levels	*	-	-	-	-
	Grade Levels	*	-	-	-	-
		General.	Cog	Plans	Homework	
SCIENCE TEST SCORES						
Total number of studies		8	14	14	10	
	Age Levels	-	-	*	-	

TABLE 40 (cont.)

Outcome Measures	Study Characteristic	AttSc	AttLr	Lang	Math	Scien
SCIENCE TEST SCORES						
Total number of studies		6	15	19	13	9
	Assignment	*	-	*	-	-
	Age Levels	*	*	*	-	-
	Grade Levels	*	-	*	-	-
SCIENCE GRADES						
Total number of studies		0	7	12	16	0
	Design Rating	-	-	*	-	-
	Socioeconomic Status	-	-	-	*	-
	Age Levels	-	-	-	*	-
COGNITIVE REASONING ABILITY						
Total number of studies		0	0	0	0	18
	Form of Publication	-	-	-	-	*
	Socioeconomic Status	-	-	-	-	*
	Grade Levels	-	-	-	-	*
ATTITUDES TOWARDS SCIENCE LEARNING						
Total number of studies		0	0	0	0	14
	Internal Validity	-	-	-	-	*
	Design Rating	-	-	-	-	*

* An asterisk indicates where 2 or more subgroups of 6 or more studies were present. In these instances comparisons can be made among subgroups. Tables detailing the comparisons are provided in the following sections.

Students' Outcomes Effect Sizes Across Study Methodological Variables

Students' Science Test Scores and Gender Across Publication Type

Table 41 presents comparative data examining the effect of gender on students' test scores across the publication type. When examining the effect of gender on students' science test scores across the form of publication, four possible publication forms were identified: journals, books, dissertations, and papers. A sufficient number of studies were available to allow computation of the effect sizes for the book form and dissertation form. Studies reported in the book form of publication (n=8) exhibited a mean effect size of r= 0.14, (Z=29.69, p<.001). A test for heterogeneity for this effect yielded a X^2 of 86.20 (p<.001) indicating that heterogeneity existed. Studies reported in dissertations (n=4) exhibited a mean effect size of r = 0.21, (Z =21.62, p<.001). A test for heterogeneity for this effect yielded a X^2 of 52.30 (p<.001) indicating that heterogeneity also existed for the dissertation form of publication.

TABLE 41

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY FORM OF PUBLICATION

Study Variable	Study Code	Sample Size	r	r_{es}
Form of Publication				
Book	058	2520	0.25	0.25
	059	1729	0.24	0.24
	070 (a)	7873	0.14	0.14
	(b)	7974	0.18	0.18
	071 (a)	6200	0.13	0.13
	(b)	3868	0.14	0.14
	072 (a)	6649	0.09	0.09
	(b)	4411	0.11	0.11
	Pooled Effect Size			r_{es} = 0.14
	Heterogeneity			X^2 = 86.20
	Z for Effect Size			Z = 39.10
	Probability associated w/ Z			= p<.001
Dissertation	008	1958	0.21	0.21
	019	130	0.06	0.06
	022 (a)	82	0.09	0.09
	(b)	421	0.19	0.19
	024	152	0.03	0.03
	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	(d)	625	0.15	0.15
	(e)	625	0.32	0.32
	(f)	625	0.34	0.34
	027	8479	0.20	0.20
	032	2719	0.27	0.27
	036	91	0.11	0.11
	Pooled Effect Size			r_{es} = 0.21
	Heterogeneity			X^2 = 52.30
	Z for Effect Size			Z = 21.61
	Probability associated w/Z			= p<.001

Students' Science Test Scores and Gender Across Assignment Type

Table 42 presents comparative data examining the effect of gender on students' science test scores across the type of assignment of subjects variable. When examining the effect of gender on students' science tests scores across the type of assignment of subjects, five possible types of assignments were identified: random, self-selected, intact, representative, and other. A sufficient number of studies were available to allow computation of the effect sizes for both the random form and the representative form of assignment. Studies with random assignment of subjects (n=6) exhibited a mean effect size of r = 0.22, (Z=13.23, $p<.001$). A test of heterogeneity for this effect yielded a X^2 of 28.72 ($p<.001$) indicating that heterogeneity existed. Studies with a representative sample type of assignment (n=14) exhibited a mean effect size of r = 0.15, (Z=38.33, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 122.00 ($p<.001$) indicating that heterogeneity also existed for this type of sample assignment.

TABLE 42

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY ASSIGNMENT TYPE

Study Variable	Study Code	Sample Size	r	r_{es}
Assignment Type				
Random	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	(d)	625	0.15	0.15
	(e)	625	0.32	0.32
	(f)	625	0.34	0.34
	Pooled Effect Size			r_{es} = 0.22
	Heterogeneity			X^2 = 28.72
	Z for Effect Size			Z = 13.22
	Probability associated w/ Z			= p<.001
Representative	008	1958	0.21	0.21
	022 (a)	82	0.09	0.09
	(b)	421	0.19	0.19
	027	8479	0.20	0.20
	052	26279	0.14	0.14
	055	499	0.20	0.20
	058	2520	0.25	0.25
	059	1729	0.24	0.24
	070 (a)	7873	0.14	0.14
	(b)	7974	0.18	0.18
	071 (a)	6200	0.13	0.13
	(b)	3868	0.14	0.14
	072 (a)	6649	0.09	0.09
	(b)	4411	0.11	0.11
	Pooled Effect Size			r_{es}= 0.15
	Heterogeneity			X2= 122.00
	Z for Effect Size			Z = 38.33
	Probability associated w/ Z			= p<.001

Students' Science Test Scores and Gender Across Studies Type

Table 43 presents comparative data examining the effect of gender on students' science test scores across the type of study variable. When examining the effect of gender on students' science test scores across the type of study variable, four possible types were identified: correlational, quasi-experimental, experimental, and other. A sufficient number of studies were available to allow computation of the effect size for the correlational and the "other" study type. Studies with the correlational type of studies (n=10) exhibited a mean correlation of r=0.16, (Z= 30.28, p<.001). A test for heterogeneity for this effect yielded a X^2 of 151.19 (p<.001) indicating that heterogeneity existed. Studies with the "other" type of study (n=13) exhibited a mean effect size of r= 0.14 (Z=27.27, p<.001). A test for heterogeneity for this effect yielded a X^2 of 94.03 (p<.001) indicating that heterogeneity also existed for this study type.

TABLE 43

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY TYPE OF STUDY

Study Variable	Study Code		Sample Size	r	r_{es}
Type of Study					
Correlational	008		1958	0.21	0.21
	019		130	0.06	0.06
	022	(a)	82	0.09	0.09
		(b)	421	0.19	0.19
	027		8479	0.20	0.20
	032		2719	0.27	0.27
	052		26279	0.14	0.14
	058		2520	0.25	0.25
	059		1729	0.24	0.24
	075		4172	0.05	0.05
	Pooled Effect Size			r_{es} =	0.16
	Heterogeneity			X^2 =	151.19
	Z for Effect Size			Z =	30.28
	Probability associated w/Z			=	p<.001
Other	026	(a)	553	0.12	0.12
		(b)	553	0.18	0.18
		(c)	553	0.22	0.22
		(d)	625	0.15	0.15
		(e)	625	0.32	0.32
		(f)	625	0.34	0.34
	055		499	0.20	0.20
	070	(a)	7873	0.14	0.14
		(b)	7974	0.18	0.18
	071	(a)	6200	0.13	0.13
		(b)	3868	0.14	0.14
	072	(a)	6649	0.09	0.09
		(b)	4411	0.11	0.11
	Pooled Effect Size			r_{es}=	0.14
	Heterogeneity			X^2=	94.03
	Z for Effect Size			Z =	27.26
	Probability associated w/ Z			=	p<.001

Students' Science Test Scores and Gender Across Method of Calculating Effect Size

Table 44 presents comparative data examining the effect of gender on students' test scores across the method of calculating r_{es} value. When examining the effect of gender on students' science test scores across the method of calculating the effect size value, four possible methods were identified: r-value, F-value, t-test, p-value, and D-value. A sufficient number of studies were available to allow computation of the effect sizes for the method of reporting the r value directly from the correlation matrix, from the t-test,or from the D-value method. Studies where the r value was derived directly from the correlation matrix (n=11) exhibited a mean effect size of 0.16, (Z=28.98, p<.001). A test for heterogeneity for this effect yielded a X^2 of 153.86 (p<.001), indicating that heterogeneity existed. Studies where the r value was calculated from the t-test (n=7) revealed a mean effect size of 0.22 (Z=12.64, p<.001). A test for heterogeneity for this effect yielded a X^2 of 29.95 (p<.001) indicating that heterogeneity existed. Finally, studies where the r value was calculated from the D-value (n=6) exhibited a mean effect size of r= 0.13, (Z=25.09, p<.001). A test for heterogeneity for this effect yielded a X^2 of 33.95 (p<.001) indicating that heterogeneity also existed.

TABLE 44

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHOD OF CALCULATING "R"

Study Variable	Study Code	Sample Size	r	r_{es}
<u>Method of Calculating "r"</u>				
r-value	008	1958	0.21	0.21
	019	130	0.06	0.06
	022 (a)	82	0.09	0.09
	(b)	421	0.19	0.19
	024	152	0.03	0.03
	027	8479	0.20	0.20
	032	2719	0.27	0.27
	052	26279	0.14	0.14
	058	2520	0.25	0.25
	059	1729	0.24	0.24
	075	4172	0.05	0.05
	Pooled Effect Size		r_{es}=	0.16
	Heterogeneity		X^2=	153.86
	Z for Effect Size		Z =	28.98
	Probability associated w/Z =			p<.001
t-test	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	(d)	625	0.15	0.15
	(e)	625	0.32	0.32
	(f)	625	0.34	0.34
	036	91	0.11	0.11
	Pooled Effect Size		r_{es}=	0.22
	Heterogeneity		X^2=	29.94
	Z for Effect Size		Z =	12.64
	Probability associated w/ Z =			p<.001

TABLE 44 (cont.)

Study Variable	Study Code	Sample Size	r	r_{es}
Method of Calculating "r"				
D value	070 (a)	7873	0.14	0.14
	(b)	7974	0.18	0.18
	071 (a)	6200	0.13	0.13
	(b)	3868	0.14	0.14
	072 (a)	6649	0.09	0.09
	(b)	4411	0.11	0.11

Pooled Effect Size $r_{es} = 0.13$
Heterogeneity $X^2 = 33.95$
Z for Effect Size $Z = 25.09$
Probability associated w/ $Z = p < .001$

Students' Science Test Scores and Gender Across Levels of Socioeconomic Status

Table 45 presents comparative data examining the effect of gender on students' test scores across the students' socioeconomic status. When examining the effect of gender on students' science test scores across the students' socioeconomic status variable, three possible levels were identified: low, medium, high, and mixed. A sufficient number of studies were available to allow computation of the effect sizes for the high and mixed status levels. Studies with high socioeconomic status samples (n=10) exhibited a mean effect size of r=0.17, (Z=19.87, p<.001). A test for heterogeneity for this effect yielded a X^2 of 125.1494 (p<.001) indicating that heterogeneity existed. Furthermore, studies with mixed socioeconomic status samples (n=12) exhibited a mean effect size of r= 0.15 (Z= 31.33, p<.001). A test for heterogeneity for this effect yielded a X^2 of 119.22 (p<.001) indicating that heterogeneity also existed.

TABLE 45

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY LEVELS OF SOCIOECONOMIC STATUS

Study Variable	Study Code	Sample Size	r	r_{es}
Socioeconomic Status				
High	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	(d)	625	0.15	0.15
	(e)	625	0.32	0.32
	(f)	625	0.34	0.34
	055	499	0.20	0.20
	058	2520	0.25	0.25
	059	1729	0.24	0.24
	075	4172	0.05	0.05
	Pooled Effect Size			r_{es}= 0.17
	Heterogeneity			X^2= 125.15
	Z for Effect Size			Z = 19.87
	Probability associated w/ Z =			$p<.001$
Mixed	008	1958	0.21	0.21
	019	130	0.06	0.06
	022 (a)	82	0.09	0.09
	(b)	421	0.19	0.19
	027	8479	0.20	0.20
	032	2719	0.27	0.27
	070 (a)	7873	0.14	0.14
	(b)	7974	0.18	0.18
	071 (a)	6200	0.13	0.13
	(b)	3868	0.14	0.14
	072 (a)	6649	0.09	0.09
	(b)	4411	0.11	0.11
	Pooled Effect Size			r_{es}= 0.15
	Heterogeneity			X^2 = 119.22
	Z for Effect Size			Z = 31.33
	Probability associated w/Z =			$p<.001$

Students' Science Test Scores and Gender Across Age Levels

Table 46 presents comparative data examining the effect of gender on student's test scores across the trends in age levels. When examining the effect of gender on students' science test scores across the trends in age levels, three possible age levels were identified: 11-13 years, 14-16 years, and 17-19 years. A sufficient number of studies were available to allow computation of the effect sizes for the 14-16 years age levels, and the 17-19 age levels. Studies carried out on student samples whose age levels ranged from 14-16 years (n=14) exhibited a mean effect size of $r = 0.13$ ($Z = 23.43$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 102.07 ($p<.001$) indicating that heterogeneity existed. Studies carried out on student samples whose mean ages ranged from 17-19 (n=10) exhibited a mean effect size of $r=0.19$ ($Z= 30.24$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 96.49 ($p<.001$) indicating that heterogeneity also existed for this age levels.

TABLE 46

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY AGE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Age Levels				
a. 14-16	008	1958	0.21	0.21
	019	130	0.06	0.06
	022	421	0.19	0.19
	024	152	0.03	0.03
	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	036	91	0.11	0.11
	052	26279	0.14	0.14
	055	499	0.20	0.20
	058	2520	0.25	0.25
	071	6200	0.13	0.13
	072	6649	0.09	0.09
	075	4172	0.05	0.05
	Pooled Effect Size			r_{es} = 0.13
	Heterogeneity			X^2 =102.07
	Z for Effect Size			Z = 23.43
	Probability associated w/ Z			= p<.001
b. 17-19	022	82	0.09	0.09
	026 (a)	625	0.15	0.15
	(b)	625	0.32	0.32
	(c)	625	0.34	0.34
	027	8479	0.20	0.20
	032	2719	0.27	0.27
	059	1729	0.24	0.24
	070	7974	0.18	0.18
	071	3868	0.14	0.14
	072	4411	0.11	0.11
	Pooled Effect Size			r_{es}= 0.19
	Heterogeneity			X^2 = 96.49
	Z for Effect Size			Z = 30.24
	Probability associated w/Z			= p<.001

Students' Science Test Scores and Gender Across Grade Levels

Table 47 presents comparative data examining the effect of gender on students' test scores across grade levels. When examining the effect of gender on student's science test scores across age levels, eight possible levels were identified: seventh-grade, eight-grade, ninth-grade, 10th-grade, 11th-grade, 11th-grade, seventh to ninth grades, and tenth to twelfth grades. A sufficient number of studies were available to allow computation of the effect sizes for the eighth grade, ninth grade, seventh to ninth grades and the tenth to twelfth grades. Studies conducted on eighth grade students (n=6) exhibited a mean effect size of $r_{..}$ of 0.12, (Z=16.95, p<.001). A test for heterogeneity for this effect yielded a X^2 of 16.59 (p<.001) indicating that heterogeneity existed. Studies carried out on eight grade students (n=6) exhibited a mean effect size of $r_{..}$ = 0.24 (Z=16.82, p<.001). A test for heterogeneity for this effect yielded a X^2 of 14.92 (p<.001) indicating that heterogeneity existed.

Furthermore, studies conducted on seventh to ninth (7-9) grade students (n=13) revealed a mean effect size r_{es} of 0.14 (Z=23.91, p<.001). A test for heterogeneity for this effect yielded a X^2 of 151.90 indicating that heterogeneity existed. Studies carried out on 10-12 grade levels (n=12) exhibited a mean effect size r_{es} of 0.16, (Z=31.55, p<.001). A test for heterogeneity for this effect yielded a X^2 of 97.81 (p<.001) indicating that heterogeneity existed.

TABLE 47

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY GRADE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Grade Levels				
8th Grade	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	070	7873	0.14	0.14
	071	6200	0.13	0.13
	072	6649	0.09	0.09
	Pooled Effect Size			r_{es} = 0.12
	Heterogeneity			X^2 = 16.59
	Z for Effect Size			Z = 16.94
	Probability associated w/ Z			= p<.001
9th Grade	008	1958	0.21	0.21
	022	421	0.19	0.19
	024	152	0.03	0.03
	032	2719	0.27	0.27
	036	91	0.11	0.11
	058	2521	0.25	0.25
	Pooled Effect Size			r_{es} = 0.24
	Heterogeneity			X^2 = 14.92
	Z for Effect Size			Z = 16.82
	Probability associated w/ Z			= p<.001

TABLE 47 (cont.)

Study Variable	Study Code	Sample Size	r	r_{es}
7-9th Grades	026 (a)	553	0.12	0.12
	(b)	553	0.18	0.18
	(c)	553	0.22	0.22
	070	7873	0.14	0.14
	071	6200	0.13	0.13
	072	6649	0.09	0.09
	008	1958	0.21	0.21
	022	421	0.19	0.19
	024	152	0.03	0.03
	032	2719	0.27	0.27
	036	91	0.11	0.11
	058	2520	0.25	0.25
	075	4172	0.05	0.05
	Pooled Effect Size			r_{es}= 0.14
	Heterogeneity			X^2= 151.90
	Z for Effect Size observed			Z = 23.91
	Probability associated w/			Z = $p<.001$
10-12 Grades	019	130	0.06	0.06
	052	26279	0.14	0.14
	022	82	0.09	0.09
	070	7974	0.18	0.18
	071	3868	0.14	0.14
	072	4411	0.11	0.11
	026 (a)	625	0.15	0.15
	(b)	625	0.32	0.32
	(c)	625	0.34	0.34
	027	8479	0.20	0.20
	055	499	0.20	0.20
	059	1729	0.24	0.24
	Pooled Effect Size			r_{es}= 0.16
	Heterogeneity			X^2= 97.81
	Z for Effect Size			Z = 31.54
	Probability associated w/			Z = $p<.001$

Students' Science Test Scores and Plans and Aspirations Across Age Levels

Table 48 presents comparative data examining the effect of plans and aspirations on students' science test scores across the trends in age levels. When examining the effect of plans and aspirations on students' science test scores across the age levels, two age levels were identified; 14-16, and 17-19. A sufficient number of studies were available to allow computation of the effect sizes of both the 14-16 and 17-19 age levels. Studies conducted on the 14-16 age levels (n=6) revealed a mean effect size of r= 0.30 (Z=43.00, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 111.15 ($p<.001$), indicating that heterogeneity existed. Studies carried out on 17-19 age level students (n=8) exhibited a mean effect size of 0.25 (Z=25.43, $p<.001$). A test for heterogeneity for the effect yielded a X^2 of 445.64 ($p<.001$) indicating that heterogeneity existed for this age level.

TABLE 48

EFFECT SIZES: PLANS AND ASPIRATIONS RELATIONSHIPS
WITH STUDENTS' SCIENCE TEST SCORES
BROKEN DOWN BY AGE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Age Levels				
b. 14-16	031 (a)	2505	0.21	0.21
	(b)	3100	0.27	0.27
	032	1958	0.36	0.36
	033	2443	0.15	0.15
	035	233	0.31	0.31
	052	26279	0.32	0.32
	Pooled Effect Size		r_{es} =	0.30
	Heterogeneity		X^2 =	111.15
	Z for Effect Size		Z =	43.00
	Probability associated w/ Z		=	p<.001
c. 17-19	004 (a)	504	0.05	0.05
	(b)	488	0.09	0.09
	(c)	648	0.23	0.23
	027	8479	0.41	0.40
	031 (a)	3259	0.15	0.15
	(b)	2822	0.16	0.16
	032	2719	0.17	0.16
	059	1729	0.05	0.05
	Pooled Effect Size		r_{es} =	0.25
	Heterogeneity		X^2 =	445.63
	Z for Effect Size		Z =	25.43
	Probability associated w/Z		=	p<.001

Students' Science Test Scores and Language Ability Across Type of Assignment

Table 49 presents comparative data examining the effect of language ability on students' test scores across the type of assignment of subjects variable. When examining the effect of language ability on students' science test scores across the type of assignment variable, four possible types were identified: random, self-selected, intact, and representative sample. A sufficient number of studies were available to allow computation of the effect size for the random type and the self-selected type of sample assignment. Studies with the random assignment of subjects (n=6) exhibited a mean effect size of $r = 0.44$ ($Z=43.49$, $p<.001$). A test for heterogeneity for this effect revealed a X^2 of 152.94 indicating that heterogeneity existed. Studies with the self-selected type of assignment, (n=6) exhibited a mean effect size of $r= 0.39$, ($Z=17.75$, $p=.001$). A test for heterogeneity for this effect yielded a X^2 of 85.63 ($p<.001$) indicating that heterogeneity also existed for this type of assignment.

TABLE 49

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY ASSIGNMENT TYPE

Study Variable	Study Code	Sample Size	r	r_{es}
Random	021	80	0.70	0.70
	031 (a)	3258	0.34	0.34
	(b)	2822	0.47	0.47
	(c)	3100	0.53	0.53
	033	2443	0.37	0.37
	068	128	0.73	0.73
	Pooled Effect Size		r_{es}=	0.44
	Heterogeneity		X^2=	152.93
	Z for Effect Size		Z =	43.49
	Probability associated w/Z=			p<.001
Self-Selected	004 (a)	541	0.22	0.22
	(b)	478	0.25	0.25
	(c)	642	0.42	0.42
	024	152	0.51	0.51
	035	233	0.68	0.68
	043	72	0.67	0.67
	Pooled Effect Size		r_{es}=	0.39
	Heterogeneity		X^2=	85.63
	Z for Effect Size		Z =	17.75
	Probability associated w/Z =			p<.001

Students' Science Test Scores and Language Ability Across Age Levels

Table 50 presents comparative data examining the effect of language ability on students's test scores across the trends in age levels. When examining the effect of language ability on students test scores across the trends in age levels, three possible levels were identified: 13-15, 14-16, and 17-19 years. A sufficient number of studies were available to allow computation of the effect sizes for both the 14-16, and the 17-19 year-age ranges. Studies carried out on 14-16 year-old students (n=10) exhibited a mean effect size of r= 0.52 (Z=36.61, p<.001). A test for heterogeneity for this effect yielded a X^2 of 61.66 (p<.001), indicating that heterogeneity existed. Studies conducted on 17-19 year-old students (n=8) revealed a mean effect size of r=0.39 (Z= 38.24, p<.001). A test for heterogeneity for this effect yielded a X^2 of 77.92 (p<.001) indicating that heterogeneity also existed for this age level.

TABLE 50

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY AGE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Age Levels:				
b. 14-16	008	1958	0.45	0.45
	021	80	0.70	0.70
	022	424	0.48	0.48
	022	421	0.58	0.58
	024	152	0.51	0.51
	031	3100	0.53	0.53
	035	233	0.68	0.68
	040	217	0.51	0.51
	043	72	0.67	0.67
	068	128	0.73	0.73
	Pooled Effect Size		r_{es} =	0.52
	Heterogeneity		X^2 =	61.67
	Z for Effect Size		Z =	36.61
	Probability associated w/ Z		=	p<.001
c. 17-19	004 (a)	541	0.22	0.22
	(b)	478	0.25	0.25
	(c)	642	0.42	0.42
	022	82	0.59	0.59
	031	3258	0.34	0.34
	031	2822	0.47	0.47
	032	2719	0.37	0.37
	033	2443	0.37	0.37
	Pooled Effect Size		r_{es} =	0.38
	Heterogeneity		X^2 =	77.92
	Z for Effect Size		Z =	38.24
	Probability associated w/Z		=	p<.001

Students' Science Test Scores and Language Ability Across the Grade Levels

Table 51 presents comparative data examining the effect of language ability students' science scores across the trends in grade levels. When examining the effect of language ability on students' science test scores across the grade levels, four possible levels were identified: seventh-grade, eight-grade, ninth-grade, 10th-grade, 11th-grade, 11th-grade, seventh to ninth grades, and tenth to twelfth grades. A sufficient number of studies were available to allow computation of the effect sizes for the ninth grade level, 7th-9th grade levels, and 10th-12th grade levels. Studies carried out on ninth grade students (n=7) exhibited a mean effect size of r= 0.51 (Z=25.69, p<.001). A test for heterogeneity for this effect yielded a X^2 of 43.80,(p<.001) indicating that heterogeneity existed. Studies conducted on twelfth grade students (n=6) revealed a mean effect size of r=0.35 (Z=31.77, p<.001). A test for heterogeneity for this effect yielded a X^2 od 24.19, (p<.001) indicating that heterogeneity existed.

Moreover, studies conducted on students in the seventh to ninth grade range (n=9) exhibited a mean effect size of r=0.53 (Z=28.51, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 64.52 ($p<.001$) indicating that heterogeneity existed. Finally, studies carried on the 10-12 grade levels (n=10) revealed a mean correlation of r=0.41 (Z=46.71, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 176.54 ($p<.001$) indicating that heterogeneity existed.

TABLE 51

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY GRADE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Grade Levels				
9th Grade	008	1958	0.45	0.45
	021	80	0.70	0.70
	022	421	0.58	0.58
	024	152	0.51	0.51
	035	233	0.68	0.68
	040	217	0.51	0.51
	043	72	0.67	0.67
	Pooled Effect Size		r_{es} =	0.51
	Heterogeneity		X^2 =	43.80
	Z for Effect Size		Z =	25.69
	Probability associated w/Z		=	p<.001
12th Grade	004 (a)	541	0.22	0.22
	(b)	478	0.25	0.25
	(c)	642	0.42	0.42
	031	3258	0.34	0.34
	032	2719	0.37	0.37
	033	2443	0.37	0.37
	Pooled Effect Size		r_{es} =	0.35
	Heterogeneity		X^2 =	24.19
	Z for Effect Size		Z =	31.77
	Probability associated w/Z		=	p<.001

TABLE 51 (cont.)

Study Variable	Study Code	Sample Size	r	r_{es}
Grade Levels				
7-9th Grades	040	226	0.62	0.62
	008	1958	0.45	0.45
	021	80	0.70	0.70
	022	421	0.58	0.58
	024	152	0.51	0.51
	035	233	0.68	0.68
	040	217	0.51	0.51
	043	72	0.67	0.67
	068	128	0.73	0.73
	Pooled Effect Size		r_{es} =	0.53
	Heterogeneity		X^2 =	64.52
	Z for Effect Size		Z =	28.51
	Probability associated w/Z		=	p<.001
10-12 Grades	022	424	0.48	0.48
	031	3100	0.53	0.53
	022	82	0.59	0.59
	031	2822	0.47	0.47
	004 (a)	541	0.22	0.22
	(b)	478	0.25	0.25
	(c)	642	0.42	0.42
	031	3258	0.34	0.34
	032	2719	0.37	0.37
	033	2443	0.37	0.37
	Pooled Effect Size		r_{es} =	0.41
	Heterogeneity		X^2 =	176.55
	Z for Effect Size		Z =	46.71
	Probability associated w/Z		=	p<.001

Students' Science Grades and Language Ability Across Study Design

Table 52 presents comparative data examining the effect of language ability on students' science grades across the design of the original studies. When examining the effect of language ability on students' science grades, three possible levels were identified: low, medium, and high. A sufficient number of studies were available to allow computation of the effect sizes of the studies with both medium and high design ratings. Studies with medium design rating (n=6) exhibited a mean effect size of r= 0.43 (12.47,p<.001). A test for heterogeneity for this effect yielded a X^2 of 72.59(p<.001) indicating that heterogeneity existed. Studies with high design rating (n=6) revealed a mean effect size of r= 0.40 (Z=15.30, p<.001). A test for heterogeneity for this effect yielded a X^2 of 34.28 (p<.001), indicating that heterogeneity also existed for the high design rating.

TABLE 52

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY DESIGN RATING

Study Variable	Study Code	Sample Size	r	r_{es}
Design Rating				
Medium	001	306	0.70	0.70
	003	312	0.36	0.35
	006 (a)	75	0.14	0.14
	(b)	215	0.23	0.23
	(c)	185	0.35	0.35
	(d)	55	0.37	0.37
	Pooled Effect Size		r_{es}	= 0.43
	Heterogeneity		X^2	= 72.59
	Z for Effect Size		Z	= 12.47
	Probability associated w/Z			= p<.001
High	016	145	0.23	0.23
	017	352	0.29	0.29
	018 (a)	546	0.41	0.41
	(b)	174	0.46	0.46
	(c)	314	0.58	0.58
	020	171	0.25	0.25
	Pooled Effect Size		r_{es}	= 0.40
	Heterogeneity		X^2	= 34.28
	Z for Effect Size		Z	= 15.30
	Probability associated w/Z			= p<.001

Students' Science Grades and Mathematics Ability Across Socioeconomic Status

Table 53 presents comparative data examining the effect of mathematics ability on students' science grades across the levels of socioeconomic status. When examining the effect of mathematics ability on students' science grades across the levels of socioeconomic status, three levels were identified: low, medium, and high. A sufficient number of studies were available to allow computation of the effect sizes for the medium and the low socioeconomic status. Studies conducted on students' from a medium socioeconomic status ($n=7$) revealed a mean effect size of $r=0.40$ ($Z=12.71$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 15.86 ($p<.001$), indicating that heterogeneity existed. Studies conducted on students from a high socioeconomic status ($n=6$) exhibited a mean effect size of $r=0.36$ ($Z=14.79$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 22.91 ($p<.001$) indicating that heterogeneity also existed for this level.

TABLE 53

EFFECT SIZES: MATHEMATICS ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY LEVELS OF SOCIOECONOMIC STATUS

Study Variable	Study Code	Sample Size	r	r_{es}
Socioeconomic Status				
Medium	003	312	0.42	0.42
	006 (a)	75	0.09	0.09
	(b)	215	0.32	0.32
	(c)	185	0.39	0.39
	(d)	55	0.37	0.37
	011	195	0.49	0.49
	038	126	0.53	0.53
	Pooled Effect Size			r_{es} = 0.40
	Heterogeneity			X^2 = 15.86
	Z for Effect Size			Z = 12.71
	Probability associated w/			Z = 0<.001
High	016	154	0.30	0.30
	017	499	0.31	0.31
	018 (a)	116	0.44	0.43
	(b)	238	0.53	0.53
	(c)	545	0.28	0.27
	020	171	0.49	0.49
	Pooled Effect Size			r_{es} = 0.36
	Heterogeneity			X^2 = 22.90
	Z for Effect Size			Z = 14.79
	Probability associated w/			Z = 0<.001

Students' Science Grades and Mathematics Ability Across Age Levels

Table 54 presents comparative data examining the effect of mathematics ability on students' science grades across the age levels. When examining the effect of mathematics ability on students' science grades across the age levels: three possible levels were identified: 13-25, 14-16, and 17-19. A sufficient number of studies were available to allow computation of the effect sizes for the 14-16, and the 17-19 age levels. Studies carried out on 14-16 year-old students (n=6) exhibited a mean effect size with a value of r= 0.41 (Z= 17.91, p<.001). A test for heterogeneity for this effect yielded a X^2 of 60.61 (p<.001), indicating that heterogeneity existed. As regarding the 17-19 age range, studies conducted on this age level (n=9) revealed a mean effect size of r = 0.45 (Z=15.26, p<.001). A test for heterogeneity for this effect yielded a X^2 of 71.85 (p<.001), indicating that heterogeneity existed.

TABLE 54

EFFECT SIZES: MATHEMATICS ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY AGE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
<u>Age Levels</u>				
a. 14-16	003	312	0.42	0.42
	017	499	0.31	0.31
	018	545	0.28	0.27
	020	171	0.49	0.49
	038	126	0.53	0.53
	064	261	0.67	0.67
	Pooled Effect Size		r_{es} =	0.41
	Heterogeneity		X^2 =	60.61
	Z for Effect Size		Z =	17.91
	Probability associated w/Z		=	p<.001
b. 17-19	001	306	0.66	0.66
	006 (a)	75	0.09	0.09
	(b)	215	0.32	0.32
	(c)	185	0.39	0.39
	(d)	55	0.37	0.37
	011	195	0.49	0.49
	018	238	0.53	0.53
	018	116	0.44	0.43
	069	143	0.09	0.09
	Pooled Effect Size		r_{es} =	0.45
	Heterogeneity		X^2 =	71.85
	Z for Effect Size		Z =	15.26
	Probability associated w/ Z		=	p<.001

Students' Cognitive Reasoning and Science Ability Across the Publication Type

Table 55 presents comparative data examining the effect of science ability on students' cognitive reasoning ability across the publication type. When examining the effect of science ability on students' cognitive reasoning ability across the form of publication, four possible publication forms were identified: journals, books, dissertations, and papers. A sufficient number of studies were available to allow computation of the effect sizes for the journal form and the dissertation form. Studies reported in the journal form of publication (n=6) exhibited a mean effect size of r= 0.41 (Z= 9.93, p<.001). A test for heterogeneity for this effect yielded a X^2 of 17.12 (p<.001) indicating that heterogeneity existed. Studies reported in the dissertation type of publication (n=12) exhibited a mean effect size of r = 0.40 (Z=15.16, p<.001). A test for heterogeneity for this effect yielded a X^2 of 50.72 (p<.001), indicating that heterogeneity existed.

TABLE 55

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY FORM OF PUBLICATION

Study Variable	Study Code	Sample Size	r	r_{es}
Form of Publication				
Journal	042	140	0.39	0.39
	043	72	0.69	0.69
	044	83	0.48	0.48
	051	92	0.30	0.30
	053	84	0.22	0.22
	060	131	0.41	0.41
	Pooled Effect Size		r_{es} =	0.41
	Heterogeneity		X^2 =	17.12
	Z for Effect Size		Z =	9.93
	Probability associated w/Z =			p<.001
Dissertation	005 (a)	33	0.39	0.38
	(b)	39	0.54	0.54
	(c)	35	0.70	0.69
	011	195	0.42	0.42
	015	84	0.47	0.47
	016	170	0.13	0.13
	017	335	0.29	0.29
	020	171	0.30	0.30
	021	95	0.65	0.65
	029	122	0.59	0.59
	030	65	0.54	0.54
	038	126	0.42	0.42
	Pooled Effect Size		r_{es} =	0.40
	Heterogeneity		X^2 =	50.71
	Z for Effect Size		Z =	15.157
	Probability associated w/Z		=	p<.001

Students' Cognitive Reasoning and Science Ability Across Levels of Socioeconomic Status

Table 56 presents comparative data examining the effect of science ability on students' cognitive reasoning ability across the levels of socioeconomic status. When examining the effect of students' science ability on their cognitive reasoning ability, three levels were identified: low, medium, and high. A sufficient number of studies were available to allow computation of the effect sizes of both the high and mixed socioeconomic status. Studies conducted on the high socioeconomic status students (n=8) exhibited a mean effect size of $r = 0.44$ ($Z = 14.82$, $p < .001$). A test for heterogeneity for this effect yielded a X^2 of 87.29 ($p < .001$) indicating that heterogeneity existed. Moreover, studies carried out on students from the mixed socioeconomic status (n=6) revealed a mean effect size of $r = 0.59$ ($Z = 10.65$, $p < .001$). A test for heterogeneity for this effect yielded a X^2 of 6.61 ($p < .001$) indicating that heterogeneity existed.

TABLE 56

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY LEVELS OF SOCIOECONOMIC STATUS

Study Variable	Study Code	Sample Size	r	r_{es}
Socioeconomic Status				
High	016	170	0.13	0.13
	017	335	0.29	0.29
	020	171	0.30	0.30
	043	72	0.69	0.69
	044	83	0.48	0.48
	053	84	0.22	0.22
	055	500	0.64	0.63
	060	131	0.41	0.41
	Pooled Effect Size			r_{es} = 0.44
	Heterogeneity			X^2 = 87.29
	Z for Effect Size			Z = 14.82
	Probability associated			w/Z = p<.001
Mixed	005 (a)	33	0.39	0.38
	(b)	39	0.54	0.54
	(c)	35	0.70	0.69
	021	95	0.65	0.65
	029	122	0.59	0.59
	030	65	0.54	0.54
	Pooled Effect Size			r_{es} = 0.59
	Heterogeneity			X^2 = 6.61
	Z for Effect Size			Z = 10.65
	Probability associated w/Z			= 0<.001

Students' Cognitive Reasoning and Science Ability Across Grade Levels

Table 57 presents comparative data examining the effect of science ability on students' cognitive reasoning ability across the grade levels. When examining the effect of science ability on students' cognitive reasoning ability across the grade levels, seven possible levels were identified: seventh-grade, eight-grade, ninth-grade, 10th-grade, 11th-grade, 12th-grade, seventh to ninth grades, and tenth to twelfth grades. A sufficient number of studies were available to allow computation of the effect sizes for the ninth grade, 7th-9th grade, and 10th-12th grades. Studies conducted on ninth grade students (n=6) exhibited a mean effect size value of r= 0.42 (Z=10.91, p<.001). A test for heterogeneity for this effect yielded a X^2 of 30.27 (p<.001), indicating that heterogeneity existed. Studies carried out on the seventh-ninth (7-9) grade (n-12) exhibited a values of r=0.42 (Z=14.81, p<.001). A test for heterogeneity for this effect yielded a X^2 of 61.22 (p<.001) indicating that heterogeneity existed. Moreover, studies conducted on students in the 10-12 grade levels (n=6) exhibited a mean effect size of r=0.50 (Z=14.30, p<.001). A test for heterogeneity for this effect yielded a X^2 of 41.45 (p<.001) indicating that heterogeneity existed.

TABLE 57

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY GRADE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Grade Levels				
9th Grade	005	33	0.39	0.38
	015	84	0.47	0.47
	017	335	0.29	0.29
	021	95	0.65	0.65
	043	72	0.69	0.69
	051	92	0.30	0.30
	Pooled Effect Size		r_{es}	= 0.42
	Heterogeneity		X^2	= 30.26
	Z for Effect Size		Z	= 10.91
	Probability associated w/Z			= p<.001
7-9th Grades	005	39	0.54	0.54
	016	170	0.13	0.13
	029	122	0.59	0.59
	005	35	0.70	0.69
	030	65	0.54	0.54
	042	140	0.39	0.39
	005	33	0.39	0.38
	015	84	0.47	0.47
	017	335	0.29	0.29
	021	95	0.65	0.65
	043	72	0.69	0.69
	051	92	0.30	0.30
	Pooled Effect Size		r_{es}	= 0.42
	Heterogeneity		X^2	= 61.22
	Z for Effect Size		Z	= 14.81
	Probability associated w/Z			= p<.001

TABLE 57 (cont.)

Study Variable	Study Code	Sample Size	r	r_{es}
<u>Grade Levels</u>				
10-12 Grades	011	195	0.42	0.42
	020	171	0.30	0.30
	038	126	0.41	0.42
	044	83	0.48	0.48
	053	84	0.22	0.22
	055	500	0.64	0.63
	Pooled Effect Size			r_{es} = 0.50
	Heterogeneity			X^2 = 41.45
	Z for Effect Size			Z = 14.30
	Probability associated w/Z			= p<.001

Students' Attitudes Toward Science Learning and Science Ability Across Internal Validity

Table 58 presents comparative data examining the effect of science ability on students' attitudes toward science learning and the science ability variable across the levels of internal validity of the coded studies. When examining the effect of science ability on students' attitudes toward science learning across the studies' internal validity, three levels were revealed: low, medium, and high. A sufficient number of studies were available to allow computation of the effect sizes for the studies with both medium and high validity. Studies with medium validity ($n=6$) revealed a mean effect size of $r=0.27$ ($Z=18.30$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 35.77 ($p<.001$), indicating that heterogeneity existed. Furthermore, studies with high validity ($n=8$) exhibited a mean effect size of $r=0.21$ ($Z=14.74$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 76.32 ($p<.001$), indicating that heterogeneity existed.

TABLE 58

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' ATTITUDES TOWARDS SCIENCE LEARNING BROKEN DOWN BY LEVELS OF INTERNAL VALIDITY

Study Variable	Study Code	Sample Size	r	r_{es}
Rated Internal Validity				
Medium	003	312	0.35	0.35
	019	185	0.36	0.36
	023	1450	0.20	0.20
	033	2443	0.34	0.33
	039	168	0.14	0.14
	049	1504	0.20	0.20
	Pooled Effect Size		r_{es} =	0.27
	Heterogeneity		X^2 =	35.77
	Z for Effect Size		Z =	18.30
	Probability associated w/Z		=	p<.001
High	004 (a)	540	0.11	0.11
	(b)	488	0.14	0.14
	(c)	644	0.26	0.26
	008	1958	0.35	0.35
	032	2719	0.15	0.15
	040 (a)	226	0.12	0.12
	(b)	217	0.05	0.05
	062	550	0.16	0.16
	Pooled Effect Size		r_{es} =	0.21
	Heterogeneity		X^2 =	76.32
	Z for Effect Size		Z =	14.74
	Probability associated w/Z		=	p<.001

Students' Attitudes Toward Science Learning and Science Ability Across Study Design

Table 59 presents comparative data examining the effect of science ability on students' attitudes toward science learning across the design of the original studies. When examining the effect of science ability on students' attitudes toward science learning, three possible levels were identified: low, medium, and high. A sufficient number of studies were available to allow computation of the effect sizes of the studies with both medium and high design. Studies with medium design rating (n=7) exhibited a mean effect size of r=0.26 (18.32, p<.001). A test for heterogeneity for this effect yielded a X^2 of 42.64 (p<.001) indicating that heterogeneity existed. Studies with high design rating (n=7) revealed a mean effect size of r= 0.21 (Z=14.39, p<.001). A test for heterogeneity for this effect yielded a X^2 of 74.58 (p<.001) indicating that heterogeneity also existed.

TABLE 59

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' ATTITUDES TOWARD SCIENCE LEARNING BROKEN DOWN BY STUDY DESIGN

Study Variable	Study Code	Sample Size	r	r_{es}
Study Design				
Medium	003	312	0.35	0.35
	019	185	0.36	0.36
	023	1450	0.20	0.20
	033	2443	0.34	0.33
	039	168	0.14	0.14
	049	1504	0.20	0.20
	062	550	0.16	0.16
	Pooled Effect Size			r_{es}= 0.26
	Heterogeneity			X^2= 42.64
	Z for Effect Size			Z = 18.316
	Probability associated			w/Z = p<.001
High	004 (a)	540	0.11	0.11
	(b)	488	0.14	0.14
	(c)	644	0.26	0.26
	008	1958	0.35	0.35
	032	2719	0.15	0.15
	040 (a)	226	0.12	0.12
	(b)	217	0.05	0.05
	Pooled Effect Size			r_{es} = 0.21
	Heterogeneity			X^2 = 74.57
	Z for Effect Size			Z = 14.39
	Probability associated w/ Z			= p<.001

Students' Science Test Scores and Attitudes Toward Science Learning Across Age Levels

Table 60 presents comparative data examining the effect of students' attitudes towards science learning across the trends of age level. When examining the effect of attitudes toward science learning on students science test scores across the trends in age levels, three possible levels were identified: 11-13, 14-16, and 17-19. A sufficient number of studies were available to allow computation of the effect sizes for the 14-16, and the 17-19 age ranges. Studies conducted on students whose age ranged from 14-16 ($n=6$) exhibited a mean effect size of $r = 0.23$, ($Z=19.43$, $p<.001$). A test of heterogeneity for this effect yielded a X^2 of 62.59 ($p<.001$) indicating that heterogeneity existed. Moreover, studies conducted on students whose age ranged from 17-19 years ($n=8$) exhibited a mean effect size of $r= 0.13$, ($Z= 20.11$, $p<.001$). A test for heterogeneity for this effect yielded a X^2 of 142.48 ($p<.001$) indicating that heterogeneity also existed at this age level.

TABLE 60

EFFECT SIZES: ATTITUDES TOWARD SCIENCE LEARNING RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY AGE LEVELS

Study Variable	Study Code	Sample Size	r	r_{es}
Age Levels				
b. 14-16	008	1958	0.35	0.35
	019	150	0.30	0.30
	040	217	0.05	0.05
	031	3100	0.16	0.16
	032	606	0.30	0.30
	057	2520	0.23	0.23
	Pooled Effect Size		r_{es}	= 0.23
	Heterogeneity		X^2	= 62.59
	Z for Effect Size		Z	= 19.43
	Probability associated w/ Z			= $p<.001$
c. 17-19	004 (a)	540	0.11	0.11
	(b)	488	0.14	0.14
	(c)	644	0.26	0.26
	031 (a)	3258	0.10	0.10
	(b)	2822	0.10	0.10
	032	2719	0.15	0.15
	033	2443	0.23	0.22
	057	1729	0.35	0.35
	Pooled Effect Size		r_{es}	= 0.13
	Heterogeneity		X^2	= 142.49
	Z for Effect Size		Z	= 20.11
	Probability associated w/Z			= $p>.001$

CHAPTER V

SUMMARY, DISCUSSION OF RESULTS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter is presented in five sections: a summary of the study, discussion of results, conclusions, implications, and recommendations for further research.

Summary of the Study

This study was designed to synthesize quantitatively the collective research pertaining to the overall assessment and evaluation of the relationship of student characteristics to their science content achievement, cognitive reasoning performance, and attitudes related to science using meta-analysis techniques. The purpose of the present study was to update the findings of previous quantitative research related to the factors affecting students' achievement and attitudes toward science, and to determine the magnitude of the relationship between the study outcomes and both methodological and student variables. A qualitative comparison between the findings of this study and earlier meta-analysis studies conducted prior to 1980 is reported.

Research was included in this review if the study had one or more of the following outcomes: science achievement expressed as either test scores or class grades, cognitive reasoning ability, attitudes toward science, or attitudes toward science learning. Variables affecting the outcomes of interest included the following: (1) student characteristics such as gender and race (ethnicity); (2) environmental variables which included the following variables: father's education, mother's education, the availability of educational items at home; (3) scholastic abilities which included language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability; (4) attitudinal measure which included both attitudes toward science, and attitudes toward science learning.

Studies carried out in the years 1980 through 1991 with U.S. students in grade 7 through grade 12 were included in this analysis.

Sixty-seven studies were coded using the meta-analysis technique. This technique allowed for the identified descriptive variables to be coded to quantify the characteristics of the study form, the research design, and the student variables. The coded information from each study, including the values of the correlations that were calculated for each outcome variable, constituted the input for the analysis.

Discussion of the Results

This section is organized by the research questions stated in Chapter I. To allow for easy comparisons, the results of prior studies related to the findings of this study are included with the question by question results. For tha reason, no separate section related to Question 6 dealing specifically with prior results is included.

Research Question 1: Student Characteristics

Findings

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when the following student characteristics are examined in a meta-analytic fashion:

- gender, and
- race?

In this study, the relationship between students' science test scores and gender differences revealed a mean effect size r_{es} of 0.15 (p_{pooled} <.001), based on 25 studies, in favor of males. A mean effect size r_{es} of 0.13 (p_{pooled} <.001), based on nine studies was also reported between students' science grades based on their sex differences, in favor of males. The relationship between students' cognitive reasoning ability and gender revealed a mean effect size r_{es} of 0.28 (p_{pooled} <.001), based on six studies, in favor of males. A mean effect size r_{es} of 0.07 (p_{pooled} <.001), based on eight studies, was also revealed between students' attitudes toward science learning, based on their gender differences, in favor of males.

As for the relationship between students' science test scores and race, the analysis of this study revealed a mean effect size r_{es} of 0.37 (p_{pooled} <.001) based on nine studies, in favor of whites.

An insufficient number of studies for the other outcome measures were available to allow further analysis.

(See Table 61)

TABLE 61

EFFECT SIZE RELATIONSHIPS BETWEEN STUDY OUTCOMES AND STUDENT CHARACTERISTICS

Variable	Mean E.S.	N	Direction
<u>Gender</u>			
Test Scores	$r_{es} = 0.15$	5	favoring males
Grades	$r_{es} = 0.13$	9	favoring males
Cog. Reasoning	$r_{es} = 0.28$	6	favoring males
Att. Science	$r_{es} = 0.07$	8	favoring males
Att Sc. Learning	- *	-	-
<u>Race</u>			
Test Scores	$r_{es} = 0.37$	9	favoring whites
Grades	-	-	-
Cog. Reasoning	-	-	-
Att. Science	-	-	-
Att. Sc. Learning	-	-	-

* In cases where fewer than 6 studies were available, no meta-analysis was undertaken.

Comparisons with Previous Studies

Comparisons between the results of the meta-analysis studies reported in the literature prior to 1980 and the results of this study revealed the following:

In regard to gender-differences, the results of this meta-analysis revealed a mean effect size $r_{..}$ of 0.15 (p_{pooled}<.001), between students' science test scores and gender, based on 25 studies; while the relationship with students' science grades revealed a mean effect size $r_{..}$ of 0.13 (p_{pooled} <.001), based on nine studies. The results of this study are higher than the findings of Fleming and Malone (1983) which revealed a mean correlation between science achievement and gender of r = 0.09 based on 49 studies, in favor of males. The results of this study are more consistent with the findings of Kahl et al. (1982) which revealed a mean correlation between science learning and gender differences of r = 0.23 (22 studies) at the junior high school level, and a mean correlation of r = 0.12 (37 studies) at the senior high school level, also in favor of males.

Gender appears to have the a strong relationship with science achievement, with males generally scoring higher than females.

The results of this study also revealed a correlation between students' cognitive reasoning ability and gender with a mean effect size of $r_{es} = 0.28$ ($p_{pooled} < .001$), based on six studies, in favor of males. This finding is similar to the finding of Tohidi (1982) who reported a mean effect size of $r = 0.27$ based on 81 effect sizes. This difference tends to favor males in the Piagetian logical operations.

The results of this study also revealed a mean effect size of $r_{es} = 0.07$ between students' attitudes toward science learning and gender based on eight studies, in favor of males. The results are in full agreement with the findings of Fleming and Malone (1983) who reported a mean effect size of $r = 0.07$ based on 37 studies, between students' attitudes toward science and gender-differences, in favor of males. The results are consistent with the findings of Kahl et al. (1983) who examined sex-related trends in pre-college attitudes toward science. Kahl's results revealed a mean correlation of $r = 0.08$ (25 studies) at the junior high level, and a mean correlation of $r = 0.07$ (45 studies) at the senior high school level in favor of males.

As for the correlation between science achievement and racial differences, the findings of this study revealed a mean effect size $r_{es} = 0.37$, based on nine studies, in favor of whites. The results are in excellent agreement with the findings of Pascarella et al. (1981) that revealed a correlation of 0.37 for the 13-year-old sample, and a mean correlation of 0.35 for the 17-year-old sample. The results are higher than the findings of Kahl (1982) who reported a mean correlation of r = 0.19, based on 12 studies at the junior high level, and a mean correlation of 0.15 (10 studies) at the senior high level. Moreover, the meta-analytic study carried out by Fleming and Malone (1983) reported that Anglo/Black comparisons with science achievement revealed an effect size of 0.16, based on 15 studies. All the results provide strong evidence for the existence of racial differences in students' science achievement, in favor of whites. Comparative results from this study and previous research are presented in Table 62.

The findings of this study indicate that gender differences correlate positively with all the outcome measures under investigation, in favor of males. The highest correlation was revealed between gender and cognitive reasoning ability outcome. Measures of science achievement, including science scores and grades, correlated moderately with gender. The least correlation was exhibited between the measures of attitudes toward science learning and gender. The results of this seem to support previous research findings which suggests that gender difference is still an essential factor in science achievement.

In regard to racial differences, the results of this study yielded a high correlation between race and science test scores, in favor of whites. This suggests that there is a large discrepancy in students' performance mainly on national tests, related to racial differences. The results seem to support previous findings.

TABLE 62

COMPARISONS BETWEEN THE STUDY OUTCOMES AND PREVIOUS STUDIES RELATED TO STUDENT CHARACTERISTICS

Variable		E.S.	N	Direction
Gender and Science Achievement				
Present Study				
Test Scores		$r_{es} = 0.15$	25	favoring males
Grades		$r_{es} = 0.13$	9	favoring males
Prior Studies				
Fleming & Malone (1983)		$r = 0.09$	49	favoring males
Kahl (1982)	junior	$r = 0.23$	22	
	senior	$r = 0.12$	37	
Gender and Cognitive Reasoning				
Present Study				
Cog. Reasoning		$r_{es} = 0.28$	6	favoring males
Prior Studies				
Tohidi (1982)		$r = 0.27$	81	favoring males
Gender and Attitudes related to Science				
Present Study				
Att. Science		$r_{es} = 0.07$	8	favoring males
Prior Studies				
Fleming & Malone		$r = 0.07$	37	favoring males
Kahl (1982)	junior	$r = 0.08$	25	favoring males
	senior	$r = 0.07$	45	favoring males

TABLE 62 (cont.)

Variable		E.S.	N	Direction
Race and Science Achievement				
Present Study				
Test Scores		$r_{es} = 0.37$	9	favoring whites
Prior Studies				
Pascarella et al. (1981)	13-year-olds	r = 0.37		favoring whites
	17-year-olds	r = 0.35		favoring whites
Kahl (1982)	junior	r = 0.19	12	favoring whites
	senior	r = 0.15	10	favoring whites
Fleming & Malone (1983)		r = 0.16	15	favoring whites

Research Question 2: Environmental Variables

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when the students' environmental variables, listed below, are examined in a meta-analysis fashion:

- father's education,
- mother's education,
- facilities at home,
- plans and aspirations, and
- number of hours of homework per week?

This study revealed a mean effect size r_{es} of 0.21 (p_{pooled} <.001), between students' science test scores and the father's education variable, based on nine studies. A mean effect size r_{es} of 0.18 (p_{pooled} <.001), was also revealed between student's science test scores and the mother's education variable, based on nine studies. These results support the concept of parental influence on a child's achievement and are influenced by the number of years his/her parents attended college. The relationship between students' science test scores and the availability of facilities at home variable revealed a mean effect size r_{es} of 0.25 (p_{pooled} <.001), based on 12 studies. As expected, the results of this study suggested a positive relationship between science achievement and the availability of educational facilities at home which is a reflection of the cultural influence of the family, which indirectly affects achievement. The results also revealed a mean effect size r_{es} of 0.28 (p_{pooled} <.001), between students' science test scores and the plans and aspirations variable, based on 14 studies. Moreover, the analysis of this study also reported a mean effect size r_{es} of 0.19 (p_{pooled} <.001), between students' science test scores and the hours of homework variable, based on 10 studies. (See Table 63)

An insufficient number of studies for the other outcome measures were available to allow for further analysis.

TABLE 63

EFFECT SIZE RELATIONSHIPS BETWEEN STUDY OUTCOMES AND ENVIRONMENTAL VARIABLES

Variable	E.S.	N	Direction
Father's Education			
Test Scores	$r_{es} = 0.21$	9	positive relation
Grades	– *	–	–
Cog. Reasoning	–	–	–
Att. Science	–	–	–
Att Sc. Learning	–	–	–
Mother's Education			
Test Scores	$r_{es} = 0.18$	9	positive relation
Grades	–	–	–
Cog. Reasoning	–	–	–
Att. Science	–	–	–
Att. Sc. Learning	–	–	–
Facilities at Home			
Test Scores	$r_{es} = 0.25$	12	positive relation
Grades	–	–	–
Cog. Reasoning	–	–	–
Att. Science	–	–	–
Att. Sc. Learning	–	–	–
Plans and Aspirations			
Test Scores	$r_{es} = 0.28$	9	positive relation
Grades	–	–	–
Cog. Reasoning	–	–	–
Att. Science	–	–	–
Att. Sc. Learning	–	–	–
Hours of Homework			
Test Scores	$r_{es} = 0.19$	10	positive relation
Grades	–	–	–
Cog. Reasoning	–	–	–
Att. Science	–	–	–
Att. Sc. Learning	–	–	–

* In cases where fewer than 6 studies were available, no meta-analysis was undertaken.

Comparisons with Previous Studies

This study investigated the relationship between students' achievement in science as related to environmental variables. As for the relationship between parental education and science test scores, the results revealed a mean correlation r_{es} of 0.21 (p_{pooled} <.001), between science achievement and father's education, based on nine studies. The results also revealed a mean correlation r_{es} of 0.18 (p_{pooled} <.001), between science achievement and mother's education, based on nine studies. These results seem to be lower than the findings of the 1977 NAEP survey carried by Schibeci and Riley (1986) which revealed mean correlation between science achievement and parental education of 0.38. The correlation between parents' education and students' science achievement implies that the higher educational level of the parents the higher the performance of their children.

This study also investigated the relationship between science test scores and the availability of educational facilities variable. The results revealed a mean correlation r_{es} of 0.25, (p_{pooled} <.001), based on 12 studies. The results are in agreement with the findings of Schibeci and Riley (1986) which reported a mean correlation of 0.30 between science achievement and the availability of educational items at home. This correlation can be a reflection of the cultural influences on the home environment which had an effect on students' achievement in science. Kremer and

Walberg (1981) reported a mean correlation between home background and science learning of r = 0.30, based on 10 studies. The home background variable included parents' education, parents' expectation for student achievement, and science equipment at home. (See Table 64)

The results of the present study also revealed that students' plans and aspirations correlated positively with their science achievement with a mean effect size r_{es} of 0.28, (p_{pooled} <.001). An explanation for this correlation is that students with high achievement are usually those who seek post secondary education as a means to fulfill their professional career goals. Finally, hours of homework correlated positively with science achievement with a mean effect size r_{es} of 0.19 (p_{pooled} <.001). The results are in full agreement with the findings of Schibeci and Riley (1986) which revealed a mean correlation of 0.20 between science achievement and hours of homework. Homework seems to enhance students' achievement in science by offering students the opportunity to apply what they have learned in the classroom, and helping them develop good study habits. Comparisons of the results of the present study seem to support the findings of previous studies which suggest that environmental variables continue to correlate positively with science achievement.

TABLE 64

COMPARISONS BETWEEN THE STUDY OUTCOMES AND AND PREVIOUS STUDIES RELATED TO ENVIRONMENTAL VARIABLES

Variable	E.S.	N	Direction
<u>Father's Education and Science Achievement</u>			
<u>Present Study</u>			
Test Scores	$r_{es} = 0.21$	9	positive relation
<u>Prior Studies</u>			
Kremer & Walberg (1981)	r = 0.30	10	
Schibeci & Riley (1986)	r = 0.38 (parents' education)		(1977 NAEP Survey)
<u>Mother's Education and Science Achievement</u>			
<u>Present Study</u>			
Test Scores	$r_{es} = 0.18$	9	positive relation
<u>Prior Studies</u>			
<u>Facilities at Home and Science Achievement</u>			
<u>Present Study</u>			
Test Scores	$r_{es} = 0.25$	12	positive relation
<u>Prior Studies</u>			
Schibeci & Riley (1986)	r = 0.30		(1977 NAEP Survey)
<u>Plans and Aspirations and Science Achievement</u>			
<u>Present Study</u>			
Test Scores	$r_{es} = 0.28$	9	positive relation

TABLE 64 (cont.)

Variable	E.S.	N	Direction
Hours of Homework and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.19$	10	positive relation
Prior Studies			
Schibeci & Riley (1986)	$r = 0.20$		(1977 NAEP Survey)

Research Question 3: Scholastic Abilities

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when the following students' scholastic abilities are examined in a meta-analytic fashion:

- language ability,
- mathematics ability,
- science ability,
- general ability, and
- cognitive reasoning ability?

Substantial relationships were reported between students' science test scores and the above mentioned variables. The findings revealed a mean effect size r_{es} of 0.43 (p_{pooled} <.001) between science test scores and language ability, based on 19 studies. A mean correlation r_{es} of 0.55 (p_{pooled} <.001) was reported between students' science test scores and mathematicsability, based on 13 studies. The results of this study also revealed a mean effect size r_{es} of 0.56 (p_{pooled} <.001) between students' science test scores and science ability, based on 9 studies. The relationship between students' science test scores and general ability indicated a mean effect size r_{es} of 0.42 (p_{pooled} <.001), based on nine studies. Finally, the relationship between students' science test scores and cognitive reasoning ability revealed a mean effect size r_{es} of 0.56 (p_{pooled} <.001), based on 13 studies.

The relationships between science grades and the above mentioned variables were also investigated. The results revealed a mean effect size r_{es} of 0.41 (p_{pooled} <.001) between students' science grades and language ability, based on 12 studies. Between students' science grades and the mathematics ability variable a mean effect size r_{es} of 0.42 (p_{pooled} <.001) was found, based on 16 studies. The findings of this study also revealed a mean effect size r_{es} of 0.33 (p_{pooled} <.001) between students' science grades and cognitive reasoning ability, based on 12 studies.

The relationships between students' cognitive reasoning outcomes measure and the above mentioned variables were investigated in this study. The results revealed a mean effect size r_{es} of 0.45 (p_{pooled} <.001) between students' cognitive reasoning ability and science ability variables, based on 19 studies. A mean effect size r_{es} of 0.55 (p_{pooled} <.001) was also revealed between students' cognitive reasoning and general ability outcome, based on seven studies.

The relationship between students' attitudes toward science and science ability revealed a mean effect size $r_{..}$ of 0.26 ($p<.001$), based on 11 studies. Finally, the relationship between students' attitudes toward science learning and science ability revealed a mean effect size of $r_{..} = 0.21$, based on 14 studies.

The results of the analyses conducted in this study indicate that students' scholastics abilities, including language ability, mathematical ability, science ability, general ability, and cognitive reasoning ability, have strong positive relationships to students' achievement in science, and science attitude measures. Too few studies for the other outcome measures were available to allow further analysis. (See Table 65)

TABLE 65

EFFECT SIZE RELATIONSHIPS BETWEEN STUDY OUTCOMES AND SCHOLASTIC ABILITIES

Variable	E.S.	N	Direction
Language Ability			
Test Scores	$r_{es} = 0.43$	19	positive relation
Grades	$r_{es} = 0.41$	12	positive relation
Cog. Reasoning	- *	-	-
Att. Science	-	-	
Att Sc. Learning	-	-	-
Mathematics Ability			
Test Scores	$r_{es} = 0.55$	13	positive relation
Grades	$r_{es} = 0.42$	16	positive relation
Cog. Reasoning	- *	-	-
Att. Science	-	-	-
Att. Sc. Learning	-	-	-
Science Ability			
Test Scores	$r_{es} = 0.56$	9	positive relation
Grades	-	-	positive relation
Cog. Reasoning	$r_{es} = 0.45$	19	positive relation
Att. Science	$r_{es} = 0.26$	11	positive relation
Att. Sc. Learning	$r_{es} = 0.21$	14	positive relation
General Ability			
Test Scores	$r_{es} = 0.42$	9	positive relation
Grades	-	-	-
Cog. Reasoning	$r_{es} = 0.55$	7	positive relation
Att. Science	-	-	-
Att. Sc. Learning	-	-	-
Cognitive Reasoning Ability			
Test Scores	$r_{es} = 0.56$	13	positive relation
Grades	$r_{es} = 0.33$	12	positive relation
Cog. Reasoning	-	-	-
Att. Science	-	-	-
Att. Sc. Learning	-	-	-

* In cases where fewer than 6 studies were available, no meta-analysis was undertaken.

Comparisons with Previous Studies

A substantial correlation was reported between science achievement and language ability with a mean effect size $r_{..}$ = 0.43, based on 19 studies. The relationship between science grades and the above mentioned variables were also investigated. The results revealed a consistent mean effect size of $r_{..}$ = 0.41 between students' science grades and language ability, based on 12 studies. The results are close to the results obtained by Thorndike (1973) who revealed a mean correlation between science achievement and reading comprehension of 0.52, and accounted for 25 percent of variance in science achievement. The results are also in agreement with Fleming and Malone (1983) whose findings revealed a mean correlation between science achievement and language ability of 0.41 based on five studies. The results are also in agreement with the findings of Kahl (1982) who reported a mean correlation between science achievement and language/verbal ability of 0.47 (8 studies), at the senior high level. Kahl also reported that science achievement and reading ability had a mean correlation of 0.62 (5 studies), at the junior high level, and a mean correlation of 0.43 (5 studies) at the senior high level.

A mean effect size of $r_{..}$ = 0.55 was reported between students' science test scores and mathematics ability, based on 13 studies. The relationship between students' science grades and the mathematics ability variable yielded a mean effect size of r_{es} = 0.42, based on 16 studies. The results are in agreement with the findings of Boulanger (1981) who reported a mean correlation between quantitative ability and science achievement of 0.51 (9 studies). The results are also consistent with the findings of Fleming and Malone (1983) who reported a mean correlation between science achievement and mathematics ability of 0.43 (7 studies) at the high school level. The results are in full agreement with the findings of Kahl (1982) who reported a mean correlation between science achievement and mathematics ability of 0.52 (3 studies) at the junior high level, and a mean correlation of 0.45 (15 studies) at the senior high level. The findings of this study provide strong support for the existence of a high relationship between science achievement and mathematics ability.

The results of the present study also revealed a strong relationship between science achievement and science ability with a mean effect size r_{es} of 0.56 ($p<.001$), based on 9 studies. This result is higher than the findings obtained by Boulanger (1980) which reported a mean correlation r_{es} of 0.46 (19 studies) between science ability and prior knowledge as related to science learning.

The relationship between students' science test scores and general ability indicated a mean effect size r_{es} of 0.42, based on nine studies. The results of this study are less than the findings of Boulanger (1980) who reported a mean effect size of 0.49, based on 34 studies. When compared with previous research the results are consistent with the findings of Fleming and Malone (1983) who reported a mean correlation of 0.42 (27 studies) between science achievement and general ability. The results of this study are also in full agreement with the findings of Kahl (1982) who reported a mean correlation between science achievement and general ability (IQ) of 0.43 based on 14 studies at the junior high level, and a mean correlation of 0.46 based on 19 studies at the senior high level. Moreover, the results of this study are also similar to the findings of Walberg (1986) who reported a mean correlation of general ability with science learning of 0.48 based on 10 studies. (See Table 66)

This study revealed a correlation between students' science test scores and cognitive reasoning ability with a mean effect size of $r_{es} = 0.56$, based on 13 studies. The findings of this study also revealed a mean effect size of $r_{es} = 0.33$ between students' science grades and cognitive reasoning ability, based on 12 studies. The results of this study are in agreement with the findings of Fleming and Malone (1983) who reported a mean correlation between science achievement and cognitive level of 0.59, based on three studies. The results of this study are close to the findings of Boulanger and Kremer (1981), whose research revealed a mean correlation of 0.40, based on 27 studies. Similar results were obtained by Walberg (1986) who reported a mean correlation between Piaget's developmental level and school achievement of 0.40, based on nine studies. More studies were reported by Kahl (1982) who revealed a mean correlation of 0.60 (one study) at the junior high level, and a mean of 0.50 (one study) at the senior high level. The results of the present study indicate that all measures of prior scholastic ability, namely, language ability, mathematics ability, science ability, general ability, and cognitive reasoning ability correlate highly with all the outcome measures under investigation. These results are in agreement with the findings of previous studies, with some slight discrepancies. This suggests that scholastic abilities are essential factors that highly contribute to science achievement. Prior science ability and general ability also relate highly to students' cognitive reasoning, students' attitudes toward science, as well as their attitudes toward science learning. The findings of this study together with the previous findings suggest that special attention by science practitioners should be given to those factors.

TABLE 66

COMPARISONS BETWEEN THE PRESENT STUDY OUTCOMES AND PREVIOUS STUDIES RELATED TO SCHOLASTIC ABILITIES

Variable		E.S.	N	Direction
Language Ability and Science Achievement				
Present Study				
Test Scores		$r_{es} = 0.43$	19	positive relation
Grades		$r_{es} = 0.41$	12	positive relation
Prior Studies				
Thorndike (1973)		$r = 0.52$		
Fleming & Malone		$r = 0.41$	5	
Kahl (1982)	junior	$r = 0.62$	5	
	senior	$r = 0.47$	8	
Mathematics Ability and Science Achievement				
Present Study				
Test Scores		$r_{es} = 0.55$	13	positive relation
Grades		$r_{es} = 0.42$	16	positive relation
Prior Studies				
Boulanger (1981)		$r = 0.51$	9	
Fleming & Malone '83		$r = 0.43$	7	
Kahl (1982)	junior	$r = 0.52$	3	
	senior	$r = 0.54$	15	

TABLE 66 (cont.)

Variable	E.S.	N	Direction
Science Ability and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.56$	9	positive relation
Prior Studies			
Boulanger (1980)	$r = 0.46$	19	
Science Ability and Cognitive Reasoning			
Present Study			
Cog. Reasoning	$r_{es} = 0.45$	19	positive relation
Prior Studies			
None			
Science Ability and Science Attitudes			
Present Study			
Att. Science	$r_{es} = 0.26$	11	positive relation
Att. Sc. Learning	$r_{es} = 0.21$	14	positive relation
Prior Studies			
None			

TABLE 66 (cont.)

Variable	E.S.	N	Direction
General Ability and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.42$	9	positive relation
Prior Studies			
Boulanger (1980)	r = 0.49	34	
Fleming & Malone	r = 0.42	27	
Kahl (1982) junior	r = 0.43	14	
senior	r = 0.46	19	
Walberg (1986)	r = 0.48	10	
General Ability and Cognitive Reasoning			
Present Study			
Cog. Reasoning	$r_{es} = 0.55$	7	positive relation
Prior Studies			
None			
Cognitive Reasoning and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.56$	13	positive relation
Grades	$r_{es} = 0.33$	12	positive relation
Prior Studies			
Fleming & Malone	r = 0.59	3	
Boulanger & Kremer	r = 0.40	27	
Walberg (1986)	r = 0.40	9	
Kahl (1982)	r = 0.61	1	
	r = 0.50	1	

Research Question 4: Attitudinal Effects

Are there significant effects on science test scores, science grades, cognitive reasoning ability, attitudes toward science, and attitudes toward science learning when students' attitudinal indicators, listed below, are examined in a meta-analytic fashion:

- attitudes toward science, and
- attitudes toward science learning?

In this meta-analytic study, the relationship between students' science test scores and attitudes toward science revealed a mean effect size of $r_{**} = 0.23$, based on eight studies. The relationship between science test scores and attitudes toward science learning revealed a mean effect size of $r_{**} = 0.19$, based on 15 studies. The results of this study also revealed a mean effect size of $r_{**} = 0.23$ between students' science grades and attitudes toward science learning variable, based on seven studies. (See Table 67)

TABLE 67

EFFECT SIZE RELATIONSHIPS BETWEEN STUDY OUTCOMES AND ATTITUDINAL INDICATORS

Variable	E.S.	N	Direction
Attitudes Toward Science			
Test Scores	$r_{es} = 0.23$	8	positive relation
Grades	-*	-	-
Cog. Reasoning	-	-	-
Att. Science	-	-	-
Att Sc. Learning	-	-	-
Attitudes Toward Science Learning			
Test Scores	$r_{es} = 0.19$	15	positive relation
Grades	$r_{es} = 0.23$	7	positive relation
Cog. Reasoning	-	-	-
Att. Science	-	-	-
Att. Sc. Learning	-	-	-

* In cases where fewer than 6 studies were available, no meta-analysis was undertaken.

Comparison with Previous Studies

In this meta-analytic study, the relationship between students' science test scores and attitudes toward science revealed a mean effect size r_{es} of 0.23, based on eight studies. The results are in full agreement with the findings of Fleming and Malone (1983) who reported a mean correlation of $r = 0.23$, based on seven studies. The finding is higher than the meta-analytic results of Willson (1983) who reported a mean correlation of $r = 0.14$, at the junior high level, based on 18 studies; and a mean correlation of $r = 0.15$ at the senior high level, based on 120 studies. This finding is consistent with the results of obtained by Haladyna and Shaughnessy (1982) who also reported a mean correlation of r = 0.15 between science achievement and attitudes toward science, based on 49 studies.

As for the relationship between science test scores and attitudes toward science learning, the results of this meta-analytic study revealed a mean effect size $r_{..}$ of 0.19, based on 15 studies. The results of this study also revealed a mean effect size $r_{..}$ of 0.23 between students' science grades and attitudes toward science learning, based on seven studies. The first finding of this study is consistent with the results obtained by Kahl (1982) who investigated, in a meta-analytic research, the relationship between attitude/motivation as related to achievement in science. Kahl's results revealed a mean correlation of r = 0.19 at the junior high level (n=3), and a mean correlation of 0.34 at the senior high level (n=6).

These results are consistent with the results of Willson (1983) who investigated the relationship between interest in science as related to achievement in science. Willson's findings revealed a mean correlation of r= 0.23 at the junior high level, and a mean correlation of r = 0.19, at the senior high level. Moreover, the results of the meta-analysis carried out by Steinkamp and Maehr (1983) reported a lower correlation value of r = 0.14 between science achievement and interest in science. (See Table 68) The results of the present study revealed that students who exhibited more positive attitudes towards science and science learning achieved better in science. In order to develop a positive attitude toward science, educational materials and teachers should contribute in making science exciting to their students.

TABLE 68

COMPARISONS BETWEEN THE PRESENT STUDY OUTCOMES AND PREVIOUS STUDIES RELATED TO ATTITUDINAL MEASURES

Variable	E.S.	N	Direction
Attitudes toward Science and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.23$	8	positive relation
Prior Studies			
Fleming & Malone	$r = 0.23$	7	
	$r = 0.20$		
Willson (1983)	$r = 0.16$	43	
Attitudes toward Science Learning and Science Achievement			
Present Study			
Test Scores	$r_{es} = 0.19$	15	positive relation
Grades	$r_{es} = 0.23$	7	positive relation
Prior Studies			
Haladyna & Shaughnessy (1982)	$r = 0.15$		
Kahl (1982)	$r = 0.19$	6	
Willson (1983) junior	$r = 0.23$	33	
senior	$r = 0.19$	13	
Steinkamp & Maehr	$r = 0.19$		

Research Question 5: Methodological Variables

Are there significant mediation effects on the above relationships, when examined in a meta-analytic manner, attributable to the study methodological variables liste' below:

- form of publication,
- length of study,
- type of study,
- internal validity,
- design rating,
- method of calculating effect size,
- socioeconomic status,
- disciplinary focus of the study,
- age levels, and
- grade levels?

Examination of the study outcomes' effect sizes associated with students' characteristics across the methodological variables were conducted. The purpose is to determine the mediating factors associated with the variations in the magnitude of the relationship between the study variables. The comparative data examining the effect of gender on students' test scores across the publication type revealed that studies reported in the dissertation form of publication exhibited a higher mean effect size r_{es} of 0.21 (n=14), as compared with a mean effect size r_{es} of 0.14 (n=8) of studies reported in the book form of publication.

The comparative data examining the effect size of gender on students' test scores across the assignment type revealed that the studies assigned in random exhibited a mean effect size r_{es} of 0.22 (n=6) as compared with the representative assignment studies with a mean effect size r_{es} of 0.15 (n=14). In regard to the effect sizes associated with gender when examining students' test scores across the method of calculating the effect size value. The results revealed that the t-test value exhibited a higher mean effect size r_{es} of 0.22 (n=7) as compared with the both the r-value and the D value with mean effect sizes r_{es}s of 0.16 (n=11) and 0.13 (n=6), respectively.

When examining the effect size associated with students' test scores and gender, across the trends in age levels, the results revealed that 17-19-year-old students exhibited a higher mean effect size r_{es} of 0.19 (n=10) as compared with the 14-16-year-olds with a mean effect size r_{es} of 0.13 (n=14), which suggests a greater correlation between students' achievement and gender as students grow older.

When comparing the mean effect size associated with students' test scores and gender across the trends in grade levels, a mean effect size r_{es} of 0.12 was revealed at the eighth grade level as compared with a mean effect size r_{es} of 0.24 at the ninth grade levels. This finding indicates that students' science achievement and gender correlate higher at the ninth grade level. The results are consistent with the findings of Kahl (1982) and Becker (1989) which reported a correlation of 0.23 and 0.29, respectively, at the junior grade level.

The comparative data examining the mean effect sizes of students' test scores associated with language ability across the trends in age levels revealed a mean effect size r_{es} of 0.52 (n= 10) at the 14-16 age level, as compared with a mean effect size r_{es} of 0.38 (n=8) at the 17-19 age levels. This finding suggests that the correlation between science test scores and language ability decreased as students grow older. Trends across grade levels across students' test scores and language ability revealed a mean effect size r_{es} of 0.51 (n= 7) at the ninth grade level, a mean effect size r_{es} of 0.35 at the 12th grade level, a mean effect size r_{es} of 0.53 at the 7-9th grade levels, and a mean effect size r_{es} of 0.41 at the 10-12th grade levels. The findings of this study are consistent with the results obtained by Fleming and Malone (1983) which revealed a mean correlation of 0.62 at the middle grade level, and a mean correlation of 0.47 at the senior grade level. The findings are also in agreement with the results obtained by Kahl (1982) which revealed a mean correlation between science achievement and language/verbal ability of 0.59 at the junior level, and a correlation of 0.47 at the senior level. Kahl (1982) also reported a mean correlation between science achievement and reading ability of 0.62 at the junior level, and a mean correlation of 0.43 at the senior level. These findings indicate that the correlations between the science scores and language ability decreases in higher grade levels.

The comparative data examining the effect sizes of students' cognitive reasoning ability and science ability revealed that students at higher socioeconomic status exhibited a mean effect size $r_{..}$ of 0.44 (n=8), while students at the mixed socioeconomic status exhibited a higher correlation with a mean effect size $r_{..}$ of 0.59 (n=6).

When comparing the mean effect size associated with attitudes toward science learning and students' test scores across age levels, a mean effect size of $r_{..}$ = 0.23, was revealed at the 14-16 age levels (n=6), as compared with a mean effect size of $r_{..}$ = 0.13 at the 17-19 age levels, (8 studies). This difference reveals that attitudes and achievement correlate higher at the 14-16 age than at the 17-19 age levels. These results are consistent with the findings of Willson (1983) which revealed a mean correlation of 0.23 between science achievement and attitudes toward science learning, at the junior level; and a mean correlation of 0.19, at the senior grade level. These findings indicate that the correlation between science achievement and attitudes toward science learning decreases when students grow older, and in higher grade levels.

Conclusions and Implications

A major goal of this study was to produce knowledge that would be useful to educational researchers, educators, science teachers, and school administrators as policy decisions in science education are made in the future. The evidence presented in this meta-analysis measures the extent to which various factors influence science learning and attitudes toward science. The consistent positive correlations between the outcome measures of this study and the investigated student variables are worth consideration, though heterogeneity was detected. This implies the existence of variations in the magnitude of the relationships between the variables. The existence of heterogeneity associated with an effect size is analogous to the existence of a large standard deviation associated with a mean. This means that the effect observed will not necessarily be reflected in single studies conducted at some future date.

Interestingly enough, most of the results were in agreement with previous findings which emphasize the consistent correlations across the years, between the outcome measures and the variables under investigation. This indicates that few changes have taken place in the relationships examined across the years.

Examination of the overall findings generated by this study leads to the following conclusions. The results of this study revealed that gender differences correlated positively with all the outcome measures under investigation, in favor of males. A major insight can also be gained by examining the high correlation between students' science test scores and the race variable, in favor of whites. Those correlations are worth serious consideration and action by educators as well as policy makers. Efforts must continue toward the development of educational programs which would foster equity and opportunity among learners.

The consistent relationship between science achievement and the measures of environmental variables is also worth further consideration by researchers and educational practitioners. All the environmental variables, namely, parents' education, the availability of educational facilities at home, plans and aspirations, and hours of homework seemed to correlate highly with science achievement.

The results of this meta-analytic study revealed that scholastic abilities correlated highly with science achievement, which reinforces the fact that ability and past learning are among the best predictors of achievement. This situation suggests that basic language, mathematics, science, and general ability as well as cognitive reasoning skills should be addressed adequately at the elementary school level. In other words, children should achieve a strong background in the basics in order to establish a strong foundation to build on later. These variables deserve closer attention from the science educator since science achievement assccciated with these constructs is subject to effective instruction. In order to assure that all students have the prerequisite abilities for later science achievement, schools should assess students' learning more frequently in order to monitor students' progress, and identify those in need of attention in the early grades before the student reaches choice points at which he or she might decide to drop science on the basis of poor performance.

The results of this study also revealed a positive correlation between science achievement and attitudinal measures, a fact that is well established among educational researchers and practitioners. Therefore, developing science programs that would encourage students to view science with positive feelings is a necessity.

The results of this study suggest the need for further investigation of these constructs at the end of this decade in order to determine whether or not any changes have occurred.

Recommendations for Further Research

Based on the findings and on the insights derived from this study, the researcher recommends the following:

1. Further meta-analytic studies applying a similar type of research analysis related to the variables investigated in this study, and involving studies conducted between 1980-1991 should be undertaken. The results of such analysis could add more information, and either confirm or contradict the findings of this study.

2. Replication of this study with further breakdown analysis across the grade levels, subject/content areas, and/or age levels. Blocking the study characteristics could assist in decreasing the variations in the magnitude of the relationships between the study variables.

3. Researchers engaged in future studies should report the findings of their studies as explicitly and in as much detail as possible. Data should be presented in a format that communicates the essence of the finding as well as the magnitudes of the effects and/or the correlations. A complete

presentation of the findings will assist the analytic researcher in coding the study characteristics and in generating the effect size values.

4. There is a need for improved primary studies
Many studies considered in this meta-analysis were rated as having low validity and poor design and or did not provide sufficient data and therefore had to be excluded from the meta-analysis. Better primary studies would have expanded the scope of this study and perhaps improved the usefulness of the results.

5. The high correlation between variables enhances the detection of confounding variables. This implies that rigorous attempts need to be made to control the role that potential confounding variables might play, and help the researcher in arriving at more reliable findings and conclusions. This will assist in generating studies that are methodologically sound and which merit inclusion in future meta-analyses.

6. Some variables or constructs are changeable and are worth not only further experimental analysis but merit constructive efforts to improve them as well. Therefore, what is needed is a periodic review to ascertain whether the fundamental situation has changed sufficiently that a restudy is in order.

7. Finally, it is essential that the results from the study of factors that relate to science achievement and attitudes toward science be presented in a fashion that can be used by policy makers and practitioners. Quality presentation of the results is needed in order to assure that science education at schools is receiving the attention it deserves, and that young people are leaving our schools with both adequate achievement in science as well as positive attitudes toward science.

BIBLIOGRAPHY

Anderson, R. D., Kahl, S. R., Glass, G. V., & Smith, M. L. (1983). Science Education: A Meta-Analysis of Major Questions, Journal of Research in Science Teaching, 20, (5), 379-385.

Becker, B. Y. (1989). Gender and Science Achievement: A Reanalysis of Studies from Two Meta-Analysis, Journal of Research in Science Teaching, 26 (2), 141-169.

Bloom, B. S. (1876). Human Characteristics and School Learning. New York: McGraw-Hill Book Company

Boulanger, F. D. (1981). Ability and Science Learning: A Quantitative Synthesis, Journal of Research in Science Teaching, 18 (2), 113-121.

Boulanger, F. D. and Kremer, B. K. (1981). Age and Developmental Level as Antecedents of Science Learning. Journal of Research in Science Teaching, 18 (4), 371-384.

Butts, D.P. (1981). A Summary of Research in Science Education. Science Education, 65 (4), 337-465.

Campbell, D. T. & Stanley, J. C. (1966). Experimental and Quasi-Experimental Designs for Research. Chicago: Rand McNally and Company.

Cohen, J. (1977). Statistical Power Analysis for the Behavioral Sciences. New York: Academic Press.

Comber L. C., and Keeves, J. P. (1973). Science Education in Nineteen Countries. Almqvist and Wiksell, Stockholm. An Empirical Study. New York: John Wiley and Sons.

Fisher, R. A. (1928). Statistical Methods for Research Workers. (2nd ed.). London: Oliver and Boyd.

Flanagan, J., and Cooley, W., (1964) Project Talent; One Year Follow-Up Studies. Pittsburgh: University of Pittsburgh.

Fleming, M. L. and Malone, M. R. (1983). The Relationship of Student Characteristics and Student Performance in Science as Viewed by Meta-Analysis Research. Journal of Research in Science Teaching, 20 (5), 481-495.

Gage, N. (1982). The Future of Educational Research. Educational Researcher, 11 (8), 11-12.

Glass, G. V., McGaw, B., and Smith, M. L. (1981). Meta Analysis in Social Research. Beverly Hills, CA: Sage Publications.

Glass, G. V., & Stanley, J. C. (1970). Statistical Methods in Education and Psychology. Englewood Cliffs, NJ: Prentice-Hall.

Haladyna, T. & Shaughnessy, J. (1982). Attitudes toward Science: A Quantitative Synthesis. Science Education, 66 (4), 547-563.

Hedges, L. V. (1981). Distribution Theory for Glass's Estimator of Effect Size and Related Estimators. Journal of Educational Statistics, 6, 107-128.

Hedges, L. V., and Olkin, I. (1985) Statistical Methods for Meta-analysis. New York, NY: Academic Press.

Hedges, L.V., Shymansky, J. A. and Woodworth, G. (1989) Modern Methods of Meta-analysis. Washington: D.C.: National Science Teacher Association

Haertel, G. D., Walberg, H. J., Junker, L., and Pascarella, E. T. (1981) Early Adolescent Sex Differences in Science Learning: Evidence from the National Assessment of Educational Progress. American Educational Research Journal, 18 (3), 329-341.

Hueftle, S. J., Rakow, S. J., and Welch, W. W. (1983). Images of Science: A Summary of Results from the 1981-1982 National Assessment in Science, Minneapolis: MN: Minnesota Research and Evaluation Center, University of Minnesota.

Hunter, J. E. Schmidt, F. L. & Jackson, G. B. (1982). Meta-Analysis: Cumulating Research Findings Across Studies. Beverly Hills, CA: Sage Publications.

Inhedler, B. Piaget, J. (1958). The Growth of Logical Thinking from Childhood to Adolescence. New York: Basic Books.

Iverson, B. K. and Walberg, H. J. (1982). "Home Environment and School Learning: A Quantitative Synthesis." Journal of Experimental Education, 50, 144-151.

Kahl, S. R. et al (1982). Sex-related Differences in Pre-college Science: Findings of the Science Meta-analysis Project. Paper presented at the annual meeting of the American Educational Research Association, New York, (ERIC Document Reproduction Service No. ED 216-909).

Kahle, J. B. (1981). Can Positive Minority Attitudes Lead to Achievement Gains in Science? Analysis of the 1977 National Assessment of Educational Progress, Attitudes Toward Science. Science Education, 66 (4), 539-546.

Keeves, J. P. and Kotte D. (1992). Disparities between the Sexes in Science Education: 1970-1984. In J. P. Keeves (Ed.), The IEA Study of Science III: Changes in Science Education and Achievement: 1970 to 1984. (pp. 141-164). Oxford: Pergamon Press.

Keeves, J. P. and Saha (1992) Home Background factors and Educational Outcomes. In J. P. Keeves, (Ed.) The IEA Study of Science III: Changes in Science Education and Achievement: 1970 to 1984. (pp. 165-186), Oxford: Pergamon Press.

Kremer, B. K. & Walberg, H. J. (1981). A Synthesis of Social and Psychological Influences on Science Learning. Science Education, 65 (1), 11-23.

Lawson, A. E. (1978). The Development and Validation of a Classroom Test of Formal Reasoning. Journal of Research in Science Teaching, 15 (1), 11-24.

Linn, M. C. et al. (1987) Gender Differences in National Assessment of Educational Progress Science Items: What does "I dont't know" Really Mean? Journal of Research in Science Teaching, 24 (3): 267-278.

Maehr, M. L. and Steinkamp, M. (1983). A Synthesis of Findings on Sex Differences in Science Educational Research. (ERIC Document Reproduction Service No. ED 229-226).

Mosteller. F. M., & Bush, R. R. (1954). Selected Quantitative Techniques. In G. Lindzey (Ed.), Handbook of Social Psychology: Vol 1. Theory and Method (p.289-334). Cambridge, MA: Addison-Wesley.

Mullis, I. V. S. et al (1991) Trends in Academic Achievement Achievement of U.S. Students in Science, 1969-1970 to 1990, Mathematics, 1973 to 1990, Reading, 1971-1990, and Writing, 1984-1990. Washington D. C. Office of Educational Research and Improvement, U.S. Department of Education.

Napier, J. D. & Riley, J. P. (1985). Relationship Between Affective Determinants and Achievement in Science for Seventeen-Year-Olds. Journal of Research in Science Teaching, 22 (4), 365-383.

Pascarella, E. T., Walberg, H. J., Junker, L. K. & Haertel (1981) Continuing Motivation in Science for Early and Late Adolescents. American Educational Research Journal. 18 (4), 439-452.

Reyes, L. H. & Padilla, M. J. (1985). Science, Math, and Gender. The Science Teacher, 52 (6), 46-48.

Roadrangka, V.. Yeany, R. H., & Padilla, M. J. (1983). The Construction and Validation of Groups Assessment of Logical Thinking (GALT). Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching, Dallas, Texas.

Rosenthal, R. (1984). Meta-analytic Procedures for Social Research. Beverly Hills, CA:Sage Publications.

Rosenthal, R. (1991). Meta-analytic Procedures for Social Research. Beverly Hills, CA:Sage Publications.

Sauls, J. M. (1976). National Assessment of Educational Progress. Highlights and Trends from National Assessment: Changes in Science Achievement, 1969-1973. (ERIC Document Reproduction Service ED 127-202)

Schibeci, R. A. and Riley, J. P. (1986). "Influence of Students' Background and Perceptions on Science Attitude and Achievement." Journal of research in Science Teaching, 23, 177-187.

Slavin, R. E. (1986). "Best-Evidence Synthesis: An Alternative to Meta-Analytic and Traditional Reviews." Educational Researcher, November, 5-11.

Snedecor, G. W (1946). Statistical Methods Applied in Agriculture and Biology, (4th ed.). Ames: Iowa State University Press.

Staver, J. R. & Gabel, D. L. (1979). The Development and Construct Validation of a Group-Administered Test of Formal Thought. Journal of Research in Science Teaching, 16 (6), 535-544.

Steinkamp, M. W. (1982). Sex related differences in Attitude Toward Science: A Quantitative Synthesis of the Research. Paper presented at the annual meeting of the American Educational Research Association. New York (ERIC Document Reproduction Service ED 220 285).

Steinkamp, M. W. & Maehr, M. L. (1983). Affect, Ability, and Science Achievement: A Quantitative Synthesis of Correlational Research. Review of Educational Research. 53 (3), 369-396.

Steinkamp, M. W. & Maehr, M. L. (1984). Gender Differences in Motivational Orientation Toward Achievement in School Science: A Quantitative Synthesis. American Educational Research Association Journal, 21, 39-59.

St. John N. (1970). The Validity of Children's Reports of their Parent's Educational Level: A Methodological Sociology of Education, 43, 255-269.

Thorndike, R. L. Reading Comprehension Education in Fifteen Countries: International Studies in Education Vol.III). New York: John Wiley and Sons, 1973.

Tohidi, N. E. (1982). "Sex Differences in Cognitive Performance on Piaget-like Tasks: A Meta-analysis of Findings." Unpublished Doctoral Dissertation, Ph.D. University of Illinois at Urbana-Champaign.

Walberg, H. J. (1967). Dimensions of Scientific Interest in Boys and Girls Studying Physics. Science Education. 51 (2), 111-116.

Walberg, H. J. (1978). A Theory of Educational Productivity. Paper presented at the Annual Meeting of the Georgia Educational Research Association. (ERIC Document Reproduction Service ED 167-462)

Walberg, H. J., Pascarella, E., Haertal, G. D., Junker, L. K., & Boulanger, F. D. (1982). Probing a Model of High School Science with National Assessment Samples. Journal of Educational Psychology, 74 (3), 295-307.

Walberg, H. J. (1986). "Syntheses of Research on Teaching." In Wittrock, M. C., Handbook of Research on Teaching. New York, NY: McMillan Publishing Company.

Walker, D. A. (1976). The IEA Subject Survey: An Empirical Study of Education in Twenty-One Countries. International Studies in Evaluation IX. New York: John Wiley & Sons.

Weiss, I. R., Nelson, B. H., Boyd, S. E., & Hudson, S. B. (1989). Science and Mathematics Education. Briefing Book. Chapel Hill, N.C.: Horizon Research, Inc.

Wert, J. E., Neidt, C. O., & Ahmann, J. S. (1954). Statistical Methods in Educational and Psychological Research. NY: Appleton-Century-Crofts, Inc.

White K. R. (1982). "The Relation between Socioeconomic Status and Academic Achievement." Psychological Bulletin, 91 (3), 461-481.

Willson, V. L. (1983). A Meta-Analysis of the Relationship between Science Achievement and Science Attitude : Kindergarten through College." Journal of Research in Science Teaching, 20 (9), 839-850.

Zerega, M. E., Haertel, D., Tsai, S. & Walberg, H, J. (1986). Late Adolescent Sex Differences in Science Learning. Science Education, 70 (4), 447-460.

APPENDIX A

CODING FORM

CODING FORM

Source ____________________

Title ____________________

Author____________________

I. Study Variables

1. Study Code
   (3 digits, corresponds to master list)

2. Publication Date

3. Total Number of Students Assigned

4. Form of Publication

   (a) journal
   (b) book
   (c) dissertation
   (d) paper

5. Length of Study

   (a) less than one month
   (b) 1-3 months
   (c) 3-6 months
   (d) more than 6 month
   (e) status study

6. Assignment of Students to Treatments

(a) random
(b) matched
(c) self-selected
(d) intact groups
(e) representative sample
(f) other

7. Type of Study

(a) correlational
(b) quasi-experimental
(c) experimental
(d) other

8. Rated Internal Validity

(a) low
(b) medium
(c) high

9. Testing
(Blank if no information provided)

(0) probable threat
(1) adequately minimized

10. Instrumentation
(Blank if no information provided)

(0) probable threat
(1) adequately minimized

11. Regression
(Blank if information not provided)

(0) probable threat
(1) adequately minimized

12. Selection
(Blank if information not provided)

(0) probable threat
(1) adequately minimized

13. Maturation
    (Blank if information not provided)

    (0) probable threat
    (1) adequately minimized

14. Selection-Maturation Interaction
    (Blank if no information provided)

    (0) probable threat
    (1) adequately minimized

15. History
    (Blank if no information provided)

    (0) probable threat
    (1) adequately minimized

16. Mortality
    (Blank if no information provided)

    (0) probable threat
    (1) adequately minimized

17. Design Rating

    (a) low
    (b) medium
    (c) high

18. Method of Calculating "r"

    (a) r-value
    (b) F-test
    (c) t-test
    (d) p-value
    (e) d-value

19. Community Type
    (Blank if no information provided)

    (a) urban
    (2) suburban
    (3) rural
    (4) mixed type communit

20. Subjects' SES
    (Blank if no information provided)

    (a) Low, disadvantaged
    (b) Average
        (including working, and lower middle class)
    (c) High, advantaged
    (d) Mixed sample

21. Disciplinary Focus of the Study

    (a) Biology
    (b) Chemistry
    (c) Physics
    (d) Earth Science
    (e) Life Science
    (f) Mix of more than 2 or if not specified, General Science

22. Age of Subjects

    (a) 11-13
    (b) 14-16
    (c) 17-19

23. Grade Level of Subjects

    (a) Grade 7
    (b) Grade 8
    (c) Grade 9
    (d) Grade 10
    (e) Grade 11
    (f) Grade 12
    (g) Grade 7-9
    (h) Grades 10-12

<u>II. Science Learning Outcomes</u>

(a) Science Test Scores
(b) Science Grades
(c) Cognitive Reasoning Ability
(d) Attitudes Toward Science
(e) Attitudes Toward Science

III. Student Characteristics

1. Sex of Subjects

   (a) male
   (b) female
   (c) mixed sex sample

2. Ethnicity (Race) of Subjects

   (a) White
   (b) Black
   (c) Mixed ethnic sample

IV. Environmental Variables

1. Father Education

   (Blank if no information provided)

   (a) Some high school completed
   (b) High school completed
   (c) Some college
   (d) Completed bachelor
   (e) Graduate study

2. Mother Education

   (Blank if no information provided)

   (a) Some high school completed
   (b) High school completed
   (c) Some college
   (d) Completed bachelor
   (e) Graduate study

3. Availability of Educational Facilities at Home

   (Books, journals, encyclopedia, or science equipment)

   (Blank if no information provided)

4. Plans and Aspirations
   (parental aspirations for the child, college plans, or educational aspirations)

   (Blank if no information provided)

5. Hours of Homework Per Week

   (Blank if no information provided)

V. Scholastic Abilities

(Blank if no information provided)

(a) Language ability
(b) Mathematics ability
(c) Science ability
(d) General ability
(e) Cognitive reasoning ability

VI.- Attitudinal Indicators

(Blank if no information provided)

(a) Attitudes toward science
(b) Attitudes toward science learning

APPENDIX B

STUDIES INCLUDED IN THE ANALYSIS

LISTED BY CODE NUMBER

List of Coded Studies

(DISSERTATIONS)

McDonald, J. (1991). "Selected Student Characteristics and Science Achievement in a Mid-Sized Secondary School." Unpublished Doctoral Dissertation, Florida Atlantic University.
Code: 001

Stoner, D. K. (1981). "The Relationship of Psychological and Skill Factors to Student Attitude and Achievement of Fifth and Tenth Grade Students." Unpublished Doctoral Dissertation, Claremont University.
Code: 003

Ferko, A. M. (1989). "An Analysis of United States Advanced Science Student Achievement." Unpublished Doctoral Dissertation, Columbia University Teachers College.
Code: 004

Dozier, J. L. (1985). "Relationships between Objective Measures of Logical Reasoning Abilities and Science Achievement of Students in a Nonpublic Junior High School in South Carolina." Unpublished Doctoral Dissertation, The University of South Carolina.
Code: 005

Brown, N. E. (1983). "The Use of selected Characteristics of Ability and Achievement as Predictors of Student Achievement in a Multi-Track Science Curriculum." Unpublished Doctoral Dissertation, University of Colorado.
Code: 006

Dryden, M. A. (1986). "Modeling Classroom Environments: An Analysis of the Ninth Grade Second IEA Science Study." Unpublished Doctoral Dissertation, The State University of New York at Buffalo.
Code: 008

Narchi, A. (1990). "Influence of Parents, Past Science Experiences, Locus of Control, Self-Actualization, and Gender on High School Students' Attitude Toward Science, Science Achievement, and Commitment to College Majoring in Science and Non-Science." Unpublished Doctoral Dissertation, University of Florida.
Code: 010

Saulson, P. A. (1990). "An Investigation of Intellectual Developmental Levels, Cognitive Style, Mathematical Computation Skills, and Sex, as Predictors for High School Chemistry Grades." Unpublished Doctoral Dissertation, Georgia State University.
Code: 011

Schlegel, R. A. (1990). "Identifying Elements of Attitude Formation by Middle School Students Toward high School Science." Unpublished Doctoral Dissertation, Temple University Graduate Board.
Code: 013

Payne, J. W. (1981). "An Assessment of the Differences in the Understanding of Formal and Concrete Science Concepts Among Ninth Grade Students at Different Piagetian Developmental Levels." Unpublished Doctoral Dissertation, Georgia State University.
Code: 015

Consuegra, G. F. (1987). "The Prediction of Performance in Seventh Grade Gifted Science Classes from Components of Gifted Identification and Selection Procedures and Certain Science-related Factors." Unpublished Doctoral Dissertation, University of Maryland College Park.
Code: 016

Elias, Joseph S., (1989). "A Correlation Study of Cognitive Development and Intelligence as Related to Achievement and Placement in Freshman Biology." Unpublished Doctoral Dissertation, Temple University.
Code: 017

Oliver, J. S. (1986). "A Longitudinal Study of Attitude, Motivation, and Self Concept as Predictors of Achievement in and Commitment to Science Among Adolescent Students." Unpublished Doctoral Dissertation, University of Georgia.
Code: 018

Hatch, P. H. (1989). "Extracurricular Correlates of Interest in Science for First Year Biology Students."Unpublished Doctoral Dissertation, George Mason University.
Code: 019

Lorson, M. V. (1991). "A Comparison of Microcomputer Based Laboratories and Traditional Methods in the High School Chemistry Laboratory." Unpublished Doctoral Dissertation, The Ohio State University.
Code: 020

Kotran, R. C. (1987). "Relationship Among Cognitive Performance, Developmental Level and Instructional Strategy, in a Group of Ninth Grade Biology Students." Unpublished Doctoral Dissertation. Temple University Graduate Board.
Code: 021

Cox, D. C. (1982). "The Effects of Type of Classroom Science, Grade Level, Years Without Science Instruction, and Elective Science Courses on Performance Level for Selected High School Science Process Skill Competencies." Unpublished Doctoral Dissertation, The Ohio State University.
Code: 022

Talton, E. L. (1983). "Relationships of Attitude Toward Classroom Environment with Attitudes Toward Science and Achievement in Science Among Tenth Grade Biology Students." Unpublished Doctoral Dissertation, University of Georgia.
Code: 023

Blatnick, R. A. (1986). "The Effect of Three-Dimensional Models on Ninth-Grade Chemistry Scores." Unpublished Doctoral Dissertation, Ph.D. The University of Utah.
Code: 024

Bishop, D .D. (1985) "Student, Teacher, and Learning Environment Variables and Student Attitudes Toward the Study of Science," Unpublished Doctoral Dissertation, University of Virginia.
Code: 025

Carroll, S. (1991). A Comparison by Gender of Science Achievement as Measured by the 1988 Massachusetts Assessment Test." Unpublished Doctoral Dissertation, Boston College.
Code: 026

Armstong, B. W. (1984) "A Study of the Relationship of Selected Student Characteristics with ACT Subtest Scores." Unpublished Doctoral Dissertation, University of Iowa.
Code: 027

Squiers, S. M. (1983). An Analysis of Attitudes of High School Seniors Towards Science and Scientists in a Southern Metropolitan High School." Unpublished Doctoral Dissertation, Auburn University of Alabama.
Code: 028

Work, J. A. (1984) "The Relationship of Early Adolescent Learning Characteristics to Problem Solving". Unpublished Doctoral Dissertation, The University of Michigan.
Code: 029

Blurton, C. G. (1985) "M-Capacity, Developmental Level, Field Dependence/Independence, Prior Knowledge and Success in Junior High School Genetics." Unpublished Doctoral Dissertation, Arizona State University.
Code: 030

Humrich, L. E. (1988). "Sex Differences in Science Attitude and Achievement." Unpublished Doctoral Dissertation, Columbia University Teachers College.
Code: 031

Beyer, S. L. (1990) "Factors in the School Environment Associated with Student Achievement in Science," Unpublished Doctoral Dissertation, Columbia University Teachers College.
Code: 032

Chandevekar, M. (1988). "Physics in the U.S." Unpublished Doctoral Dissertation, Columbia University Teachers College.
Code: 033

Micik, J. M. (1986). "Science Achievement in an American School: A Case Study." Unpublished Doctoral Dissertation, Columbia University Teachers College.
Code: 035

Leising, R. A. (1986). "Investigation of the Relationship Between Personality Type and Selected Teaching Strategies in Developing Students' Science Process Ability, Logical Thinking Ability and Science Achievement." Unpublished Doctoral Dissertation, The University of Michigan.
Code: 036

Falls, Timothy Harold (1984). "The Ability of High School Chemistry Students to Solve Computational Problems Requiring Proportional Reasoning a Affected by Item In-Task Variables. Unpublished Doctoral Dissertation, The University of Michigan.
Code: 037

Cook, D. H. (1984). "The Development and the Evaluation of a Diagnostic Mathematics Pretest for Chemistry and of a Program to Strengthen Mathematics Proficiencies for Chemistry Students." Unpublished Doctoral Dissertation, Temple University.
Code: 038

Sanford, R. P. (1991). "The Relationship between Attitudes Toward Instruction in Science Held by Seventh Grade Earth Science Students and Selected Independent Variables." Unpublished Doctoral Dissertation, Mississippi State University.
Code: 039

Akinmade, C. T. (1982) "An Investigation of the Attitudes and Perceptions of Junior High School Students Toward Science Courses." Unpublished Doctoral Dissertation, The University of Michigan.
Code: 040

List of Coded Studies

(JOURNAL ARTICLES, ERIC DOCUMENTS AND REPORTS

Mattheis, F. E.; Spooner, W. E. and Coble, C. R. (1985). A Study of the Logical Thinking Skills, Integrated Process Skills, and Attitudes of Junior High School Students in North Carolina. Paper presented at the United States-Japan Seminar on Science Education (Honolulu, HI, September 14-20, 1986). (ERIC Document Reproduction Service No. ED 285 754).
Code: 041

Chiappetta, E. L. & Russell, J. M. (1982). "The Relationship Among Logical Thinking, Problem Solving Instruction, and Knowledge and Application of Earth Science Subject Matter." Science Education, 66 (1), 85-93.
Code: 042

Lawson, A. E. (1982). "Formal Reasoning, Achievement, and Intelligence: An Issue of Importance." Science Education, 66 (1), 77-83.
Code: 043

Staver, J. R. & Jacks, T. (1988). The Influence of Cognitive Reasoning Level, Cognitive Restructuring Ability, Disembedding Ability, Working Memory Capacity, and Prior Knowledge on Students' Performance on Balancing Equations by Inspection. Journal of Research in Science Teaching. 25 (9), 763-775.
Code: 044

DeHernandez, L., Marek, E. A., & Renner, J. W. (1984). Relationships Among Gender, Age, and Intellectual Development. Journal of Research in Science Teaching. 21 (4), 365-375.
Code: 045

Baker, D.R. (1985). Predictive Value of Attitude, Cognitive Ability, and Personality to Science Achievement in The Middle School. Journal of Research in Science Teaching. 22 (2), 103-113.
Code: 047

Levin, J. & Fowler, H. S. (1984). "Sex, Grade, and Course Differences in Attitudes that are Related to Cognitive Performance in Secondary Science". Journal of Research in Science Teaching. 21 (2), 151-166.
Code: 048

Wareing, C. (1990). A Survey of Antecedents of Attitudes Toward Science. Journal of Research in Science Teaching. 27 (4), 371-386.
Code: 049

Linn, M., Pulos, S., & Gans, A.(1981). "Correlates of Formal Reasoning: Content and Problem Effects." Journal of Research in Science Teaching. 18 (5), 435-447.
Code: 050

Marek, E. (1981). Correlations Among Cognitive Development, Intelligence Quotient, and Achievement of High School Biology Students. Journal of Research in Science Teaching. 18 (1), 9-14.
Code: 051

Staver, J. R. & Walberg, H. J. (1986)."An Analysis of Factors that Affect Public and Private School Science Achievement". Journal of Research in Science Teaching. 23 (2), 97-112.
Code: 052

Staver, J. R. & Halsted, D. A. (1985). The Effects of Reasoning, Use of Models, Sex Type, and Their Interactions on Posttest Achievement in Chemical Bonding after Constant Instruction. Journal of Research in Science Teaching, 22 (5), 437-447.
Code: 053

Simpson, R. D. & Oliver, J. S. (1985). Attitude Toward Science and Achievement Motivation Profiles of Male and Female Science Students in Grades Six through Ten. Science Education, 69 (4), 511-526.
Code: 054

Boucher, E. F., & Fletcher, R. K. (1982). "A Comparison of Levels of Cognitive Thought Determined by the Longeot Test and Achievement Levels of Secondary School Science Students". Paper presented at the Mid-Atlantic AETS Meeting, Pineville, KY, (ERIC Document Reproduction Service No. ED 226 959).
Code: 055

Keeves, J. P. and Saha (1992) Home Background Factors and Educational Outcomes. In J. P. Keeves, (Ed.) The IEA Study of Science III: Changes in Science Education and Achievement: 1970 to 1984. (pp. 165-186), Oxford: Pergamon Press.
Code: 056

Keeves, J. P. and Morgentern, C. (1992). Attitudes Towards Science: Measures and Effects. In J. P. Keeves (Ed.) The IEA Study of Science III: Changes in Science Education and Achievement: 1970 to 1984.(pp. 122-140), Oxford: Pergamon Press.
Code: 057

Keeves, J. P. and Kotte D. (1992). Disparities Between the Sexes in Science Education: 1970-1984. In J. P. Keeves (Ed.), The IEA Study of Science III: Changes in Science Education and Achievement: 1970 to 1984, (pp. 141-164), Oxford: Pergamon Press.
Code: 058

Keeves, J. P. and Soydhurum, P. (1992). Speciations in Science and Performance at the Terminal Secondary School Level. In Keeves, J. P. The IEA Study of Science III Changes in Science Education and Achievement: 1970 to 1984, (pp. 234-262) Oxford: Pergamon Press.
Code: 059

Lawson, A. E. & Thompson, L. D. (1988). Formal Reasoning Ability and Misconceptions Concerning Genetics and Natural Selection. Journal of Research in Science Teaching. 25 (9), 733-746.
Code: 060

Hall, V. C., Howe, A., Merkel, S. & Lederman, N. (1986). "Behavior, Motivation, and Achievement in Desegregated Junior High School Classes." Journal of Educational Psychology. 78 (2), 108-115.
Code: 061

Oliver, J. S. and Simpson, R. D (1988) Influences of Attitude Toward Science, Achievement Motivation, and Science Self Concept on Achievement in Science: A Longitudinal Study. Science Education, 72 (2), 143-155.
Code: 062

Bitner, B. L. (1991). Formal Operational Reasoning Modes: Predictors of Critical Thinking Abilities and Grades Assigned by Teachers in Science and Mathematics for Students in Grade Nine Through Twelve. Journal of Research in Science Teaching. 28 (3), 265-274.
Code: 063

Jacobowitz, T. (1983). Relationship of Sex, Achievement, and Science Self-Concept to the Science Career Preferences of Black Students. Journal of Research in Science Teaching. 20 (7), 621-628.
Code: 064

Texley, J. T. & Norman, J. (1984). The Development of a Group Test of Formal Operational Logic in The Content Area of Environmental Science. Journal of Research in Science Teaching. 21 (6), 589-597.
Code: 065

Howe, A.C. & Durr, B. P. (1982). "Analysis of An Instructional Unit for Level of Cognitive Demand." Journal of Research in Science Teaching. 19 (3), 217-224.
Code: 066

Ronning, R. R., McCurdy, D., and Ballinger, R. (1984). Individual Differences: A Third Component in Problem-Solving Instruction. Journal of Research in Science Teaching, 21 (1), 71-82.
Code: 068

DeBoer, G. E. (1987). Predicting Continued Participation in College Chemistry for Men and Women. Journal of Research in Science Teaching. 24 (6), 527-538.
Code: 069

Mullis, I. et al. (1991). Trends in Academic Progress: Achievement of U.S. Students in Science, 1969-70 to 1990; Mathematics, 1973 to 1990; Reading, 1971 to 1990; Writing, 1984 to 1990. National Center for Educational Statistics, Washington, D.C.
Codes: 070, 071, & 072.

Hueftle, S. J., Rakow, S. J., and Welch, W. W. (1983). Images of Science: A Summary of Results from the 1981-1982 National Assessment in Science, Minneapolis: MN: Minnesota Research and Evaluation Center, University of Minnesota.
Code: 070

Beaton, A.E., et al. (1988). Expanding the New Design: The NAEP 1985-1986 Technical Report, Educational Testing Service, Princeton, New Jersey.
Code: 071

Johnson, E. G., & Allen, N. L. (1992). The NAEP 1990 Technical Report, National Center for Education Statistics. U.S. Department of Education, Washington, D.C.
Code: 072

Hill, O. W., Petttus C., & Hedin, B. A. (1990). "Three Studies of Factors Affecting the Attitudes of Blacks and Females Toward the Pursuit of Science and Science-Related Careers." Journal of Research in Science Teaching. 27 (4), 289-314.
Code: 073

Krajick, J. S. & Haney, R. E. (1987). Proportional Reasoning and Achievement in High School Chemistry. School Science and Mathematics. 87 (1), 25-32.
Code: 074

Simpson, R. D. & Oliver, J. S. (1990). A Summary of Major Influences on Attitudes Toward and Achievement in Science Among Adolescent Students. Science Education. 74 (1), 1-18.
Code: 075

APPENDIX C

STUDIES WITHHELD FROM ANALYSIS

Dissertations not Included

Adams, S. D. (1985) "An Analysis of the Relationship between Mental Operativity, Science Ability, Aptitude Information Variables and the Measured Achievement in Science and Mathematics of Secondary School Students in a Summer Program." Unpublished Doctoral Dissertation, University of Pittsburgh.

Afshari, M. R. (1980). "A Comparison of the Predictive Validation of the Scholastic Aptitude Test and a Piagetian test of formal Operations." Unpublished Doctoral Dissertation, University of Pittsburgh.

Baker, R. J. (1989) "Science Achievement of Non-Science in An Urban school District," Unpublished Doctoral Dissertation, Columbia University Teachers College.

Baker, Dale Rose (1987). "Differences in Personality, Attitude, and Cognitive Abilities found among Biological, Physical science, and Nonscience Students. "Unpublished Doctoral Dissertation, The State University of New Jersey.

Burton, W. P. (1980) "The Relationship between Achievement and Selected School, Teacher, Student, and Science Program Characteristics." Unpublished Doctoral Dissertation, University of Virginia.

Cannon, R. K. (1983). "Relationship Among Attitude, Motivation, and Achievement of Ability Grouped Seventh Grade, Life Science Students." Unpublished Doctoral Dissertation, University of Georgia.

Dillashaw, F. G. (1980). "The Effect Abilities and Science Achievement of Students in a Nonpublic Junior High School in South Carolina." Unpublished Doctoral Dissertation, University of Southern Carolina.

Dimit, C. F. (1989). "Student Attitudes toward Science and the Affecting Personal, Home, and School Environment Variables." Unpublished Doctoral Dissertation, Claremont Graduate School.

Haukoos, G. D. (1981). "The Interaction Effect of Selected Student Characteristics and Learning Environment of Science Process Skills." Unpublished Doctoral Dissertation, The University of Iowa.

Fidler, R. A. (1988), "Factors Explaining Success and Lack of Success on the Michigan Educational Assessment Program Science Assessment." Unpublished Doctoral Dissertation, The University of Michigan.

Harpole, S. H. (1986). "An Analysis of Factors Contributing to Achievement in Physics and Chemistry of Secondary Students in Mississippi Schools." Unpublished Doctoral Dissertation, Mississippi State University.

Gussett, J. (1983). "Relationships between Selected Reading Performance Objectives and Science Achievement in a Middle School." Unpublished Doctoral Dissertation, University of Virginia.

Lisowski, M. (987). "The Effect of Field Biology Learning Experiences on Students' Understanding of Selected Biological Concepts." Unpublished Doctoral Dissertation, The Ohio State University.

Lynch , C. K. (1982). "The Relationship Between Selected Normative Variables, Performance Variables, and High School MCT Scores." Unpublished Doctoral Dissertation, Illinois State University.

McDowell, C. L. (1988). "The Consideration of Race, Class,and Gender Effect in Reasoning on Children's Understanding of Scientific Phenomena". Unpublished Doctoral Dissertation, Harvard University.

Moody, J. D. (1990). "The Effect of Grouping by Formal Reasoning Ability, Formal Reasoning Ability Levels, Group Size, and Gender on Achievement in Laboratory Chemistry." Unpublished Doctoral Dissertation, Mississippi State University.

Neathery, M. F. (1991). "Relationship Between Science Achievement and Attitudes Toward Science and the Relationship of Attitudes Toward Science and Additional School Subjects." Unpublished Doctoral Dissertation, Texas A & M University.

Rakow, S. J. (1984). "Prediction of the Science Inquiry Skills of Seventeen-Year-Olds: A Test of the Educational Productivity Model." Unpublished Doctoral Dissertation, University of Minnesota.

Randolph, C. F. (1983). "The Relationship Among Cognitive Style, Achievement in Science, Selected Personality Variables, and Sex of Students." Unpublished Doctoral Dissertation, University of South Carolina.

Pogge, A. F. (1986). "The Attiudes Toward Science and Science Teaching of the Teachers and Students at Baldwin Intermediate School, Quency, Illinois." Unpublished Doctoral Dissertation, The University of Iowa.

Haynes, S. V. (1982). "The Relationship of selected high Schools and Student Characteristics with Scores Achieved on the ACT Assessment in the Seven Great Lianas States." Unpublished Doctoral Dissertation, The University of Iowa.

Shreiber, D. A. (1984). "Factors Affecting Female Attitude Formation toward Science, Specific Reference to 12-14 Year-Old-Female Adolescents and their Affective Orientation toward Middle School Science." Unpublished Master's Thesis, University of Cincinnati.

Schapp, T. (1980). "The Relationship of Science Attitudes of Senior High School Students to Descriptive, Parental, Motivational, and Cognitive Variables." Unpublished Doctoral Dissertation, Northern Illinois University.

Smith, J.D. (1988). "A Comparative Analysis of Patterns and Determinants of Students' Attitudes Toward Science of Junior High Schools in Selected Northeast Mississippi Schools As A Function of School and Non-School Variables." Unpublished Doctoral Dissertation, The University of Mississippi.

Taylor, J. B. (1991). "The Development and Analysis of a Field Project Model Curriculum and Its Impact on Achievement and Attitude Toward Science An the Environment with At-Risk Eleventh and Twelfth Grade Students." Unpublished Doctoral Dissertation, Florida International University.

Welborn, T. T. (1990). "Gender Differences in Science Education." Unpublished Doctoral Dissertation, University of South Carolina.

Wong, E. G. (1991). "An Investigation of Home, School, and Religious Factors that Relate to Achievement of Hispanic Tenth and Twelfth Graders in the U. S.". Unpublished Doctoral Dissertation, The University of Akron.

Journal Articles not Included

Anamuah-Mensah, J., Erickson, G. & Gaskel, J. (1987). "Development and Validation of a Path Analytic Model of Student's Performance in Chemistry." Journal of Research in Science Teaching. 24 (8), 723-738.

Anderson, O. R. (1989). The Teaching and Learning of Biology in the United States. Second IEA Science Study (IEA). New York, N.Y.,: Teachers College, Columbia University.

Barrington, B.L. & Hendricks, B. (1988). Attitude Toward Science and Science Knowledge of Intellectually Gifted and Average Students in the Third, Seventh, and Eleventh Grades. Journal of Research in Science Teaching, 25 (8), 679-687.

Biermann, C. A. & Sarinsky, G. B. (1989). Selected Facotors Associated with Achievement in Biology Preparatory Students and their Follow-Up to Higher Level Biology Courses. Journal of Research in Science Teaching, 26 (7), 575-586.

Bridgeman, D. J. et al. (1985). "The Reationship of Attitudes Toward Science and Family environment." (ERIC Document Reproduction Service ED 255-388).

Burkman, E. , Tate, R. L., Snyder, W. R., & Beditz, J. (1981). Effects of Academic Ability, Time Allowed for Study, and Teacher Directness on Achievement in a High School Science Course (ISCS). Journal of Research in Science Teaching, 18(6), 563-576.

Cannon, R. K. & Simpson, R. D. (1985). Relationships Among Attitude, Motivation, and Achievement of Ability Grouped, Seventh-Grade, Life Science Students. Science Education, 69(2), 121-138.

Chandran, S., Treagust, D. F. & Tobin, K. (1987). The Role of Cognitive Factors in Chemistry Achievement. Journal of Research in Science Teaching. 24 (2), 145-160.

Crawley, F. E. & Trout, J. S. (1985). "Attitude and Achievement in Ninth Grade Physical Science of Low Need Level Students: A Re-Examination of the Matching Hypothesis. Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching, French Lick Springs, IN., April, 1985. (ERIC Document Reproduction Service No. ED 255-368).

Doran, R. L. (1985). Description of Samples for the USA Participation in the Second IEA Science Study. Unpublished Manuscript, Columbia University, Teachers College, New York.

Fraser, b. J., Walberg, h. J. & Welch, W. W. (1985). Educational Productivity in Science Education: Secondary Analysis of National Assessment in Science Data. Paper Presented at the Annual Meeting of the NARST, French Lick Springs, IN, April 1985.

Gabel, D. L. & Sherwood, R. D. (1980). Effect of Using Analogies on Chemistry Achievement According to Piagetian Level. Science Education. 64(5), 709-716.

Gabel, D. L. and Sherwood, R. (1980). The Effect of Student Manipulation of Molecular Models on Chemistry Achievement According to Piagetian Level. Journal of Research in Science Teaching, 17 (1), 75-81.

Glasson, G. E. (1989). The Effects of Hands-On and Teacher Demonstration Laboratory Methods on Science Achievement in Relation to Reasoning Ability and Prior Knowledge. Journal of Reaearch in Science Teaching, 26 (2), 121-131.

Gooding, C. T., Swift, J.N. Swift, Schell, R. E., Swift, P. R. & McCroskery, J. H. (1990). A Causal Analysis Relating Previous Achievement, Attitudes, Discourse, and Intervention to Achievement in Biology and Chemistry. Journal of Research in Science Teaching, 27 (8), 789-801.

Gorman, S. & Yu, C. C. (1990). "Science Achievement and Home Environment : National Assessment of Educational Progress 1985-1986." (ERIC Document Reproduction Service No.ED 330-702).

Haertel, G. D., Walberg, H. J., Junker, L., and Pascarella, E. T. (1981) Early Adolescent Sex Differences in Science Learning: Evidence from The National Assessment of Educational Progress. American Educational Research Journal, 18 (3), 329-341.

Haladyna, T., Olsen, R. & Shaughnessy, J. (1982). Relations of Student, teacher, and Learning Environment Variables to Attitudes Toward Science. Science Education, 66 (5), 671-687.

Handley, H. M. & Morse, L. W. (1984). Two-Year Study Relating Adolescents' Self-Concept and Gender Role Perceptions to Achievement and Attitudes Toward Science. Journal of Research in Science Teaching, 21 (6), 599-607.

Harty, H., Hamrick, L., Ault, Jr., C. & Samuel, K. V. (1987) Gender Influences on Concept Structure Interrelatedness Competence. Science Education, 71 (1), 105-115.

Harty, H., Hamrick, L. & Samuel, K. V. (1985). Relationships Between Middle School Students' Science Concept Structure Interrelatedness Competence and Selected Cognitive and Affective Tendencies, Journal of Research in Science Teaching, 22 (2), 179-191.

Hewson, M. G. & Hewson, P. W. (1983). Effect of Instruction Using Students' Prior Knowledge and Conceptual Change Strategies on Science Learning. Journal of Research in Science Teaching, 20 (8), 731-743.

Hough, L. W. & Piper, M. K. (1982). The Relationship Between Attitudes and Science Achievement. Journal of Research in Science Teaching, 19 (1), 33-38.

Jacobson, Willard J. & Doran, Rodney L (1985). How Are Our Ninth Graders Doing? The Second Interantional Science Study in the U.S. Teachers College, Columbia University.

Jolly, P. E. & Barbara M. Strawitz. (1983). "Teacher-Student Cognitive Style and Achievement in Biology). Paper Presented at the Annual Meeting of the National Association for Research in Science Teaching, Dallas, TX (B.P. 116 Ziguichor, Senegal, West Africa).

Koran, J. J.Jr., Koran, M. L., Foster, J. S. and Fire,W., (1989). Curiousity, Verbal Ability, and Learning Concepts in Biology, School Science and Mathematics, 89 (5), 405-410.

Kubota, C. A. & Olstad, R. G. (1991). Effects of Novelty Reducing Preparation on Exploratory Behavior and Cognitive Learning in a Science Museum Setting. Journal of Research in Science Teaching, 28 (3), 225-234.

Lapointe, A. E., Mead, N. A. & Phillips, G. W. (1989). "A World of Difference. An International Assessment of Mathematics and Science." Report No. (19-CAEP-01). Educational Testing Service. Department of Education, Washington, D. C. (ERIC Document Reproduction Service ED 309 068).

Lavoie, D. R. (1989). "Effects of Prior Knowledge and Piagetian Cognitive Development on the Process skill of Prediction in the Learning Cycle. (ERIC Document Reproduction Service No. ED 309 078).

Lawson, A. E. (1983). Predicting Science Achievement: Role of Developmental Level, Disembedding Ability, Mental Capacity, Prior Knowledge, and beliefs. Journal of Research in Scienc Teaching, 20 (9), 117-129.

Linn, M.C., Clement, C. Pulos, S., and Sullivan, P. (1989) Scientific Reasoning During Adolescence: The Influence of Instruction in Science Knowledge and Reasoning Strategies. Journal of Research in Science Teaching, 26(2), 171-187.

Linn, M. C., De Benedictis, T., Delucchi, K. Harris, A. & Stage, E. (1987) "Gender Differences in National Assessment of Educational Progress Science Items: What Does "I Don't Know" Really Mean? Journal of Research in Science Teaching, 24 (3), 267-278.

Linn, M. C. & and Hyde, J. S. (1989). Gender, Mathematics, and Science. Educational Researcher, 18 (8), 17-27.

Napier, J. & Riley, J. P. (1985). "Relationship Between Affective Determinants and Achievement in Science for Seventeen-Year-Olds." Journal of Research in Science Teaching, 22 (4), 365-383.

Niaz, M. (1991). Correlates of Formal Operational Reasoning: A Neo-Piagetian Analysis. Journal of Research in Science Teaching, 28 (1), 19-40.

Pascarella, E. T., Walberg, H. J., Junker, L. K. & Haertel (1981) Continuing Motivation in Science for Early and Late Adolescents. American Educational Research Journal. 18 (4), 439-452.

Peng, Samuel S.: Fetters, William B.; & Kolstad, Andrew J. High School and Beyond - A National Longitudinal Study of The 1980s. A Capsule Description of High School Students, National Center for Educational Statistics, Washington, D.C. 1981.

Piburn, M. D. (1990). Reasoning About Logical Propositions and Success in Science. Journal of Research in Science Teaching, 27 (9), 887-900.

Rakow, S. J. & Walker, C. L. (1985). The Status of Hispanic American Students in Science Achievement and Exposure." Science Education, 69 (4), 557-565.

Rennie, L. J., & Punch, K. F. (1991). The Relationship Between Affect and Achievement in Science. Journal of Research in Science Teaching, 28 (2), 193-209.

Schibeci, R. A. (1989). "Home, School, and Peer Group Influences on Student Attitudes and Achievement in Science." Science Education, 73 (1), 13-24.

Schibeci, R. A. & Riley, J. P. II (1986). Influences of Students' Background and Perceptions on Science Attitudes and achievement. Journal of Research in Science Teaching. 23 (3), 177-187.

Sweet, P. (1984). Transcript Analysis of 15,000 Seniors, From Science and Math Education in American High Schools Results from High School and Beyond Study. National Center for Educational Statistics: NCES Bulletin.

Song, I., & Hattie, J. (1984), Home Environment, Self Concept, and Academic Achievement: A Causal modeling Approach. Journal of Educational Psychology, 76 (6), 1269-1281.

Simpson, R. D. & Troost, K. M. (1982) Influences on Commitment to and Learning of Science among Adolescent Students. Science Education, 66 (5), 763-781.

Talton, E. L. & Simpson, R. D. (1986). Relationships of Attitude Toward Self, Family, and School with Attitude Toward Science Among Adolescents. Science Education, 70 (4), 365-374.

Talton, E. L. & Simpson, R. D. (1987). Relationships of Attitude Toward Classroom Environment with Attitude Toward and Achievement in Science Among Tenth Grade Biology Students. Journal of Research in Science Teaching, 24 (6), 507-525.

Tate, R. & Burkman, E. (1983). Interactive Effects of Source of Direction, Allocated Time, an Reading Ability, and Study Orientation on Achievement in High School Science. Science Education. 67 (4), 509-522.

Tobin, K. G. & Capie, W. (1982). "Relationships Between Formal Reasoning Ability, Locus of Control, Academic Engagement and Integrated Process Skills Achievement." Journal of Research in Science Teaching, 19 (2), 113-121.

Tobin, K. G. & Capie, W. (1982). Development and Validation of A Group Test of Integrated Science Processes. Journal of Research in Science Teaching, 19 (2), 133-141.

Wavering, M. J. (1985). "The Logical Reasoning Necessary to Make Line Graphs. Paper Presented at the Annual Meeting of The National Association for Research in Science Teaching. (58th, French Lick Springs, IN, April 15-18, 1985) (ERIC Service Reproduction Service ED 254 409).

Zerega, M. E., Haertel, D., Tsai, S. & Walberg, H. J. (1986). Late Adolescent Sex Differences in Science Learning. Science Education, 70 (4), 447-460.

APPENDIX D

TABLES OF INDIVIDUAL STUDY RESULTS

RELATED TO RESEARCH QUESTION 5

TABLE 69

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	052	26279	0.14	0.1400
	075	4172	0.05	0.0540
Book	058	2520	0.25	0.2498
	059	1729	0.24	0.2398
	070 (a)	7873	0.14	0.1376
	(b)	7974	0.18	0.1788
	071 (a)	6200	0.13	0.1257
	(b)	3868	0.14	0.1418
	072 (a)	6649	0.09	0.0890
	(b)	4411	0.11	0.1102
Dissertation	008	1958	0.21	0.2099
	019	130	0.06	0.0560
	022 (a)	82	0.09	0.0868
	(b)	421	0.19	0.1866
	024	152	0.03	0.0305
	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	(d)	625	0.15	0.1459
	(e)	625	0.32	0.3242
	(f)	625	0.34	0.3398
	027	8479	0.20	0.1998
	032	2719	0.27	0.2709
	036	91	0.11	0.1101
Paper	055	499	0.20	0.1992

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
<u>Length of Study</u>					
Less 1 month	036		91	0.11	0.1101
1-3 months	none				
3-6 months	024		152	0.03	0.0305
more than 6	none				
Status Study	008		1958	0.21	0.2099
	019		130	0.06	0.0560
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
		(d)	625	0.15	0.1459
		(e)	625	0.32	0.3202
		(f)	625	0.34	0.2298
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	055		499	0.20	0.1992
	058		2520	0.25	0.2498
	059		1729	0.24	0.2398
	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.1788
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102
	075		4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	(d)	625	0.15	0.1459
	(e)	625	0.32	0.3242
	(f)	625	0.34	0.3398
Self-Selected	019	130	0.06	0.0560
	024	152	0.03	0.0305
Intact Groups	036	91	0.11	0.1101
Representative	008	1958	0.21	0.2099
	022 (a)	82	0.09	0.0868
	(b)	421	0.19	0.1866
	027	8479	0.20	0.1998
	052	26279	0.14	0.1400
	055	499	0.20	0.1992
	058	2520	0.25	0.2498
	059	1729	0.24	0.2398
	070 (a)	7873	0.14	0.1376
	(b)	7974	0.18	0.1788
	071 (a)	6200	0.13	0.1257
	(b)	3868	0.14	0.1418
	072 (a)	6649	0.09	0.0890
	(b)	4411	0.11	0.1102
Other	032	2719	0.27	0.2709
	075	4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Type of Study				
Correlational	008	1958	0.21	0.2099
	019	130	0.06	0.0560
	022 (a)	82	0.09	0.0868
	(b)	421	0.19	0.1866
	027	8479	0.20	0.1998
	032	2719	0.27	0.2709
	052	26279	0.14	0.1400
	058	2520	0.25	0.2498
	059	1729	0.24	0.2398
	075	4172	0.05	0.0540
Quasi-Exper.	none			
Experimental	024	152	0.03	0.0305
	036	91	0.11	0.1101
Other	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	(d)	625	0.15	0.1459
	(e)	625	0.32	0.3242
	(f)	625	0.34	0.3398
	[illegible]5	499	0.20	0.1992
	070 (a)	7873	0.14	0.1376
	(b)	7974	0.18	0.1788
	071 (a)	6200	0.13	0.1257
	(b)	3868	0.14	0.1418
	072 (a)	6649	0.09	0.0890
	(b)	4411	0.11	0.1102

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	019		130	0.06	0.0560
	024		152	0.03	0.0305
	036		91	0.11	0.1101
	055		499	0.20	0.1992
High	008		1958	0.21	0.2099
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
		(d)	625	0.15	0.1459
		(e)	625	0.32	0.3242
		(f)	625	0.34	0.3398
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	058		2520	0.25	0.2498
	059		1729	0.24	0.2398
	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.1788
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102
	075		4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Design Rating					
Medium	019		130	0.06	0.0560
	024		152	0.03	0.0305
	036		91	0.11	0.1101
	055		499	0.20	0.1992
High	008		1958	0.21	0.2099
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
		(d)	625	0.15	0.1459
		(e)	625	0.32	0.3242
		(f)	625	0.34	0.3398
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	058		2520	0.25	0.2498
	059		1729	0.24	0.239
	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.1788
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102
	075		4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Method of Calculating "r"					
r-value	008		1958	0.21	0.2099
	019		130	0.06	0.0560
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	024		152	0.03	0.0305
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	058		2520	0.25	0.2498
	059		1729	0.24	0.2398
	075		4172	0.05	0.0540
t-test	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
		(d)	625	0.15	0.1459
		(e)	625	0.32	0.3242
		(f)	625	0.34	0.3398
	036		91	0.11	0.1101
p-value	055		499	0.20	0.1992
D value	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.1788
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Community Type					
Urban	none				
Suburban	019		130	0.06	0.0560
	024		152	0.03	0.0305
Rural	036		91	0.11	0.1101
Mixed	008		1958	0.21	0.2099
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
		(d)	625	0.15	0.1459
		(e)	625	0.32	0.3242
		(f)	625	0.34	0.3398
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	055		499	0.20	0.1992
	058		2520	0.25	0.2498
	059		1729	0.24	0.2398
	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.178
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102
	075		4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	024	152	0.03	0.0305
	052	26279	0.14	0.1400
Medium	036	91	0.11	0.1101
High	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	(d)	625	0.15	0.1459
	(e)	625	0.32	0.3242
	(f)	625	0.34	0.3398
	055	499	0.20	0.1992
	058	2520	0.25	0.2498
	059	1729	0.24	0.2398
	075	4172	0.05	0.0540
Mixed	008	1958	0.21	0.2099
	019	130	0.06	0.0560
	022 (a)	82	0.09	0.0868
	(b)	421	0.19	0.1866
	027	8479	0.20	0.1998
	032	2719	0.27	0.2709
	070 (a)	7873	0.14	0.1376
	(b)	7974	0.18	0.1788
	071 (a)	6200	0.13	0.1257
	(b)	3868	0.14	0.1418
	072 (a)	6649	0.09	0.0890
	(b)	4411	0.11	0.1102

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Disciplinary Focus of the Study					
Biology	019		130	0.056	0.0560
Chemistry	024		152	0.03	0.0305
Physics	026	(a)	553	0.18	0.1798
		(b)	625	0.34	0.3398
	036		91	0.11	0.1101
Earth Science	026	(a)	553	0.22	0.2164
		(b)	625	0.32	0.3242
Life Science	026	(a)	625	0.15	0.1459
		(b)	553	0.12	0.1205
General Science	008		1958	0.21	0.2099
	022	(a)	82	0.09	0.0868
		(b)	421	0.19	0.1866
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	052		26279	0.14	0.1400
	055		499	0.20	0.1992
	058		2520	0.25	0.2498
	059		1729	0.24	0.2398
	070	(a)	7873	0.14	0.1376
		(b)	7974	0.18	0.1788
	071	(a)	6200	0.13	0.1257
		(b)	3868	0.14	0.1418
	072	(a)	6649	0.09	0.0890
		(b)	4411	0.11	0.1102
	075		4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Age Levels					
a. 11-13	070		7873	0.14	0.1376
b. 14-16	008		1958	0.21	0.2099
	019		130	0.06	0.0560
	022		421	0.19	0.1866
	024		152	0.03	0.0305
	026	(a)	553	0.12	0.1205
		(b)	553	0.18	0.1798
		(c)	553	0.22	0.2164
	036		91	0.11	0.1101
	052		26279	0.14	0.1400
	055		499	0.20	0.1992
	058		2520	0.25	0.2498
	071		6200	0.13	0.1257
	072		6649	0.09	0.0890
	075		4172	0.05	0.0540
c. 17-19	022		82	0.09	0.0868
	026	(a)	625	0.15	0.1459
		(b)	625	0.32	0.3242
		(c)	625	0.34	0.3398
	027		8479	0.20	0.1998
	032		2719	0.27	0.2709
	059		1729	0.24	0.2398
	070		7974	0.18	0.1788
	071		3868	0.14	0.1418
	072		4411	0.11	0.1102

TABLE 69 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
7th Grade	none			
8th Grade	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	070	7873	0.14	0.1376
	071	6200	0.13	0.1257
	072	6649	0.09	0.0890
9th Grade	008	1958	0.21	0.2099
	022	421	0.19	0.1866
	024	152	0.03	0.0305
	032	2719	0.27	0.2709
	036	91	0.11	0.1101
	058	2521	0.25	0.2498
10th Grade	019	130	0.06	0.0560
	052	26279	0.14	0.1400
11th Grade	022	82	0.09	0.0868
	070	7974	0.18	0.1788
	071	3868	0.14	0.1418
	072	4411	0.11	0.1102
12th Grade	026 (a)	625	0.15	0.1459
	(b)	625	0.32	0.3242
	(c)	625	0.34	0.3398
	027	8479	0.20	0.1998
	059	1729	0.24	0.2398
7-9th Grades	026 (a)	553	0.12	0.1205
	(b)	553	0.18	0.1798
	(c)	553	0.22	0.2164
	070	7873	0.14	0.1376
	071	6200	0.13	0.1257
	072	6649	0.09	0.0890
	008	1958	0.21	0.2099
	022	421	0.19	0.1866
	024	152	0.03	0.0305
	032	2719	0.27	0.2709
	036	91	0.11	0.1101
	058	2520	0.25	0.2498
	075	4172	0.05	0.0540

TABLE 69 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
10-12 Grades	019	130	0.06	0.0560
	052	26279	0.14	0.1400
	022	82	0.09	0.0868
	070	7974	0.18	0 .788
	071	3868	0.14	0.1418
	072	4411	0.11	0.1102
	026 (a)	625	0.15	0.1459
	(b)	625	0.32	0.3242
	(c)	625	0.34	0.3398
	027	8479	0.20	0.1998
	055	499	0.20	0.1992
	059	1729	0.24	0.2398

TABLE 70

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	064	261	0.05	0.0499
	069	143	-0.14	-0.1405
	075	4172	0.10	0.1024
Book	none			
Dissertation	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	039	168	0.20	0.1977
Paper	none			
Length of Study				
less 1 month	039	168	0.20	0.1977
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	064	261	0.05	0.0499
	069	143	-0.14	-0.1405
	075	4172	0.10	0.1024

TABLE 70 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	011	195	0.09	0.0867
	051	92	0.09	0.0850
Self-Selected	019	185	0.13	0.1286
	039	168	0.20	0.1977
	049	1504	0.15	0.1458
	069	143	-0.14	-0.1405
Intact Groups	none			
Representative	001	306	0.20	0.2038
	064	261	0.05	0.0499
Other	075	4172	0.10	0.1024
Type of Study				
Correlational	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	064	261	0.05	0.0499
	069	143	-0.14	-0.1405
	075	4172	0.10	0.1024
Quasi-Exper.	039	168	0.20	0.1977
Experimental	none			
Other	none			

TABLE 70 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	039	168	0.20	0.1977
	049	1504	0.15	0.1458
	069	143	-0.14	-0.1405
High	051	92	0.09	0.0850
	064	261	0.05	0.0499
	075	4172	0.10	0.1024
Design Rating				
Medium	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	039	168	0.20	0.1977
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	069	143	-0.14	-0.1405
High	064	261	0.05	0.0499
	075	4172	0.10	0.1024

TABLE 70 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	039	168	0.20	0.1977
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	064	261	0.05	0.0499
	069	143	-0.14	-0.1405
	075	4172	0.10	0.1024
F-test	none			
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban	064	261	0.05	0.0499
Suburban	019	185	0.13	0.1286
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
Rural	075	4172	0.10	0.1024
Mixed	001	306	0.20	0.2038
	011	195	0.09	0.0867
	039	168	0.20	0.1977
	069	143	-0.14	-0.1405

TABLE 70 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	001	306	0.20	0.2038
	049	1504	0.15	0.1458
	064	261	0.05	0.0499
Medium	011	195	0.09	0.0867
	051	92	0.09	0.0850
High	075	4172	0.10	0.1024
Mixed	019	185	0.13	0.1286
	039	168	0.20	0.1977
	069	143	-0.14	-0.1405
Disciplinary Focus of the Study				
Biology	019	185	0.13	0.1286
	051	92	0.09	0.0850
Chemistry	011	195	0.09	0.0867
	069	143	-0.14	-0.1405
Physics	none			
Earth Science	039	168	0.20	0.1977
Life Science	none			
General Science	001	306	0.20	0.2038
	049	1504	0.15	0.1458
	064	261	0.05	0.0499
	075	4172	0.10	0.1024

TABLE 70 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	039	168	0.20	0.1977
b. 14-16	019	185	0.13	0.1286
	049	1504	0.15	0.1458
	051	92	0.09	0.0850
	064	261	0.05	0.0499
	075	4172	0.10	0.1024
c. 17-19	001	306	0.20	0.2038
	011	195	0.09	0.0867
	069	143	-0.14	-0.1405
Grade Level				
7th Grade	039	168	0.20	0.1977
8th Grade	064	261	0.05	0.0499
9th Grade	051	92	0.09	0.0850
10th Grade	019	185	0.13	0.1286
11th Grade	none			
12th Grade	001	306	0.20	0.2038
	069	143	-0.14	-0.1405
7-9th Grades	039	168	0.20	0.1977
	064	261	0.05	0.0499
	051	92	0.09	0.0850
	075	4172	0.10	0.1024
9-12 Grades	001	306	0.20	0.2038
	011	195	0.09	0.0867
	019	185	0.13	0.1286
	049	1504	0.15	0.1458
	069	143	-0.14	-0.1405

TABLE 71

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	045	140	0.32	0.3188
	051	92	0.25	0.2486
Book	none			
Dissertation	011	195	0.14	0.1426
	036	91	0.39	0.3897
	037	77	0.06	0.0596
Paper	055	634	0.32	0.3197
Length of Study				
less 1 month	036	91	0.39	0.3897
1-3 months	none			
3-6 months	037	77	0.06	0.0596
more than 6 m.	none			
Status Study	011	195	0.14	0.1426
	045	140	0.32	0.3188
	051	92	0.25	0.2486
	055	634	0.32	0.3197

TABLE 71 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Assignment of Students</u>				
Random	011	195	0.14	0.1426
	045	140	0.32	0.3188
	051	92	0.25	0.2486
Self-Selected	037	77	0.06	0.0596
Intact Groups	036	91	0.39	0.3897
Representative	055	634	0.32	0.3197
Other	none			
<u>Type of Study</u>				
Correlational	011	195	0.14	0.1426
	037	77	0.06	0.0596
	045	140	0.32	0.3188
	051	92	0.25	0.2486
Quasi-exper.	none			
Experimental	037	77	0.06	0.0596
Other	055	634	0.32	0.3197
<u>Rated Internal Validity</u>				
Medium	011	195	0.14	0.1426
	036	91	0.39	0.3897
	037	77	0.06	0.0596
	055	634	0.32	0.3197
High	045	140	0.32	0.3188
	051	92	0.25	0.2486

TABLE 71 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Design Rating				
Medium	011	195	0.14	0.1426
	036	91	0.39	0.3897
	037	77	0.06	0.0596
	045	140	0.32	0.3188
	051	92	0.25	0.2486
	055	634	0.32	0.3197
High	none			
Method of Calculating "r"				
r-value	011	195	0.14	0.1426
	037	77	0.06	0.0596
	045	140	0.32	0.3188
	051	92	0.25	0.2486
F-test	none			
t-test	036	91	0.39	0.3897
p-value	none			
d-value	055	634	0.32	0.3197
Community Type				
Urban	none			
Suburban	037	77	0.06	0.0596
	051	92	0.25	0.2486
Rural	036	91	0.39	0.3897
Mixed	011	195	0.14	0.1426
	045	140	0.32	0.3188
	055	634	0.32	0.3197

TABLE 71 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	none			
Medium	011	195	0.14	0.1426
	036	91	0.39	0.3897
	037	77	0.06	0.0596
High	055	634	0.32	0.3197
Mixed	045	140	0.32	0.3188
Disciplinary Focus of the Study				
Biology	051	92	0.25	0.2486
Chemistry	011	195	0.14	0.1426
	037	77	0.06	0.0596
Physics	036	91	0.39	0.3897
Earth Science	none			
Life Science	none			
General Science	045	140	0.32	0.3188
	055	634	0.32	0.3197
Age Levels				
a. 11-13	none			
b. 14-16	036	91	0.39	0.3897
	037	77	0.06	0.0596
	051	92	0.25	0.2486
	055	634	0.32	0.3197
c. 17-19	011	195	0.14	0.1426
	045	140	0.32	0.3188

TABLE 71 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	none			
8th Grade	none			
9th Grade	036	91	0.39	0.3897
10th Grade	none			
11th Grade	none			
12th Grade	none			
7-9th Grades	051	92	0.25	0.2486
9-12 Grades	011	195	0.14	0.1426
	037	77	0.06	0.0596
	045	140	0.32	0.3188
	055	634	0.32	0.3197

TABLE 72

EFFECT SIZES: GENDER RELATIONSHIPS WITH STUDENTS' ATTITUDES TOWARD SCIENCE LEARNING BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	049	1504	-0.06	-0.0642
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559
Book	none			
Dissertation	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
Paper	none			
<u>Length of Study</u>				
less 1 month	039	168	-0.02	-0.0246
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	049	1504	-0.06	-0.0642
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559

TABLE 72 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	054	3663	0.12	0.1206
Self-Selected	019	185	0.02	0.0168
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642
Intact Groups	none			
Representative	008	1958	0.10	0.0999
Other	032	2719	0.09	0.0929
	075	4172	0.06	0.0559
Type of Study				
Correlational	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	049	1504	-0.06	-0.0642
Quasi-exper.	039	168	-0.02	-0.0246
	075	4172	0.06	0.0559
Experimental	073	509	0.09	0.0875
Other	054	3663	0.12	0.1206

TABLE 72 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	185	0.02	0.0168
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642
High	008	1958	0.10	0.0999
	032	2719	0.09	0.0929
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559
Design Rating				
Medium	019	185	0.02	0.0168
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642
High	008	1958	0.10	0.0999
	032	2719	0.09	0.0929
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559

TABLE 72 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642
	054	3663	0.12	0.1206
	075	4172	0.06	0.0559
F-test	073	509	0.09	0.0875
t-test	none			
p value	none			
Other	none			
Community Type				
Urban	none			
Suburban	019	185	0.02	0.0168
	049	1504	-0.06	-0.0642
Rural	075	4172	0.06	0.0559
Mixed	008	1958	0.10	0.0999
	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
	054	3663	0.12	0.1206
	073	509	0.09	0.0875

TABLE 72 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	049	1504	-0.06	-0.0642
	073	509	0.09	0.0875
Medium	none			
High	054	3663	0.12	0.1206
	075	4172	0.06	0.0559
Mixed	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
Disciplinary Focus of the Study				
Biology	019	185	0.02	0.0168
Chemistry	none			
Physics	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
Earth Science	none			
Life Science	none			
General Science	008	1958	0.10	0.0999
	049	1504	-0.06	-0.0642
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559

TABLE 72 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	008	1958	0.10	0.0999
	019	185	0.02	0.0168
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559
c. 17-19	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642
Grade Level				
7th Grade	none			
8th Grade	none			
9th Grade	008	1958	0.10	0.0999
10th Grade	019	185	0.02	0.0168
11th Grade	none			
12th Grade	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
7-9th Grades	008	1958	0.10	0.0999
	054	3663	0.12	0.1206
	073	509	0.09	0.0875
	075	4172	0.06	0.0559
10-12 Grades	019	185	0.02	0.0168
	032	2719	0.09	0.0929
	039	168	-0.02	-0.0246
	049	1504	-0.06	-0.0642

TABLE 73

EFFECT SIZES: RACE RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	052	26279	0.36	0.3600
	075	4172	0.11	0.1129
Book	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3700
Dissertation	019	130	0.43	0.4282
Paper	none			
<u>Length of Study</u>				
less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	019	130	0.43	0.4282
	052	26279	0.36	0.3600
	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
	075	4172	0.11	0.1129

TABLE 73 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	none			
Self-Selected	019	130	0.43	0.4282
Intact Groups	none			
Representative	052	26279	0.36	0.3600
	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
Other	075	4172	0.11	0.1129
Type of Study				
Correlational	019	130	0.43	0.4282
	052	26279	0.36	0.3600
	075	4172	0.11	0.1129
Quasi-experimental				
Experimental	none			
Other	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703

TABLE 73 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	130	0.43	0.4282
High	052	26279	0.36	0.3600
	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
	075	4172	0.11	0.1129
Design Rating				
Medium	019	130	0.43	0.4282
High	052	26279	0.36	0.3600
	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
	075	4172	0.11	0.1129

TABLE 73 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	019	130	0.43	0.4282
	052	26279	0.36	0.3600
	075	4172	0.11	0.1129
F-test	none			
t-test	none			
p value	none			
d value	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
Community Type				
Urban	none			
Suburban	019	130	0.43	0.4282
Rural	none			
Mixed	052	26279	0.36	0.3600
	070 (a)	7322	0.38	0.3780
	(b)	7496	0.44	0.4370
	071 (a)	3300	0.40	0.3979
	(b)	5129	0.45	0.4541
	072 (a)	5425	0.35	0.3456
	(b)	3905	0.37	0.3703
	075	4172	0.11	0.1129

TABLE 73 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Socioeconomic Status					
Low	052		26279	0.36	0.3600
Medium	none				
High	075		4172	0.11	0.1129
Mixed	019		130	0.43	0.4282
	070	(a)	7322	0.38	0.3780
		(b)	7496	0.44	0.4370
	071	(a)	3300	0.40	0.3979
		(b)	5129	0.45	0.4541
	072	(a)	5425	0.35	0.3456
		(b)	3905	0.37	0.3703
Disciplinary Focus of the Study					
Biology	019		130	0.43	0.4282
Chemistry	none				
Physics	none				
Earth Science	none				
Life Science	none				
General Science	052		26279	0.36	0.3600
	070	(a)	7322	0.38	0.3780
		(b)	7496	0.44	0.4370
	071	(a)	3300	0.40	0.3979
		(b)	5129	0.45	0.4541
	072	(a)	5425	0.35	0.3456
		(b)	3905	0.37	0.3703
	075		4172	0.12	0.1129

TABLE 73 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	070	7322	0.38	0.3780
	071	5129	0.45	0.4541
	072	5425	0.35	0.3456
b. 14-16	019	130	0.43	0.4282
	052	26279	0.36	0.3600
	075	4172	0.11	0.1129
c. 17-19	070	7496	0.44	0.4370
	071	3300	0.40	0.3979
	072	3905	0.37	0.3703

TABLE 73 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
7th Grade	none			
8th Grade	070	7322	0.38	0.3780
	071	5129	0.45	0.4541
	072	5425	0.35	0.3456
9th Grade	none			
10th Grade	019	130	0.43	0.4282
	052	26279	0.36	0.3600
11th Grade	070	7496	0.44	0.4370
	071	3300	0.40	0.3979
	072	3905	0.37	0.3703
12th Grade	none			
7-9th Grades	070	7322	0.38	0.3780
	071	5129	0.45	0.4541
	072	5425	0.35	0.3456
	075	4172	0.11	0.1129
10-12 Grades	019	130	0.43	0.4282
	052	26279	0.36	0.3600
	070	7496	0.44	0.4370
	071	3300	0.40	0.3979
	072	3905	0.37	0.3703

TABLE 74

EFFECT SIZES: FATHER'S EDUCATION RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	none			
Book	056	2520	0.30	0.2998
Dissertation	019	130	0.42	0.4197
	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
Paper	055	495	0.19	0.1909
Length of Study				
less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	019	130	0.42	0.4197
	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
	055	495	0.19	0.1909
	056	2520	0.30	0.2998

TABLE 74 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	033	2443	0.12	0.1198
Self-Selected	019	130	0.42	0.4197
Intact Groups	none			
Representative	055	495	0.19	0.1909
	056	2520	0.30	0.2998
Other	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
Type of Study				
Correlational	019	130	0.42	0.4197
	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
	056	2520	0.30	0.2998
Quasi-exper.	none			
Experimental	none			
Other	055	495	0.19	0.1909

TABLE 74 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	130	0.42	0.4197
	033	2443	0.12	0.1198
	055	495	0.19	0.1909
High	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	056	2520	0.30	0.2998
Design Rating				
Medium	019	130	0.42	0.4197
	055	495	0.19	0.1909
High	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
	056	2520	0.30	0.2998

TABLE 74 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	019	130	0.42	0.4197
	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
	056	2520	0.30	0.2998
F-test	none			
t-test	none			
p-value	055	495	0.19	0.01909
d-value	none			
Community Type				
Urban	none			
Suburban	019	130	0.42	0.4197
Rural	none			
Mixed	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
	055	495	0.19	0.1909
	056	2520	0.30	0.2998

TABLE 74 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Socioeconomic Status</u>				
Low	none			
Medium	none			
High	055	495	0.19	0.1909
	056	2520	0.30	0.2998
Mixed	019	130	0.42	0.4197
	031 (a)	2822	0.16	0.1566
	(b)	3258	0.18	0.1758
	(c)	3100	0.26	0.2560
	032 (a)	2719	0.18	0.1789
	(b)	1958	0.28	0.2819
	033	2443	0.12	0.1198
<u>Disciplinary Focus of the Study</u>				
Biology	019	130	0.42	0.4197
	031	3100	0.26	0.2560
Chemistry	031	2822	0.16	0.1566
Physics	031	3258	0.18	0.1758
	032	2719	0.18	0.1789
	033	2443	0.12	0.1198
Earth Science	none			
Life Science	none			
General Science	032	1858	0.28	0.2819
	055	495	0.19	0.1909
	056	2520	0.30	0.2998

TABLE 74 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	019	130	0.42	0.4197
	031	3100	0.26	0.2560
	032	1958	0.28	0.2819
	055	495	0.19	0.1909
	056	2520	0.30	0.2998
c. 17-19	031	2822	0.16	0.1566
	031	3258	0.18	0.1758
	032	2719	0.18	0.1789
	033	2443	0.12	0.1198
Grade Levels				
7th Grade	none			
8th Grade	none			
9th Grade	032	1958	0.28	0.2819
	056	2520	0.30	0.2998
10th Grade	019	130	0.42	0.4197
	031	3100	0.26	0.2560
11th Grade	031	2822	0.16	0.1566
12th Grade	031	3258	0.18	0.1758
	032	2719	0.18	0.1789
	033	2443	0.12	0.1198
7-9th Grades	032	1958	0.28	0.2819
	056	2520	0.30	0.2998
9-12 Grades	019	130	0.42	0.4197
	031	3100	0.26	0.2560
	031	2822	0.16	0.1566
	031	3258	0.18	0.1758
	032	2719	0.18	0.1789
	033	2443	0.12	0.1198
	055	495	0.19	0.1909

TABLE 75

EFFECT SIZES: MOTHER'S EDUCATION RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	none			
Book	056	2520	0.27	0.2698
Dissertation	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
Paper	055	498	0.19	0.1864
<u>Length of Study</u>				
Less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	055	498	0.19	0.1864
	056	2520	0.27	0.2698

TABLE 75 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	033	2443	0.11	0.1098
Self-Selected	019	130	0.32	0.3156
Intact Groups	none			
Representative	008	1958	0.27	0.2729
	055	498	0.19	0.1864
	056	2520	0.27	0.2698
Other	032	2719	0.12	0.1229
Type of Study				
Correlational	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	056	2520	0.27	0.2698
Quasi-exper.	none			
Experimental	none			
Other	055	498	0.19	0.1864

TABLE 75 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	130	0.32	0.3156
	033	2443	0.11	0.1098
	055	498	0.19	0.1864
High	008	1958	0.27	0.2729
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	056	2520	0.27	0.2698
Design Rating				
Medium	019	130	0.32	0.3156
	055	498	0.19	0.1864
High	008	1958	0.27	0.2729
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	056	2520	0.27	0.2698

TABLE 75 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	056	2520	0.27	0.2698
F-test	none			
t-test	none			
p-value	055	498	0.19	0.1864
d-value	none			
Community Type				
Urban	none			
Suburban	019	130	0.32	0.3156
Rural	none			
Mixed	008	1958	0.27	0.2729
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	055	498	0.19	0.1864
	056	2520	0.27	0.2698

TABLE 75 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	none			
Medium	none			
High	055	498	0.19	0.1864
	056	2520	0.27	0.2698
Mixed	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031 (a)	2822	0.13	0.1348
	(b)	3258	0.14	0.1428
	(c)	3100	0.23	0.2299
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
Disciplinary Focus of the Study				
Biology	019	130	0.32	0.3156
	031	3100	0.23	0.2299
Chemistry	031	2822	0.13	0.1348
Physics	031	3258	0.14	0.1428
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
Earth Science	none			
Life Science	none			
General Science	008	1958	0.27	0.2729
	055	498	0.19	0.1864
	056	2520	0.27	0.2698

TABLE 75 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	008	1958	0.27	0.2729
	019	130	0.32	0.3156
	031	3100	0.23	0.2299
	055	498	0.19	0.1864
	056	2520	0.27	0.2698
c. 17-19	031	2822	0.13	0.1348
		3258	0.14	0.1428
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
Grade Levels				
7th Grade	none			
8th Grade	none			
9th Grade	008	1958	0.27	0.2729
	056	2520	0.27	0.2698
10th Grade	019	130	0.32	0.3156
	031	3100	0.23	0.2299
11th Grade	031	2822	0.13	0.1348
12th Grade	031	3258	0.14	0.1428
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
7-9th Grades	008	1958	0.27	0.2729
	056	2520	0.27	0.2698
10-12 Grades	019	130	0.32	0.3156
	031	3100	0.23	0.2299
	031	2822	0.13	0.1348
	031	3258	0.14	0.1428
	032	2719	0.12	0.1229
	033	2443	0.11	0.1098
	056	2520	0.27	0.2698

TABLE 76

E FECT SIZES: FACILITIES AT HOME RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	052	26279	0.26	0.2600
Book	056	2520	0.34	0.3398
Dissertation	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	008	1958	0.34	0.3429
	031 (a)	2822	0.17	0.1685
	(b)	3258	0.18	0.1815
	(c)	3100	0.27	0.2738
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298
	035	233	0.41	0.4093
Paper	none			
Length of Study				
less 1 month	none			
1-3 months	none			
3-6 months	none			
More than 6 m.	none			
Status Study	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	008	1958	0.34	0.3429
	031 (a)	2822	0.17	0.1685
	(b)	3258	0.18	0.1815
	(c)	3100	0.27	0.2738
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298
	035	233	0.41	0.4093
	052	26279	0.26	0.2600
	056	2520	0.34	0.3398

TABLE 76 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Assignment of Students					
Random	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	033		2443	0.23	0.2298
Self-Selected	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	035		233	0.41	0.4093
Intact Groups	none				
Representative	008		1958	0.34	0.3429
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398
Other	032		2719	0.22	0.2219
Type of Study					
Correlational	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	008		1958	0.34	0.3429
	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	032		2719	0.22	0.2219
	033		2443	0.23	0.2298
	035		233	0.41	0.4093
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398
Quasi-exper.	none				
Experimental	none				
Other	none				

TABLE 76 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	033		2443	0.23	0.2298
	035		233	0.41	0.4093
High	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	008		1958	0.34	0.3429
	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	032		2719	0.22	0.2219
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398
Design Rating					
Medium	035		233	0.41	0.4093
High	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	008		1958	0.34	0.3429
	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	032		2719	0.22	0.2219
	033		2443	0.23	0.2298
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398

TABLE 76 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Method of Calculating "r"					
r-value	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	008		1958	0.34	0.3429
	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	032		2719	0.22	0.2219
	033		2443	0.23	0.2298
	035		233	0.41	0.4093
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398
F-test	none				
t-test	none				
p-value	none				
d-value	none				
Community Type					
Urban	none				
Suburban	035		233	0.41	0.4093
Rural	none				
Mixed	004	(a)	538	0.10	0.1035
		(b)	487	0.21	0.2051
		(c)	644	0.21	0.2123
	008		1958	0.34	0.3429
	031	(a)	2822	0.17	0.1685
		(b)	3258	0.18	0.1815
		(c)	3100	0.27	0.2738
	032		2719	0.22	0.2219
	033		2443	0.23	0.2298
	052		26279	0.26	0.2600
	056		2520	0.34	0.3398

TABLE 76 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	052	26279	0.26	0.2600
Medium	none			
High	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	035	233	0.41	0.4093
	056	2520	0.34	0.3398
Mixed	008	1958	0.34	0.3429
	031 (a)	2822	0.17	0.1685
	(b)	3258	0.18	0.1815
	(c)	3100	0.27	0.2738
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298
Disciplinary Focus of the Study				
Biology	004	644	0.21	0.2123
	031	3100	0.27	0.2738
	035	233	0.41	0.4093
Chemistry	004	538	0.10	0.1035
	031	2822	0.17	0.1685
Physics	004	487	0.21	0.2051
	031	3258	0.18	0.1815
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298
Earth Science	none			
Life Science	none			
General Science	008	1958	0.34	0.3429
	052	26279	0.26	0.2600
	056	2520	0.34	0.3398

TABLE 76 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	008	1958	0.34	0.3429
	031	3100	0.27	0.2738
	035	233	0.41	0.4093
	052	26279	0.26	0.2600
	056	2520	0.34	0.3398
c. 17-19	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	031 (a)	2822	0.17	0.1685
	(b)	3258	0.18	0.1815
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298

TABLE 76 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
7th Grade	none			
8th Grade	none			
9th Grade	008	1958	0.34	0.3429
	035	233	0.41	0.4093
	056	2520	0.34	0.3398
10th Grade	031	3100	0.27	0.2738
	052	26279	0.26	0.2600
11th Grade	031	2822	0.17	0.1685
12th Grade	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	031	3258	0.18	0.1815
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298
7-9th Grades	008	1958	0.34	0.3429
	035	233	0.41	0.4093
	056	2520	0.34	0.3398
10-12 Grades	031	3100	0.27	0.2738
	052	26279	0.26	0.2600
	031	2822	0.17	0.1685
	004 (a)	538	0.10	0.1035
	(b)	487	0.21	0.2051
	(c)	644	0.21	0.2123
	031	3258	0.18	0.1815
	032	2719	0.22	0.2219
	033	2443	0.23	0.2298

TABLE 77

EFFECT SIZES: PLANS AND ASPIRATIONS RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	052	26279	0.32	0.3200
Book	059	1729	0.05	0.0499
Dissertation	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
Paper	none			

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Length of Study				
less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	033	2443	0.15	0.1498
Self-Selected	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	035	233	0.31	0.3094
Intact Groups	none			
Representative	027	8479	0.41	0.4049
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499
Other	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Type of Study				
Correlational	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499
Quasi-exper.	none			
Experimental	none			
Other	none			

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	033	2443	0.15	0.1498
	035	233	0.31	0.3094
High	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Design Rating				
Medium	035	233	0.31	0.3094
High	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499
Method of Calculating "r"				
r-value	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499
F-test	none			
t-test	none			
p-value	none			
d-value	none			

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	none			
Suburban	035	233	0.31	0.3094
Rural	none			
Mixed	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499
Socioeconomic Status				
Low	052	26279	0.32	0.3200
Medium	none			
High	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	035	233	0.31	0.3094
	059	1729	0.05	0.0499
Mixed	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	(c)	2505	0.21	0.2099
	(d)	3100	0.27	0.2661
	032 (a)	2719	0.17	0.1649
	(b)	1958	0.36	0.3618
	033	2443	0.15	0.1498

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	004	648	0.23	0.2287
	031	3100	0.27	0.2661
	035	233	0.31	0.3094
Chemistry	004	504	0.05	0.0499
	031	2822	0.16	0.1611
Physics	004	488	0.09	0.0919
	031	3259	0.15	0.1492
	032	2719	0.17	0.1649
	033	2443	0.15	0.1498
Earth Science	none			
Life Science	none			
General Science	027	8479	0.41	0.4049
	031	2505	0.21	0.2099
	032	1958	0.36	0.3618
	052	26279	0.32	0.3200
	059	1729	0.05	0.0499

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	031 (a)	2505	0.21	0.2099
		3100	0.27	0.2661
	032	1958	0.36	0.3618
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
	052	26279	0.32	0.3200
c. 17-19	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031 (a)	3259	0.15	0.1492
	(b)	2822	0.16	0.1611
	032	2719	0.17	0.1649
	059	1729	0.05	0.0499

TABLE 77 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	none			
8th Grade	none			
9th Grade	031	2505	0.21	0.2099
	033	2443	0.15	0.1498
	035	233	0.31	0.3094
10th Grade	031	3100	0.27	0.2661
	052	26279	0.32	0.3200
11th Grade	031	2822	0.16	0.1611
12th Grade	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031	3259	0.15	0.1492
	032	2719	0.17	0.1649
	033	2443	0.15	0.1498
	059	1729	0.05	0.0499
7-9th Grades	031	2505	0.21	0.2099
	032	1958	0.36	0.3618
	035	233	0.31	0.3094
10-12 Grades	031	3100	0.27	0.2661
	052	26279	0.32	0.3200
	031	2822	0.16	0.1611
	004 (a)	504	0.05	0.0499
	(b)	488	0.09	0.0919
	(c)	648	0.23	0.2287
	027	8479	0.41	0.4049
	031	3259	0.15	0.1492
	032	2719	0.17	0.1649
	033	2443	0.15	0.1498
	059	1729	0.05	0.0499

TABLE 78

EFFECT SIZES: HOURS OF HOMEWORK RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	052	26279	0.21	0.2100
Book	none			
Dissertation	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
Paper	none			
Length of Study				
less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
	052	26279	0.21	0.2100

TABLE 78 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
Self-Selected	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	035	233	0.11	0.1098
Intact Groups	none			
Representative	052	26279	0.21	0.2100
Other	032	1958	0.26	0.2587
Type of Study				
Correlational	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
	052	26279	0.21	0.2100
Quasi-exper.	none			
Experimental	none			
Other	none			

TABLE 78 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	035		233	0.11	0.1098
High	004	(a)	540	-0.17	-0.1717
		(b)	488	-0.11	-0.1121
		(c)	645	0.14	0.1394
	031	(a)	3258	0.06	0.0570
		(b)	2822	0.18	0.1755
		(c)	2505	0.19	0.1899
		(d)	3100	0.20	0.2019
	032		1958	0.26	0.2587
	035		233	0.11	0.1098
	052		26279	0.21	0.2100
Design Rating					
Medium	035		233	0.11	0.1098
High	004	(a)	540	-0.17	-0.1717
		(b)	488	-0.11	-0.1121
		(c)	645	0.14	0.1394
	031	(a)	3258	0.06	0.0570
		(b)	2822	0.18	0.1755
		(c)	2505	0.19	0.1899
		(d)	3100	0.20	0.2019
	032		1958	0.26	0.2587
	052		26279	0.21	0.2100

TABLE 78 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
	052	26279	0.21	0.2100
F-test	none			
t-test	none			
p-value	none			
Other	none			
Community Type				
Urban	none			
Suburban	035	233	0.11	0.1098
Rural	none			
Mixed	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	052	26279	0.21	0.2100

TABLE 78 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	052	26279	0.21	0.2100
Medium	none			
High	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	035	233	0.11	0.1098
Mixed	031 (a)	3258	0.06	0.0570
	(b)	2822	0.18	0.1755
	(c)	2505	0.19	0.1899
	(d)	3100	0.20	0.2019
	032	1958	0.26	0.2587
Disciplinary Focus of the Study				
Biology	004	645	0.14	0.1394
	031	3100	0.20	0.2019
	035	233	0.11	0.1098
Chemistry	004	540	-0.17	-0.1717
	031	2822	0.18	0.1755
Physics	004	488	-0.11	-0.1121
	031	3258	0.06	0.0570
Earth Science	none			
Life Science	none			
General Science	031	2505	0.19	0.1899
	032	1958	0.26	0.2587
	052	26279	0.21	0.2100

TABLE 78 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	031 (a)	2505	0.19	0.1899
	(b)	3100	0.20	0.2019
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
	052	26279	0.21	0.2100
c. 17-19	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031 (a)	2822	0.18	0.1755
	(b)	3258	0.06	0.0570

TABLE 78 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	none			
8th Grade	none			
9th Grade	031	2505	0.19	0.1899
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
10th Grade	031	3100	0.20	0.2019
	052	26279	0.21	0.2100
11th Grade	031	2822	0.18	0.1755
12th Grade	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031	3258	0.06	0.0570
7-9th Grades	031	2505	0.19	0.1899
	032	1958	0.26	0.2587
	035	233	0.11	0.1098
10-12 Grades	031	3100	0.20	0.2019
	052	26279	0.21	0.2100
	031	2822	0.18	0.1755
	004 (a)	540	-0.17	-0.1717
	(b)	488	-0.11	-0.1121
	(c)	645	0.14	0.1394
	031	3258	0.06	0.0570

TABLE 79

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	043	72	0.67	0.6673
	068	128	0.73	0.7287
Book	none			
Dissertation	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	008	1958	0.45	0.4498
	021	80	0.70	0.6977
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	024	152	0.51	0.5121
	031 (a)	3258	0.34	0.3358
	(b)	2822	0.47	0.4705
	(c)	3100	0.53	0.5319
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698
	035	233	0.68	0.6792
	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092
Paper	none			

TABLE 79 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Length of Study					
less 1 month	none				
1-3 months	021		80	0.70	0.6977
3-6 months	024		152	0.51	0.5121
more than 6 m.	none				
Status Study	004	(a)	541	0.22	0.2166
		(b)	478	0.25	0.2526
		(c)	642	0.42	0.4174
	008		1958	0.45	0.4498
	022	(a)	424	0.48	0.4831
		(b)	421	0.58	0.5841
		(c)	82	0.59	0.5896.
	031	(a)	3258	0.34	0.3358
		(b)	2822	0.47	0.4705
		(c)	3100	0.53	0.5319
	032		2719	0.37	0.3689
	033		2443	0.37	0.3698
	035		233	0.68	0.6792
	040	(a)	226	0.62	0.6191
		(b)	217	0.51	0.5092
	043		72	0.67	0.6673
	068		128	0.73	0.7287

TABLE 79 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Assignment of Students					
Random	021		80	0.70	0.6977
	031	(a)	3258	0.34	0.3358
		(b)	2822	0.47	0.4705
		(c)	3100	0.53	0.5319
	033		2443	0.37	0.3698
	068		128	0.73	0.7287
Self-Selected	004	(a)	541	0.22	0.2166
		(b)	478	0.25	0.2526
		(c)	642	0.42	0.4174
	024		152	0.51	0.5121
	035		233	0.68	0.6792
	043		72	0.67	0.6673
Intact Groups	none				
Representative	008		1958	0.45	0.4498
	022	(a)	424	0.48	0.4831
		(b)	421	0.58	0.5841
		(c)	82	0.59	0.5896
Other	032		2719	0.37	0.3689
	040	(a)	226	0.62	0.6191
		(b)	217	0.51	0.5092

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Type of Study				
Correlational	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	008	1958	0.45	0.4498
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	031 (a)	3258	0.34	0.3358
	(b)	2822	0.47	0.4705
	(c)	3100	0.53	0.5319
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698
	035	233	0.68	0.6792
	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092
	043	72	0.67	0.6673
	068	128	0.73	0.7287
Quasi-exper.	none			
Experimental	021	80	0.70	0.6977
	024	152	0.51	0.5121
Other	none			

TABLE 79 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	021		80	0.70	0.6977
	024		152	0.51	0.5121
	033		2443	0.37	0.3698
	035		233	0.68	0.6792
	043		72	0.67	0.6673
High	004	(a)	541	0.22	0.2166
		(b)	478	0.25	0.2526
		(c)	642	0.42	0.4174
	008		1958	0.45	0.4498
	022	(a)	424	0.48	0.4831
		(b)	421	0.58	0.5841
		(c)	82	0.59	0.5896
	031	(a)	3258	0.34	0.3358
		(b)	2822	0.47	0.4705
		(c)	3100	0.53	0.5319
	032		2719	0.37	0.3689
	040	(a)	226	0.62	0.6191
		(b)	217	0.51	0.5092
	068		128	0.73	0.7287

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Design Rating				
Medium	021	80	0.70	0.6977
	024	152	0.51	0.5121
	035	233	0.68	0.6792
	043	72	0.67	0.6673
High	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	008	1958	0.45	0.4498
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	031 (a)	3258	0.34	0.3358
	(b)	2822	0.47	0.4705
	(c)	3100	0.53	0.5319
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698
	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092
	068	128	0.73	0.7287

TABLE 79 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
<u>Method of Calculating "r"</u>					
r-value	004	(a)	541	0.22	0.2166
		(b)	478	0.25	0.2526
		(c)	642	0.42	0.4174
	008		1958	0.45	0.4498
	021		80	0.70	0.6977
	022	(a)	424	0.48	0.4831
		(b)	421	0.58	0.5841
		(c)	82	0.59	0.5896
	024		152	0.51	0.5121
	031	(a)	3258	0.34	0.3358
		(b)	2822	0.47	0.4705
		(c)	3100	0.53	0.5319
	032		2719	0.37	0.3689
	033		2443	0.37	0.3698
	035		233	0.68	0.6792
	040	(a)	226	0.62	0.6191
		(b)	217	0.51	0.5092
	043		72	0.67	0.6673
	068		128	0.73	0.7287
F-test	none				
t-test	none				
p-value	none				
d-value	none				

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	021	80	0.70	0.6977
Suburban	024	152	0.51	0.5121
	035	233	0.68	0.6792
	043	72	0.67	0.6673
	068	128	0.73	0.7287
Rural	none			
Mixed	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	008	1958	0.45	0.4498
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	031 (a)	3258	0.34	0.3358
	(b)	2822	0.47	0.4705
	(c)	3100	0.53	0.5319
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698
	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	024	152	0.51	0.5121
Medium	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092
	068	128	0.73	0.7287
High	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	035	233	0.68	0.6792
	043	72	0.67	0.6673
Mixed	008	1958	0.45	0.4498
	021	80	0.70	0.6977
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	031 (a)	3258	0.34	0.3358
	(b)	2822	0.47	0.4705
	(c)	3100	0.53	0.5319
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	004	642	0.42	0.4174
	021	80	0.70	0.6977
	031	3100	0.53	0.5319
	035	233	0.68	0.6792
Chemistry	004	541	0.22	0.2166
	024	152	0.51	0.5121
	031	2822	0.47	0.4705
Physics	004	478	0.25	0.2526
	031	3258	0.34	0.3358
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698
Earth Science	none			
Life Science	none			
General Science	008	1958	0.45	0.4498
	022 (a)	424	0.48	0.4831
	(b)	421	0.58	0.5841
	(c)	82	0.59	0.5896
	040 (a)	226	0.62	0.6191
	(b)	217	0.51	0.5092
	043	72	0.67	0.6673
	068	128	0.73	0.7287

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	040	226	0.62	0.6191
b. 14-16	008	1958	0.45	0.4498
	021	80	0.70	0.6977
	022	424	0.48	0.4831
	022	421	0.58	0.5841
	024	152	0.51	0.5121
	031	3100	0.53	0.5319
	035	233	0.68	0.6792
	040	217	0.51	0.5092
	043	72	0.67	0.6673
	068	128	0.73	0.7287
	043	72	0.67	0.6673
	068	128	0.73	0.7287
c. 17-19	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	022	82	0.59	0.5896
	031	3258	0.34	0.3358
	031	2822	0.47	0.4705
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
7th Grade	040	226	0.62	0.6191
8th Grade	none			
9th Grade	008	1958	0.45	0.4498
	021	80	0.70	0.6977
	022	421	0.58	0.5841
	024	152	0.51	0.5121
	035	233	0.68	0.6792
	040	217	0.51	0.5092
	043	72	0.67	0.6673
10th Grade	022	424	0.48	0.4831
	031	3100	0.53	0.5319
11th Grade	022	82	0.59	0.5896
	031	2822	0.47	0.4705
12th Grade	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	031	3258	0.34	0.3358
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698

TABLE 79 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels (cont.)				
7-9th Grades	040	226	0.62	0.6191
	008	1958	0.45	0.4498
	021	80	0.70	0.6977
	022	421	0.58	0.5841
	024	152	0.51	0.5121
	035	233	0.68	0.6792
	040	217	0.51	0.5092
	043	72	0.67	0.6673
	068	128	0.73	0.7287
10-12 Grades	022	424	0.48	0.4831
	031	3100	0.53	0.5319
	022	82	0.59	0.5896
	031	2822	0.47	0.4705
	004 (a)	541	0.22	0.2166
	(b)	478	0.25	0.2526
	(c)	642	0.42	0.4174
	031	3258	0.34	0.3358
	032	2719	0.37	0.3689
	033	2443	0.37	0.3698

TABLE 80

EFFECT SIZES: LANGUAGE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	none			
Book	none			
Dissertation	001	306	0.70	0.6994
	003	312	0.36	0.3546
	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
	016	145	0.23	0.2293
	017	352	0.29	0.2926
	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804
	020	171	0.25	0.2454
Paper	none			
Length of Study				
Less 1 month	020	171	0.25	0.2454
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	001	306	0.70	0.6994
	003	312	0.36	0.3546
	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
	016	145	0.23	0.2293
	017	352	0.29	0.2926
	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804

TABLE 80 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	016	145	0.23	0.2293
Self-Selected	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804
Intact Groups	020	171	0.25	0.2454
Representative	001	306	0.70	0.6994
	003	312	0.36	0.3546
	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
Other	017	352	0.29	0.2926
Type of Study				
Correlational	001	306	0.70	0.6994
	003	312	0.36	0.3546
	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
	016	145	0.23	0.2293
	017	352	0.29	0.2926
	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804
Quasi-exper.	none			
Experimental	020	171	0.25	0.2454
Other	none			

TABLE 80 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	001		306	0.70	0.6994
	003		312	0.36	0.3546
	006	(a)	75	0.14	0.1439
		(b)	215	0.23	0.2274
		(c)	185	0.35	0.3499
		(d)	55	0.37	0.3652
	016		145	0.23	0.2293
	017		352	0.29	0.2926
	018	(a)	546	0.41	0.4137
		(b)	174	0.46	0.4600
		(c)	314	0.58	0.5804
	020		171	0.25	0.2454
High	none				
Design Rating					
Medium	001		306	0.70	0.6994
	003		312	0.36	0.3546
	006	(a)	75	0.14	0.1439
		(b)	215	0.23	0.2274
		(c)	185	0.35	0.3499
		(d)	55	0.37	0.3652
High	016		145	0.23	0.2293
	017		352	0.29	0.2926
	018	(a)	546	0.41	0.4137
		(b)	174	0.46	0.4600
		(c)	314	0.58	0.5804
	020		171	0.25	0.2454

TABLE 80 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Method of Calculating "r"</u>				
r-value	001	306	0.70	0.6994
	003	312	0.36	0.3546
	016	145	0.23	0.2293
	017	352	0.29	0.2926
	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804
	020	171	0.25	0.2454
F-test	none			
t-test	none			
p-value	none			
d-value	none			
<u>Community Type</u>				
Urban	017	352	0.29	0.2926
Suburban	003	312	0.36	0.3546
	020	171	0.25	0.2454
Rural	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
Mixed	001	306	0.70	0.6994
	016	145	0.23	0.2293
	018 (a)	546	0.41	0.4137
	(b)	174	0.46	0.4600
	(c)	314	0.58	0.5804

TABLE 80 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Socioeconomic Status					
Low	001		306	0.70	0.6994
Medium	003		312	0.36	0.3546
	006	(a)	75	0.14	0.1439
		(b)	215	0.23	0.2274
		(c)	185	0.35	0.3499
		(d)	55	0.37	0.3652
High	016		145	0.23	0.2293
	017		352	0.29	0.2926
	018	(a)	546	0.41	0.4137
		(b)	174	0.46	0.4600
		(c)	314	0.58	0.5804
	020		171	0.25	0.2454
Mixed	none				
Disciplinary Focus of the Study					
Biology	006		55	0.37	0.3652
	017		352	0.29	0.2926
Chemistry	006		185	0.35	0.3499
	020		171	0.25	0.2454
Physics	003		312	0.36	0.3546
	006		75	0.14	0.1439
Earth Science	006		215	0.23	0.2274
Life Science	none				
General Science	001		306	0.70	0.6994
	016		145	0.23	0.2293
	018	(a)	546	0.41	0.4137
		(b)	174	0.46	0.4600
		(c)	314	0.58	0.5804

TABLE 80 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
<u>Age Levels</u>					
a. 11-13	016		145	0.23	0.2293
b. 14-16	003		312	0.36	0.3546
	017		352	0.29	0.2926
	018		546	0.41	0.4137
c. 17-19	001		306	0.70	0.6994
	006	(a)	75	0.14	0.1439
		(b)	215	0.23	0.2274
		(c)	185	0.35	0.3499
		(d)	55	0.37	0.3652
	018		314	0.58	0.5804
	018		546	0.41	0.4137
	020		171	0.25	0.2454

TABLE 80 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	016	145	0.23	0.2293
8th Grade	none			
9th Grade	017	352	0.29	0.2926
10th Grade	003	312	0.36	0.3546
	018	546	0.41	0.4137
11th Grade	018	314	0.58	0.5804
12th Grade	001	306	0.70	0.6994
7-9th Grades	016	145	0.23	0.2293
	017	352	0.29	0.2926
10-12 Grades	001	306	0.70	0.6994
	003	312	0.36	0.3546
	006 (a)	75	0.14	0.1439
	(b)	215	0.23	0.2274
	(c)	185	0.35	0.3499
	(d)	55	0.37	0.3652
	018	314	0.58	0.5804
	018	546	0.41	0.4137
	020	171	0.25	0.2454

TABLE 81

EFFECT SIZES: MATHEMATICS ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	043	72	0.73	0.7275
	068	128	0.70	0.6987
Book	none			
Dissertation	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
Paper	none			

TABLE 81 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Length of Study				
Less 1 month	none			
1-3 months	none			
3-6 months	none			
More than 6 m.	none			
Status Study	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
	043	72	0.73	0.7275
	068	128	0.70	0.6987
Assignment of Students				
Random	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	068	128	0.70	0.6987
Self-Selected	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	043	72	0.73	0.7275
Intact Groups	none			
Representative	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
Other	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492

TABLE 81 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Type of Study</u>				
Correlational	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
	043	72	0.73	0.7275
	068	128	0.70	0.6987
Quasi-exper.	none			
Experimental	none			
Other	none			
<u>Rated Internal Validity</u>				
Medium	043	72	0.73	0.7275
High	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
	068	128	0.70	0.6987

TABLE 81 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
<u>Design Rating</u>					
Medium	043		72	0.73	0.7275
High	004	(a)	489	0.40	0.3984
		(b)	648	0.57	0.5722
		(c)	542	0.58	0.5836
	022	(a)	424	0.55	0.5521
		(b)	82	0.60	0.5996
		(c)	421	0.67	0.6690
	031	(a)	473	0.45	0.4497
		(b)	3100	0.57	0.5741
		(c)	2822	0.59	0.5855
	040	(a)	226	0.41	0.4092
		(b)	217	0.45	0.4492
	068		128	0.70	0.6987
<u>Method of Calculating "r"</u>					
r-value	004	(a)	489	0.40	0.3984
		(b)	648	0.57	0.5722
		(c)	542	0.58	0.5836
	022	(a)	424	0.55	0.5521
		(b)	82	0.60	0.5996
		(c)	421	0.67	0.6690
	031	(a)	473	0.45	0.4497
		(b)	3100	0.57	0.5741
		(c)	2822	0.59	0.5855
	040	(a)	226	0.41	0.4092
		(b)	217	0.45	0.4492
	043		72	0.73	0.7275
	068		128	0.70	0.6987
F-test	none				
t-test	none				
p-value	none				
d-value	none				

TABLE 81 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	none			
Suburban	043	72	0.73	0.7275
	068	128	0.70	0.6987
Rural	none			
Mixed	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
Socioeconomic Status				
Low	none			
Medium	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
	068	128	0.70	0.6987
High	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	043	72	0.73	0.7275
Mixed	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	031 (a)	473	0.45	0.4497
	(b)	3100	0.57	0.5741
	(c)	2822	0.59	0.5855

TABLE 81 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	004	648	0.57	0.5722
	031	3100	0.57	0.5741
Chemistry	004	542	0.58	0.5836
	031	2822	0.59	0.5855
Physics	004	489	0.40	0.3984
	031	473	0.45	0.4497
Earth Science	none			
Life Science	none			
General Science	022 (a)	424	0.55	0.5521
	(b)	82	0.60	0.5996
	(c)	421	0.67	0.6690
	040 (a)	226	0.41	0.4092
	(b)	217	0.45	0.4492
	043	72	0.73	0.7275
	068	128	0.70	0.6987
Age Levels				
a. 11-13	040	226	0.41	0.4092
	068	128	0.70	0.6987
b. 14-16	022	424	0.55	0.5521
	022	421	0.67	0.6690
	031	3100	0.57	0.5741
	040	217	0.45	0.4492
	043	72	0.73	0.7275
c. 17-19	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	022	82	0.60	0.5996
	031	473	0.45	0.4497
	031	2822	0.59	0.5855

TABLE 81 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Levels				
7th Grade	040	226	0.41	0.4092
8th Grade	none			
9th Grade	022	421	0.67	0.6690
	040	217	0.45	0.4492
	043	72	0.73	0.7275
10th Grade	022	424	0.55	0.5521
	031	3100	0.57	0.5741
11th Grade	022	82	0.60	0.5996
	031	2822	0.59	0.5855
12th Grade	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	031	473	0.45	0.4497
7-9th Grades	040	226	0.41	0.4092
	022	421	0.67	0.6690
	040	217	0.45	0.4492
	043	72	0.73	0.7275
	068	128	0.70	0.6987
9-12 Grades	022	424	0.55	0.5521
	031	3100	0.57	0.5741
	022	82	0.60	0.5996
	031	2822	0.59	0.5855
	004 (a)	489	0.40	0.3984
	(b)	648	0.57	0.5722
	(c)	542	0.58	0.5836
	031	473	0.45	0.4497

TABLE 82

EFFECT SIZES: MATHEMATICS ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	064	261	0.67	0.6696
	069	143	0.09	0.0898
Book	none			
Dissertation	001	306	0.66	0.6614
	003	312	0.42	0.4192
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	011	195	0.49	0.4890
	016	154	0.30	0.2955
	017	499	0.31	0.3095
	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2747
	020	171	0.49	0.4890
	038	126	0.53	0.5291
Paper	none			

TABLE (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Length of Study</u>				
less 1 month	020	171	0.49	0.4890
1-3 months	none			
3-6 months	none			
more than 6 m.	038	126	0.53	0.5291
Status Study	001	306	0.66	0.6614
	003	312	0.42	0.4192
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	011	195	0.49	0.4890
	016	154	0.30	0.2955
	017	499	0.31	0.3095
	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2747
	064	261	0.67	0.6696
	069	143	0.09	0.0898

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	011	195	0.49	0.4890
	016	154	0.30	0.2955
Self-Selected	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2747
	069	143	0.09	0.0898
Intact Groups	020	171	0.49	0.4890
	038	126	0.53	0.5291
Representative	001	306	0.66	0.6614
	003	312	0.42	0.4192
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	064	261	0.67	0.6696
Other	017	499	0.31	0.3095

TABLE 82 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Type of Study					
Correlational	001		306	0.66	0.6614
	003		312	0.42	0.4192
	006	(a)	75	0.09	0.0893
		(b)	215	0.32	0.3192
		(c)	185	0.39	0.3870
		(d)	55	0.37	0.3710
	011		195	0.49	0.4890
	016		154	0.30	0.2955
	017		499	0.31	0.3095
	018	(a)	116	0.44	0.4345
		(b)	238	0.53	0.5291
		(c)	545	0.28	0.2747
	064		261	0.67	0.6696
	069		143	0.09	0.0898
Quasi-exper.	038		126	0.53	0.5291
Experimental	020		171	0.49	0.4890
Other	none				

TABLE 82 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	001		306	0.66	0.6614
	003		312	0.42	0.4192
	006	(a)	75	0.09	0.0893
		(b)	215	0.32	0.3192
		(c)	185	0.39	0.3870
		(d)	55	0.37	0.3710
	011		195	0.49	0.4890
	016		154	0.30	0.2955
	017		499	0.31	0.3095
	018	(a)	116	0.44	0.4345
		(b)	238	0.53	0.5291
		(c)	545	0.28	0.2747
	020		171	0.49	0.4890
	038		126	0.53	0.5291
	069		143	0.09	0.0898
High	064		261	0.67	0.6696
Design Rating					
Medium	001		306	0.66	0.6614
	003		312	0.42	0.4192
	006	(a)	75	0.09	0.0893
		(b)	215	0.32	0.3192
		(c)	185	0.39	0.3870
		(d)	55	0.37	0.3710
	011		195	0.49	0.4890
	016		154	0.30	0.2955
	017		499	0.31	0.3095
	018	(a)	116	0.44	0.4345
		(b)	238	0.53	0.5291
		(c)	545	0.28	0.2747
	020		171	0.49	0.4890
	038		126	0.53	0.5291
	064		261	0.67	0.6696
	069		143	0.09	0.0898
High	none				

TABLE 82 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Method of Calculating "r"					
r-value	001		306	0.66	0.6614
	003		312	0.42	0.4192
	006	(a)	75	0.09	0.0893
		(b)	215	0.32	0.3192
		(c)	185	0.39	0.3870
		(d)	55	0.37	0.3710
	011		195	0.49	0.4890
	016		154	0.30	0.2955
	017		499	0.31	0.3095
	018	(a)	116	0.44	0.4345
		(b)	238	0.53	0.5291
		(c)	545	0.28	0.2747
	020		171	0.49	0.4890
	038		126	0.53	0.5291
	064		261	0.67	0.6696
	069		143	0.09	0.0898
F-test	none				
t-test	none				
p-value	none				
d-value	none				

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	017	499	0.31	0.3095
	038	126	0.53	0.5291
	064	261	0.67	0.6696
Suburban	003	312	0.42	0.4192
	020	171	0.49	0.4890
Rural	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
Mixed	001	306	0.66	0.6614
	011	195	0.49	0.4890
	016	154	0.30	0.2955
	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2747
	069	143	0.09	0.0898

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	001	306	0.66	0.6614
	064	261	0.67	0.6696
Medium	003	312	0.42	0.4192
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	011	195	0.49	0.4890
	038	126	0.53	0.5291
High	016	154	0.30	0.2955
	017	499	0.31	0.3095
	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2747
	020	171	0.49	0.4890
Mixed	069	143	0.09	0.0898

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	006	55	0.37	0.3710
	017	499	0.31	0.3095
Chemistry	006	185	0.39	0.3870
	011	195	0.49	0.4890
	020	171	0.49	0.4890
	038	126	0.53	0.5291
	069	143	0.09	0.0898
Physics	003	312	0.42	0.4192
	006	75	0.09	0.0893
Earth Science	006	215	0.32	0.3192
Life Science	none			
General Science	001	306	0.66	0.6614
	016	154	0.30	0.2955
	018 (a)	116	0.44	0.4345
	(b)	238	0.53	0.5291
	(c)	545	0.28	0.2740
	064	261	0.67	0.6696

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	016	154	0.30	0.2955
b. 14-16	003	312	0.42	0.4192
	017	499	0.31	0.3095
	018	545	0.28	0.2747
	020	171	0.49	0.4890
	038	126	0.53	0.5291
	064	261	0.67	0.6696
c. 17-19	001	306	0.66	0.6614
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	011	195	0.49	0.4890
	018	238	0.53	0.5291
	018	116	0.44	0.4345
	069	143	0.09	0.0898

TABLE 82 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	016	154	0.30	0.2955
8th Grade	064	261	0.67	0.6696
9th Grade	017	499	0.31	0.3095
10th Grade	018	545	0.28	0.2747
11th Grade	018	238	0.53	0.5291
12th Grade	001	306	0.66	0.6614
	018	116	0.44	0.4345
	069	143	0.09	0.0898
7-9th Grades	016	154	0.30	0.2955
	064	261	0.67	0.6696
	017	499	0.31	0.3095
10-12 Grades	001	306	0.66	0.6614
	003	312	0.42	0.4192
	006 (a)	75	0.09	0.0893
	(b)	215	0.32	0.3192
	(c)	185	0.39	0.3870
	(d)	55	0.37	0.3710
	011	195	0.49	0.4890
	018	116	0.44	0.4345
	020	171	0.49	0.4890
	038	126	0.53	0.5291
	069	143	0.09	0.0898

TABLE 83

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	044	83	0.27	0.2679
Book	none			
Dissertation	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	0.7170
	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	030	65	0.68	0.6742
	033	2443	0.63	0.6298
Paper	none			
Length of Study				
Less 1 month	030	65	0.68	0.6742
	044	83	0.27	0.2679
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	0.7170
	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	033	2443	0.63	0.6298

TABLE 83 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	033	2443	0.63	0.6298
Self-Selected	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	C.7170
Intact Groups	030	65	0.68	0.6742
	044	83	0.27	0.2679
Representative	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
Other	none			
Type of Study				
Correlational	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	0.7170
	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	030	65	0.68	0.6742
	033	2443	0.63	0.6298
Quasi-exper.	none			
Experimental	none			
Other	044	83	0.27	0.2679

TABLE 83 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	019		185	0.72	0.7170
	030		65	0.68	0.6742
	033		2443	0.63	0.6298
	044		83	0.27	0.2679
High	004	(a)	478	0.30	0.2928
		(b)	541	0.42	0.4221
		(c)	648	0.45	0.4462
	022	(a)	424	0.53	0.5305
		(b)	421	0.67	0.6678
Design Rating					
Medium	019		185	0.72	0.7170
	044		83	0.27	0.2679
High	004	(a)	478	0.30	0.2928
		(b)	541	0.42	0.4221
		(c)	648	0.45	0.4462
	022	(a)	424	0.53	0.5305
		(b)	421	0.67	0.6678
	033		2443	0.63	0.6298
	030		65	0.68	0.6742

TABLE 83 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	0.7170
	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	030	65	0.68	0.6742
	033	2443	0.63	0.6298
	044	83	0.27	0.2679
F-test	none			
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban	none			
Suburban	019	185	0.72	0.7170
	030	65	0.68	0.6742
	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	044	83	0.27	0.2679
Rural	none			
Mixed	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	033	2443	0.63	0.6298

TABLE 83 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	none			
Medium	none			
High	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	030	65	0.68	0.6742
	044	83	0.27	0.2679
Mixed	019	185	0.72	0.7170
	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678
	033	2443	0.63	0.6298
Disciplinary Focus of the Study				
Biology	004	648	0.45	0.4462
	019	185	0.72	0.7170
	030	65	0.68	0.6742
Chemistry	004	541	0.42	0.4221
	044	83	0.27	0.2679
Physics	004	478	0.29	0.2928
	033	2443	0.63	0.6298
Earth Science	none			
Life Science	none			
General Science	022 (a)	424	0.53	0.5305
	(b)	421	0.67	0.6678

TABLE 83 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Age Levels</u>				
a. 11-13	030	65	0.78	0.6742
b. 14-16	019	185	0.72	0.7170
	022	421	0.67	0.6678
	022	424	0.53	0.5303
c. 17-19	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	033	2443	0.63	0.6298
	044	83	0.27	0.2679
<u>Grade Level</u>				
7th Grade	none			
8th Grade	030	65	0.78	0.6742
9th Grade	022	421	0.67	0.6678
10th Grade	019	185	0.72	0.7170
	022	424	0.53	0.5303
11th Grade	044	83	0.27	0.2679
12th Grade	004 (a)	478	0.30	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	033	2443	0.63	0.6298
7-9th Grades	022	421	0.67	0.6678
	030	65	0.68	0.6742
10-12 Grades	004 (a)	478	0.29	0.2928
	(b)	541	0.42	0.4221
	(c)	648	0.45	0.4462
	019	185	0.72	0.7170
	022	424	0.53	0.5305
	033	2443	0.63	0.6298
	044	83	0.27	0.2679

TABLE 84

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	042	140	0.39	0.3873
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	060	131	0.41	0.4085
Book	none			
Dissertation	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	038	126	0.41	0.4155
Paper	055	500	0.64	0.6346

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Length of Study				
less 1 month	015	84	0.47	0.4677
	020	171	0.30	0.2992
	030	65	0.54	0.5400
	044	83	0.48	0.4770
	053	84	0.22	0.2221
1-3 months	021	95	0.65	0.6480
3-6 months	none			
more than 6 m.	038	126	0.41	0.4155
Status Study	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	029	122	0.59	0.5894
	042	140	0.39	0.3873
	043	72	0.69	0.6874
	051	92	0.30	0.2984
	055	500	0.64	0.6346
	060	131	0.41	0.4085

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Assignment of Students</u>				
Random	011	195	0.42	0.4211
	016	170	0.13	0.1296
	0[illegible]1	95	0.65	0.6480
	042	140	0.39	0.3873
	051	92	0.30	0.2984
	053	84	0.22	0.2221
Self-Selected	029	122	0.59	0.5894
	043	72	0.69	0.6874
Intact Groups	020	171	0.30	0.2992
	030	65	0.54	0.5400
	038	126	0.41	0.4155
	044	83	0.48	0.4770
Representative	015	84	0.47	0.4677
	055	500	0.64	0.6346
	060	131	0.41	0.4085
Other	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	017	335	0.29	0.2868

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Type of Study				
Correlational	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	043	72	0.69	0.6874
	051	92	0.30	0.2984
	060	131	0.41	0.4085
Quasi-exper.	038	126	0.41	0.4155
Experimental	015	84	0.47	0.4677
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	042	140	0.39	0.3873
	053	84	0.22	0.2221
Other	044	83	0.48	0.4770
	055	500	0.64	0.6346

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	235	0.29	0.2868
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	038	126	0.41	0.4155
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	055	500	0.64	0.6346
High	042	140	0.39	0.3873
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	060	131	0.41	0.4085

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Design Rating				
Medium	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	038	126	0.41	0.4155
	042	140	0.39	0.3873
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	055	500	0.64	0.6346
	060	131	0.41	0.4085
High	none			

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	038	126	0.41	0.4155
	042	140	0.39	0.3873
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	060	131	0.41	0.4085
F-test	none			
t-test	none			
p-value	055	500	0.64	0.6346
d-value	none			

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	017	335	0.29	0.2868
	021	95	0.65	0.6480
	038	126	0.41	0.4155
Suburban	015	84	0.47	0.4677
	020	171	0.30	0.2992
	029	122	0.59	0.5894
	030	65	0.54	0.5400
	042	140	0.39	0.3873
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	060	131	0.41	0.4085
Rural	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
Mixed	011	195	0.42	0.4211
	016	170	0.13	0.1296
	055	500	0.64	0.6346

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	none			
Medium	011	195	0.42	0.4211
	015	84	0.47	0.4677
	038	126	0.41	0.4155
	042	140	0.39	0.3873
	051	92	0.30	0.2984
High	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	043	72	0.69	0.6874
	044	83	0.48	0.4770
	053	84	0.22	0.2221
	055	500	0.64	0.6346
	060	131	0.41	0.4085
Mixed	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	021	95	0.65	0.6480
	029	122	0.59	0.5894
	030	65	0.54	0.5400

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	017	335	0.29	0.2868
	021	95	0.65	0.6480
	030	65	0.54	0.5400
	051	92	0.30	0.2984
Chemistry	011	195	0.42	0.4211
	020	171	0.30	0.2992
	038	126	0.41	0.4155
	044	83	0.48	0.4770
	053	84	0.22	0.2221
Physics	015	84	0.47	0.4677
Earth Science	042	140	0.39	0.3873
Life Science	029	122	0.59	0.5894
	060	131	0.41	0.4085
General Science	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	016	170	0.13	0.1296
	043	72	0.69	0.6874
	055	500	0.64	0.6346

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	016	170	0.13	0.1296
	029	122	0.59	0.5894
	042	140	0.39	0.3873
	060	131	0.41	0.4085
b. 14-16	005 (a)	33	0.39	0.3808
	(b)	39	0.54	0.5360
	(c)	35	0.70	0.6947
	015	84	0.47	0.4677
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	021	95	0.65	0.6480
	030	65	0.54	0.5400
	038	126	0.41	0.4155
	043	72	0.69	0.6874
	051	92	0.30	0.2984
	053	84	0.22	0.2221
	055	500	0.64	0.6346
c. 17-19	011	195	0.42	0.4211
	044	83	0.48	0.4770

TABLE 84 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	005	39	0.54	0.5360
	016	170	0.13	0.1296
	029	122	0.59	0.5894
8th Grade	005	35	0.70	0.6947
	030	65	0.54	0.5400
	042	140	0.39	0.3873
9th Grade	005	33	0.39	0.3808
	015	84	0.47	0.4677
	017	335	0.29	0.2868
	021	95	0.65	0.6480
	043	72	0.69	0.6874
	051	92	0.30	0.2984
10th Grade	none			
11th Grade	044	83	0.48	0.4770
	053	84	0.22	0.2221
12th Grade	none			
7-9th Grades	005	39	0.54	0.5360
	016	170	0.13	0.1296
	029	122	0.59	0.5894
	005	35	0.70	0.6947
	030	65	0.54	0.5400
	042	140	0.39	0.3873
	005	33	0.39	0.3808
	015	84	0.47	0.4677
	017	335	0.29	0.2868
	021	95	0.65	0.6480
	043	72	0.69	0.6874
	051	92	0.30	0.2984
10-12 Grades	011	195	0.42	0.4211
	020	171	0.30	0.2992
	038	126	0.41	0.4155
	044	83	0.48	0.4770
	053	84	0.22	0.2221
	055	500	0.64	0.6346

TABLE 85

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' ATTITUDES TOWARD SCIENCE BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code		Sample Size	r	E.S.(r)
Form of Publication					
Journal	047		97	0.26	0.2587
Book	none				
Dissertation	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	010		321	0.36	0.3625
	013		4000	0.24	0.2419
	016		170	0.10	0.0997
	033		2443	0.33	0.3299
	038		126	0.28	0.2780
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
Paper	none				
Length of Study					
less 1 month	none				
1-3 months	none				
3-6 months	none				
more than 6 m.	038		126	0.28	0.2780
Status Study	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	010		321	0.36	0.3625
	013		4000	0.24	0.2419
	016		170	0.10	0.0997
	033		2443	0.33	0.3299
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
	047		97	0.26	0.2587

TABLE 85 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	016	170	0.10	0.0997
	033	2443	0.33	0.3299
Self-Selected	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	047	97	0.26	0.2587
Intact Groups	038	126	0.28	0.2780
Representative	none			
Other	040 (a)	226	0.17	0.1696
	(b)	217	0.19	0.1898
Type of Study				
Correlational	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	013	4000	0.24	0.2419
	016	170	0.10	0.0997
	033	2443	0.33	0.3299
	040 (a)	226	0.17	0.1696
	(b)	217	0.19	0.1898
Quasi-exper.	038	126	0.28	0.2780
Experimental	none			
Other	047	97	0.26	0.2587

TABLE 85 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	010		321	0.36	0.3625
	016		170	0.10	0.0997
	033		2443	0.33	0.3299
	038		126	0.28	0.2780
	047		97	0.26	0.2587
High	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	013		4000	0.24	0.2419
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
Design Rating					
Medium	010		321	0.36	0.3625
	016		170	0.10	0.0997
	038		126	0.28	0.2780
	047		97	0.26	0.2587
High	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	013		4000	0.24	0.2419
	033		2443	0.33	0.3299
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898

TABLE 85 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	013	4000	0.24	0.2419
	016	170	0.10	0.0997
	033	2443	0.33	0.3299
	038	126	0.28	0.2780
	040 (a)	226	0.17	0.1696
	(b)	217	0.19	0.1898
F-test	047	97	0.26	0.2587
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban	038	126	0.28	0.2780
	047	97	0.26	0.2587
Suburban	none			
Rural	none			
Mixed	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	013	4000	0.24	0.2419
	016	170	0.10	0.0997
	033	2443	0.33	0.3299
	040 (a)	226	0.17	0.1696
	(b)	217	0.19	0.1898

TABLE 85 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Socioeconomic Status					
Low	none				
Medium	010		321	0.36	0.3625
	013		4000	0.24	0.2419
	038		126	0.28	0.2780
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
	047		97	0.26	0.2587
High	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	016		170	0.10	0.0997
Mixed	033		2443	0.33	0.3299
Disciplinary Focus of the Study					
Biology	004		644	0.28	0.2757
Chemistry	004		540	0.18	0.1831
	038		126	0.28	0.2780
Physics	004		488	0.11	0.1107
	010		321	0.36	0.3625
	033		2443	0.33	0.3299
Earth Science	none				
Life Science	none				
General Science	013		4000	0.24	0.2419
	016		170	0.10	0.0997
	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
	047		97	0.26	0.2587

TABLE 85 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	016	170	0.10	0.0997
	040	226	0.17	0.1696
	047	97	0.26	0.2587
b. 14-16	013	4000	0.24	0.2419
	040	217	0.19	0.1898
c. 17-19	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	033	2443	0.33	0.3299
	038	126	0.28	0.2780
Grade Level				
7th Grade	016	170	0.10	0.0997
	040	226	0.17	0.1696
8th Grade	047	97	0.26	0.2587
9th Grade	040	217	0.19	0.1898
10th Grade	none			
11th Grade	none			
12th Grade	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
7-9th Grades	013	4000	0.24	0.2419
10-12 Grades	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	010	321	0.36	0.3625
	033	2443	0.33	0.3299
	038	126	0.28	0.2780

TABLE 86

EFFECT SIZES: SCIENCE ABILITY RELATIONSHIPS WITH STUDENTS' ATTITUDES TOWARD SCIENCE LEARNING BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	049	1504	0.20	0.1958
	062	550	0.16	0.1550
Book	none			
Dissertation	003	312	0.35	0.3495
	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	032	2719	0.15	0.1469
	033	2443	0.34	0.3349
	039	168	0.14	0.1439
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
Paper	none			

TABLE 86 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Length of Study					
Less 1 month	039		168	0.14	0.1439
1-3 months	none				
3-6 months	none				
more than 6 m.	none				
Status Study	003		312	0.35	0.3495
	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	008		1958	0.35	0.3499
	019		185	0.36	0.3586
	023		1450	0.20	0.2039
	032		2719	0.15	0.1469
	033		2443	0.34	0.3349
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499
	049		1504	0.20	0.1958
	062		550	0.16	0.1550
Assignment of Students					
Random	033		2443	0.34	0.3349
Self-Selected	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	019		185	0.36	0.3586
	039		168	0.14	0.1439
	049		1504	0.20	0.1958
	062		550	0.16	0.1550
Intact Groups	none				
Representative	008		1958	0.35	0.3499
	023		1450	0.20	0.2039
Other	032		2719	0.15	0.1469
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499

TABLE 86 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Type of Study					
Correlational	003		312	0.35	0.3495
	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	008		1958	0.35	0.3499
	019		185	0.36	0.3586
	023		1450	0.20	0.2039
	032		2719	0.15	0.1469
	033		2443	0.34	0.3349
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499
	049		1504	0.20	0.1958
Quasi-exper.	039		168	0.14	0.1439
Experimental	062		550	0.16	0.1550
Other	none				
Rated Internal Validity					
Medium	003		312	0.35	0.3495
	019		185	0.36	0.3586
	023		1450	0.20	0.2039
	033		2443	0.34	0.3349
	039		168	0.14	0.1439
	049		1504	0.20	0.1958
High	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	008		1958	0.35	0.3499
	032		2719	0.15	0.1469
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499
	062		550	0.16	0.1550

TABLE 86 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Design Rating				
Medium	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	033	2443	0.34	0.3349
	039	168	0.14	0.1439
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
High	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	032	2719	0.15	0.1469
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
Method of Calculating "r"				
r-value	003	312	0.35	0.3495
	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	032	2719	0.15	0.1469
	033	2443	0.34	0.3349
	039	168	0.14	0.1439
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
F-test	none			
t-test	none			
p-value	none			
d-value	none			

TABLE 86 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	none			
Suburban	003	312	0.35	0.3495
	019	185	0.36	0.3586
	049	1504	0.20	0.1958
Rural	none			
Mixed	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	023	1450	0.20	0.2039
	032	2719	0.15	0.1469
	033	2443	0.34	0.3349
	039	168	0.14	0.1439
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	062	550	0.16	0.1550
Socioeconomic Status				
Low	049	1504	0.20	0.1958
Medium	003	312	0.35	0.3495
	023	1450	0.20	0.2039
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
High	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	062	550	0.16	0.1550
Mixed	008	1958	0.35	0.3499
	019	185	0.36	0.3586
	032	2719	0.15	0.1469
	039	168	0.14	0.1439
	033	2443	0.34	0.3349

TABLE 86 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	004	644	0.26	0.2637
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
Chemistry	004	540	0.11	0.1087
Physics	004	488	0.14	0.1436
	032	2719	0.15	0.1469
	033	2443	0.34	0.3349
Earth Science	039	168	0.14	0.1439
Life Science	none			
General Science	008	1958	0.35	0.3499
	032	2719	0.15	0.1469
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
Age Levels				
a. 11-13	039	168	0.14	0.1439
b. 14-16	003	312	0.35	0.3495
	008	1958	0.35	0.3499
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	032	2719	0.15	0.1469
	040	226	0.12	0.1198
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
c. 17-19	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	033	2443	0.34	0.3349
	040	217	0.05	0.0499

TABLE 86 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Grade Level					
7th Grade	039		168	0.14	0.1439
	040		226	0.12	0.1198
8th Grade	none				
9th Grade	008		1958	0.35	0.3499
	032		2719	0.15	0.1469
	040		217	0.05	0.0499
10th Grade	003		312	0.35	0.3495
	019		185	0.36	0.3586
	023		1450	0.20	0.2039
11th Grade	062		550	0.16	0.1550
12th Grade	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	032		2719	0.15	0.1469
	033		2443	0.34	0.3349
7-9th Grades	039		168	0.14	0.1439
	040		226	0.12	0.1198
	008		1958	0.35	0.3499
	032		2719	0.15	0.1469
	040		217	0.05	0.0499
	039		168	0.14	0.1439
10-12 Grades	003		312	0.35	0.3495
	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	019		185	0.36	0.3586
	023		1450	0.20	0.2039
	032		2719	0.15	0.1469
	033		2443	0.34	0.3349
	049		1504	0.20	0.1958
	062		550	0.16	0.1550

TABLE 87

EFFECT SIZES: GENERAL ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	068	128	0.74	0.7386
Book	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
Dissertation	019	185	0.50	0.5012
	024	152	0.64	0.6456
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
Paper	none			
Length of Study				
Less 1 month	none			
1-3 months	none			
3-6 months	024	152	0.64	0.6456
More than 6 m.	none			
Status Study	019	185	0.50	0.5012
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386

TABLE 87 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	068	128	0.74	0.7386
Self-Selected	019	185	0.50	0.5012
	024	152	0.64	0.6456
Intact Groups	none			
Representative	027	8479	0.42	0.4193
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
Type of Study				
Correlational	019	185	0.50	0.5012
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386
Quasi-exper.	none			
Experimental	024	152	0.64	0.6456

TABLE 87 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	185	0.50	0.5012
	024	152	0.64	0.6456
High	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386
Design Rating				
Medium	019	185	0.50	0.5012
	024	152	0.64	0.6456
High	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386

TABLE 87 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	019	185	0.50	0.5012
	024	152	0.64	0.6456
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386
F-test	none			
t-test	none			
p-value	none			
d-value				
Community Type				
Urban	none			
Suburban	019	185	0.50	0.5012
	024	152	0.64	0.6456
	068	128	0.74	0.7386
Rural	none			
Mixed	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398

TABLE 87 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	024	152	0.64	0.6456
Medium	068	128	0.74	0.7386
High	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
Mixed	019	185	0.50	0.5012
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
Disciplinary Focus of the Study				
Biology	019	185	0.50	0.5012
	031	3100	0.38	0.3760
Chemistry	024	152	0.64	0.6456
	031	2822	0.37	0.3748
Physics	031	473	0.22	0.2198
Earth Science				
Life Science				
General Science	027	8479	0.42	0.4193
	058	2520	0.45	0.4498
	059	1729	0.54	0.5398
	068	128	0.74	0.7386

TABLE 87 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	none			
b. 14-16	019	185	0.50	0.5012
	024	152	0.64	0.6456
	031	3100	0.38	0.3760
	058	2520	0.45	0.4498
	068	128	0.74	0.7386
c. 17-19	027	8479	0.42	0.4193
	031	2822	0.37	0.3748
	031	473	0.22	0.2198
	059	1729	0.54	0.5398
Grade Levels				
7th Grade	none			
8th Grade	none			
9th Grade	024	152	0.65	0.6456
	058	2520	0.45	0.4498
10th Grade	019	185	0.50	0.5012
	031	3100	0.38	0.3760
11th Grade	031	2822	0.37	0.3748
12th Grade	027	8479	0.42	0.4193
	031	473	0.22	0.2198
	059	1729	0.54	0.5398
7-9th Grades	024	152	0.65	0.6456
	058	252C	0.45	0.4498
	068	128	0.74	0.7386
10-12 Grades	019	185	0.50	0.5012
	027	8479	0.42	0.4193
	031 (a)	473	0.22	0.2198
	(b)	2822	0.37	0.3748
	(c)	3100	0.38	0.3760
	059	1729	0.54	0.5398

TABLE 88

EFFECT SIZES: GENERAL ABILITY RELATIONSHIPS WITH STUDENTS' COGNITIVE REASONING BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	044	83	0.18	0.1780
	050	120	0.19	0.1890
	051	92	0.56	0.5578
Book	none			
Dissertation	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	029	122	0.72	0.7206
Paper	none			
<u>Length of Study</u>				
less 1 month	020	171	0.15	0.1528
	044	83	0.18	0.1780
1-3 months	021	95	0.56	0.5578
3-6 months	none			
more than 6 m.	none			
Status Study	017	351	0.76	0.7595
	029	122	0.72	0.7206
	050	120	0.19	0.1890
	051	92	0.56	0.5578

TABLE 88 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Assignment of Students</u>				
Random	021	95	0.56	0.5578
	051	92	0.56	0.5578
Self-Selected	029	122	0.72	0.7206
Intact Groups	020	171	0.15	0.1528
	044	83	0.18	0.1780
Representative	none			
Other	017	351	0.76	0.7595
	050	120	0.19	0.1890
<u>Type of Study</u>				
Co relational	017	351	0.76	0.7595
	029	122	0.72	0.7206
	050	120	0.19	0.1890
	051	92	0.56	0.5578
Quasi-exper.	none			
Experimental	020	171	0.15	0.1528
	021	95	0.56	0.5578
Other	044	83	0.18	0.1780

TABLE 88 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Rated Internal Validity</u>				
Medium	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	029	122	0.72	0.7206
	044	83	0.18	0.1780
	050	120	0.19	0.1890
High	051	92	0.56	0.5578
<u>Design Rating</u>				
Medium	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	029	122	0.72	0.7206
	044	83	0.18	0.1780
	050	120	0.19	0.1890
	051	92	0.56	0.5578
High	none			

TABLE 88 (cont.)

Study Variable	Study Code	Sample Size	r	E.(r)
Method of Calculating "r"				
r-value	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	029	122	0.72	0.7206
	044	83	0.18	0.1780
	050	120	0.19	0.1890
	051	92	0.56	0.5578
F-test	none			
t-test	none			
p value	none			
Other	none			
Community Type				
Urban	017	351	0.76	0.7595
	021	95	0.56	0.5578
	050	120	0.19	0.1890
Suburban	020	171	0.15	0.1528
	029	122	0.72	0.7206
	044	83	0.18	0.1780
	051	92	0.56	0.5578
Rural	none			
Mixed	none			

TABLE 88 (cont.)

Study Variable	Study Code	Sample Size	r	E.(r)
<u>Socioeconomic Status</u>				
Low	none			
Medium	051	92	0.56	0.5578
High	017	351	0.76	0.7595
	020	171	0.15	0.1528
	029	122	0.72	0.7206
	044	83	0.18	0.1780
	050	120	0.19	0.1890
Mixed	021	95	0.56	0.5578
<u>Disciplinary Focus of the Study</u>				
Biology	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	044	83	0.18	0.1780
	051	92	0.56	0.5578
Chemistry	none			
Physics	none			
Earth Science	none			
Life Science	029	122	0.72	0.7206
General Science	050	120	0.19	0.1890

TABLE 88 (cont.)

Study Variable	Study Code	Sample Size	r	E.(r)
Age Levels				
a. 11-13	029	122	0.72	0.7206
	050	120	0.19	0.1890
b. 14-16	017	351	0.76	0.7595
	020	171	0.15	0.1528
	021	95	0.56	0.5578
	051	92	0.56	0.5578
c. 17-19	044	83	0.18	0.1780
Grade Level				
7th Grade	029	122	0.72	0.7206
	050	120	0.19	0.1890
8th Grade	none			
9th Grade	017	351	0.76	0.7595
	021	95	0.56	0.5578
	051	92	0.56	0.5578
10th Grade	none			
11th Grade	044	83	0.18	0.1780
12th Grade	none			
7-9th Grades	017	351	0.76	0.7595
	021	95	0.56	0.5578
	029	122	0.72	0.7206
	050	120	0.19	0.1890
	051	92	0.56	0.5578
10-12 Grades	044	83	0.18	0.1780
	020	171	0.15	0.1528

TABLE 89

EFFECT SIZES: COGNITIVE REASONING ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	042	140	0.39	0.3873
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	053	84	0.22	0.2221
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
	074	725	0.55	0.5470
Book	none			
Dissertation	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	021	95	0.65	0.6480
	030	65	0.39	0.3834
Paper	055	500	0.64	0.6346

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Length of Study				
less 1 month	030	65	0.39	0.3834
	044	83	0.48	0.4778
	053	84	0.22	0.2221
1-3 months	021	95	0.65	0.6480
3-6 months	none			
more than 6 m.	none			
Status Study	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	042	140	0.39	0.3873
	043	72	0.69	0.6875
	055	500	0.64	0.6346
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
	074	725	0.55	0.5470

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	021	95	0.65	0.6480
	042	140	0.39	0.3873
	053	84	0.22	0.2221
Self-Selected	043	72	0.69	0.6875
	066	71	0.66	0.6600
	074	725	0.55	0.5470
Intact Groups	030	65	0.39	0.3834
	044	83	0.48	0.4778
Representative	055	500	0.64	0.6346
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
Other	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
Type of Study				
Correlational	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	030	65	0.39	0.3834
	043	72	0.69	0.6875
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
Quasi-exper.	none			
Experimental	021	95	0.65	0.6480
	042	140	0.39	0.3873
	053	84	0.22	0.2221
	074	725	0.55	0.5470
Other	044	83	0.48	0.4778
	055	500	0.64	0.6346

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	021	95	0.65	0.6480
	030	65	0.39	0.3834
	042	140	0.39	0.3873
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	055	500	0.64	0.6346
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
High	042	140	0.39	0.3873
	053	84	0.22	0.2221
	066	71	0.66	0.6600
	074	725	0.55	0.5470
Design Rating				
Medium	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	021	95	0.65	0.6480
	030	65	0.39	0.3834
	042	140	0.39	0.3873
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	053	84	0.22	0.2221
	055	500	0.64	0.6346
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
High	074	725	0.55	0.5470

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	021	95	0.65	0.6480
	030	65	0.39	0.3834
	042	140	0.39	0.3873
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	053	84	0.22	0.2221
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
F-test	none			
t-test	none			
p-value	055	500	0.64	0.6346
d-value	074	725	0.55	0.5470
Community Type				
Urban	021	95	0.65	0.6480
Suburban	074	725	0.55	0.5470
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	030	65	0.39	0.3834
	042	140	0.39	0.3873
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	053	84	0.22	0.2221
	066	71	0.66	0.6600
Rural	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
Mixed	055	500	0.64	0.6346

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	none			
Medium	042	140	0.39	0.3873
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
	066	71	0.66	0.6600
High	030	65	0.39	0.3834
	043	72	0.69	0.6875
	044	83	0.48	0.4778
	053	84	0.22	0.2221
	055	500	0.64	0.6346
	074	725	0.55	0.5470
Mixed	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	021	95	0.65	0.6480
Disciplinary Focus of the Study				
Biology	021	95	0.65	0.6480
	030	65	0.39	0.3834
	065 (a)	152	0.61	0.6086
	(b)	44	0.71	0.7053
Chemistry	044	83	0.48	0.4778
	053	84	0.22	0.2221
	066	71	0.66	0.6600
	074	725	0.55	0.5470
Physics	none			
Earth Science	042	140	0.39	0.3873
Life Science	none			
General Science	005 (a)	39	0.54	0.5360
	(b)	35	0.70	0.6947
	(c)	33	0.39	0.3808
	043	72	0.69	0.6875
	055	500	0.64	0.6346

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Age Levels</u>				
a. 11-13	005	39	0.54	0.5360
	005	35	0.70	0.6947
	042	140	0.39	0.3873
b. 14-16	005	33	0.39	0.3808
	021	95	0.65	0.6480
	043	72	0.69	0.6875
	065 (a)	152	0.61	0.6086
	(b)	44	0.71	0.7053
c. 17-19	053	84	0.22	0.2221
	055	500	0.64	0.6346
	066	71	0.66	0.6600
	044	83	0.48	0.4778
	074	725	0.55	0.5470

TABLE 89 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	005	39	0.54	0.5360
8th Grade	005	35	0.70	0.6947
	030	65	0.39	0.3834
	042	140	0.39	0.3873
9th Grade	005	33	0.39	0.3808
	021	95	0.65	0.6480
	043	72	0.69	0.6875
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
10th Grade	none			
11th Grade	044	83	0.48	0.4778
	053	84	0.22	0.2221
	066	71	0.66	0.6600
	074	725	0.55	0.5470
12th Grade	none			
7-9th Grades	005	39	0.54	0.5360
	005	35	0.70	0.6947
	030	65	0.39	0.3834
	042	140	0.39	0.3873
	005	33	0.39	0.3808
	021	95	0.65	0.6480
	043	72	0.69	0.6875
	065 (a)	44	0.71	0.7053
	(b)	152	0.61	0.6086
9-12 Grades	044	83	0.48	0.4778
	053	84	0.22	0.2221
	055	500	0.64	0.6346
	074	725	0.55	0.5470

TABLE 90

EFFECT SIZES: COGNITIVE REASONING ABILITY RELATIONSHIPS WITH STUDENTS' SCIENCE GRADES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	051	92	0.30	0.2985
Book	none			
Dissertation	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(b)	55	0.27	0.2628
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	029	112	0.59	0.5894
	038	126	0.42	0.4158
Paper	none			
Length of Study				
less 1 month	015	84	0.47	0.4677
	020	171	0.30	0.2992
1-3 months	none			
3-6 months	none			
more than 6 m.	038	126	0.42	0.4158
Status Study	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(b)	55	0.27	0.2628
	011	195	0.42	0.4211
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	029	112	0.59	0.5894
	051	92	0.30	0.2985
	063	101	0.51	0.5087

TABLE 90 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	011	195	0.42	0.4211
	016	170	0.13	0.1296
	051	92	0.30	0.2985
Self-Selected	029	112	0.59	0.5894
Intact Groups	020	171	0.30	0.2992
	038	126	0.42	0.4158
Representative	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(b)	55	0.27	0.2628
	015	84	0.47	0.4677
	063	101	0.51	0.5087
Other	017	335	0.29	0.2868
Type of Study				
Correlational	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(b)	55	0.27	0.2628
	011	195	0.42	0.4211
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	029	112	0.59	0.5894
	051	92	0.30	0.2985
	063	101	0.51	0.5087
Quasi-exper.	038	126	0.42	0.4158
Experimental	015	84	0.47	0.4677
	020	171	0.30	0.2992
Other	none			

TABLE 90 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	006	(a)	215	0.24	0.2404
		(b)	185	0.26	0.2575
		(b)	55	0.27	0.2628
	011		195	0.42	0.4211
	015		84	0.47	0.4677
	016		170	0.13	0.1296
	017		335	0.29	0.2868
	020		171	0.30	0.2992
	029		112	0.59	0.5894
	038		126	0.42	0.4158
High	051		92	0.30	0.2985
	063		101	0.51	0.5087
Design Rating					
Medium	006	(a)	215	0.24	0.2404
		(b)	185	0.26	0.2575
		(b)	55	0.27	0.2628
	011		195	0.42	0.4211
	015		84	0.47	0.4677
	016		170	0.13	0.1296
	017		335	0.29	0.2868
	020		171	0.30	0.2992
	029		112	0.59	0.5894
	038		126	0.42	0.4158
	051		92	0.30	0.2985
High	063		101	0.51	0.5087

TABLE 90 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	029	112	0.59	0.5894
	038	126	0.42	0.4158
	051	92	0.30	0.2985
	063	101	0.51	0.5087
F-test	none			
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban	017	335	0.29	0.2868
	038	126	0.42	0.4158
Suburban	015	84	0.47	0.4677
	020	171	0.30	0.2992
	029	112	0.59	0.5894
	051	92	0.30	0.2985
Rural	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
	063	101	0.51	0.5087
Mixed	011	195	0.42	0.4211
	016	170	0.13	0.1296

TABLE 90 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	063	101	0.51	0.5087
Medium	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
	011	195	0.42	0.4211
	015	84	0.47	0.4677
	038	126	0.42	0.4158
	051	92	0.30	0.2985
High	016	170	0.13	0.1296
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	029	112	0.59	0.5894
Mixed	none			
Disciplinary Focus of the Study				
Biology	006	55	0.27	0.2628
	017	335	0.29	0.2868
	051	92	0.30	0.2985
Chemistry	006	185	0.26	0.2575
	011	195	0.42	0.4211
	020	171	0.30	0.2992
	038	126	0.42	0.4158
Physics	015	84	0.47	0.4677
Earth Science	006	215	0.24	0.2404
Life Science	029	112	0.59	0.5894
General Science	016	170	0.13	0.1296
	063	101	0.51	0.5087

TABLE 90 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	016	170	0.13	0.1296
	029	112	0.59	0.5894
b. 14-16	015	84	0.47	0.4677
	017	335	0.29	0.2868
	020	171	0.30	0.2992
	038	126	0.42	0.4158
	051	92	0.30	0.2985
c. 17-19	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
	011	195	0.42	0.4211
	063	101	0.51	0.5087

TABLE 90 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	016	170	0.13	0.1296
	029	112	0.59	0.5894
8th Grade	none			
9th Grade	015	84	0.47	0.4677
	017	335	0.29	0.2868
	051	92	0.30	0.2985
10th Grade	none			
11th Grade	none			
12th Grade	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
7-9th Grades	016	170	0.13	0.1296
	029	112	0.59	0.5894
	015	84	0.47	0.4677
	017	335	0.29	0.2868
	051	92	0.30	0.2985
9-12 Grades	006 (a)	215	0.24	0.2404
	(b)	185	0.26	0.2575
	(c)	55	0.27	0.2628
	011	195	0.42	0.4211
	020	171	0.30	0.2992
	038	126	0.42	0.4158
	063	101	0.51	0.5087

TABLE 91

EFFECT SIZES: ATTITUDES TOWARD SCIENCE RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Form of Publication</u>				
Journal	068	128	0.30	0.2989
Book	059	1729	0.11	0.1099
Dissertation	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
Paper	none			
<u>Length of Study</u>				
less 1 month	none			
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
	059	1729	0.11	0.1099
	068	128	0.30	0.2989

TABLE 91 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	033	2443	0.33	0.3299
	068	128	0.30	0.2989
Self-Selected	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
Intact Groups	none			
Representative	059	1729	0.11	0.1099
Other	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
Type of Study				
Correlational	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
	059	1729	0.11	0.1099
	068	128	0.30	0.2989
Quasi-exper.	none			
Experimental	none			
Other	none			

TABLE 91 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Rated Internal Validity					
Medium	033		2443	0.33	0.3299
High	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	040	(a)	217	0.19	0.1898
		(b)	226	0.17	0.1696
	059		1729	0.11	0.1099
	068		128	0.30	0.2989
Design Rating					
Medium	none				
High	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	033		2443	0.33	0.3299
	040	(a)	217	0.19	0.1898
		(b)	226	0.17	0.1696
	059		1729	0.11	0.1099
	068		128	0.30	0.2989

TABLE 91 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
	059	1729	0.11	0.1099
	068	128	0.30	0.2989
F-test	none			
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban				
Suburban	068	128	0.30	0.2989
Rural	none			
Mixed	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	033	2443	0.33	0.3299
	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
	059	1729	0.11	0.1099

TABLE 91 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Socioeconomic Status</u>				
Low	none			
Medium	040 (a)	217	0.19	0.1898
	(b)	226	0.17	0.1696
	068	128	0.30	0.2989
High	004 (a)	488	0.11	0.1107
	(b)	540	0.18	0.1831
	(c)	644	0.28	0.2757
	059	1729	0.11	0.1099
Mixed	033	2443	0.33	0.3299
<u>Disciplinary Focus of the Study</u>				
Biology	004	644	0.28	0.2757
Chemistry	004	540	0.18	0.1831
Physics	004	488	0.11	0.1107
	033	2443	0.33	0.3299
Earth Science	none			
Life Science	none			
General Science	040 (a)	217	0.19	0.1899
	(b)	226	0.17	0.1697
	059	1729	0.11	0.1099
	068	128	0.30	0.2989

TABLE 91 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Age Levels					
a. 11-13	040		226	0.17	0.1696
b. 14-16	040		217	0.19	0.1898
	068		128	0.30	0.2989
c. 17-19	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	033		2443	0.33	0.3299
	059		1729	0.11	0.1099
Grade Level					
7th Grade	040		226	0.17	0.1696
8th Grade	none				
9th Grade	040		217	0.19	0.1898
10th Grade	none				
11th Grade	none				
12th Grade	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	033		2443	0.33	0.3299
	059		1729	0.11	0.1099
7-9th Grades	040	(a)	226	0.17	0.1696
		(b)	217	0.19	0.1898
10-12 Grades	004	(a)	488	0.11	0.1107
		(b)	540	0.18	0.1831
		(c)	644	0.28	0.2757
	033		2443	0.33	0.3299
	059		1729	0.11	0.1099
	068		128	0.30	0.2989

TABLE 92

EFFECT SIZES: ATTITUDES TOWARD SCIENCE LEARNING RELATIONSHIPS WITH STUDENTS' SCIENCE TEST SCORES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	none			
Book	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499
Dissertation	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	019	150	0.30	0.3027
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	033	2443	0.23	0.2249
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
Paper	none			

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Length of Study				
Less 1 month	none			
1-3 months	none			
3-6 months	none			
More than 6 m.	none			
Status Study	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	019	150	0.30	0.3027
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	033	2443	0.23	0.2249
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499

TABLE 92 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Assignment of Students					
Random	031	(a)	2822	0.10	0.0993
		(b)	3258	0.10	0.1034
		(c)	3100	0.16	0.1575
	033		2443	0.23	0.2249
Self-Selected	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	019		150	0.30	0.3027
Intact Groups	none				
Representative	008		1958	0.35	0.3499
	057	(a)	2520	0.23	0.2298
		(b)	1729	0.35	0.3499
Other	032	(a)	2719	0.15	0.1469
		(b)	606	0.30	0.2998
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Type of Study</u>				
Correlational	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	019	150	0.30	0.3027
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	306	0.30	0.2998
	033	2443	0.23	0.2249
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499
Quasi-exper.	none			
Experimental	none			
Other	none			

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Rated Internal Validity				
Medium	019	150	0.30	0.3027
	033	2443	0.23	0.2249
High	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499
Design Rating				
Medium	019	150	0.30	0.3027
High	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	008	1958	0.35	0.3499
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	033	2443	0.23	0.2249
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499

TABLE 92 (cont.)

Study Variable	Study Code		Sample Size	r	E.S.(r)
Method of Calculating "r"					
r-value	004	(a)	540	0.11	0.1087
		(b)	488	0.14	0.1436
		(c)	644	0.26	0.2637
	008		1958	0.35	0.3499
	019		150	0.30	0.3027
	031	(a)	2822	0.10	0.0993
		(b)	3258	0.10	0.1034
		(c)	3100	0.16	0.1575
	032	(a)	2719	0.15	0.1469
		(b)	606	0.30	0.2998
	033		2443	0.23	0.2249
	040	(a)	226	0.12	0.1198
		(b)	217	0.05	0.0499
	057	(a)	2520	0.23	0.2298
		(b)	1729	0.35	0.3499
F-test	none				
t-test	none				
p value	none				
d-value	none				

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Community Type				
Urban	none			
Suburban	019	150	0.30	0.3027
Rural	none			
Mixed	008	1958	0.35	0.3499
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	033	2443	0.23	0.2249
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499
Socioeconomic Status				
Low	none			
Medium	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
High	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499
Mixed	008	1958	0.35	0.3499
	019	150	0.30	0.3027
	031 (a)	2822	0.10	0.0993
	(b)	3258	0.10	0.1034
	(c)	3100	0.16	0.1575
	032 (a)	2719	0.15	0.1469
	(b)	606	0.30	0.2998
	033	2443	0.23	0.2249

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Disciplinary Focus of the Study				
Biology	004	644	0.26	0.2637
	019	150	0.30	0.3027
	031	3100	0.16	0.1575
Chemistry	004	540	0.11	0.1087
	031	2822	0.10	0.0993
Physics	004	488	0.14	0.1436
	031	3258	0.10	0.1034
	032	2719	0.15	0.1469
	033	2443	0.23	0.2249
Earth Science	none			
Life Science	none			
General Science	008	1958	0.35	0.3499
	032	606	0.30	0.2998
	040 (a)	226	0.12	0.1198
	(b)	217	0.05	0.0499
	057 (a)	2520	0.23	0.2298
	(b)	1729	0.35	0.3499

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	040	226	0.12	0.1198
b. 14-16	008	1958	0.35	0.3499
	019	150	0.30	0.3027
	040	217	0.05	0.0499
	031	3100	0.16	0.1575
	032	606	0.30	0.2998
	057	2520	0.23	0.2298
c. 17-19	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	031	3258	0.10	0.1034
	031	2822	0.10	0.0993
	032	2719	0.15	0.1469
	033	2443	0.23	0.2249
	057	1729	0.35	0.3499

TABLE 92 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Grade Level				
7th Grade	040	226	0.12	0.1198
8th Grade	none			
9th Grade	008	1958	0.35	0.3499
	040	217	0.05	0.0499
	032	606	0.30	0.2998
	057	2520	0.23	0.2298
10th Grade	019	150	0.30	0.3027
	031	3100	0.16	0.1575
11th Grade	031	2822	0.10	0.0993
12th Grade	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	031	3258	0.10	0.1034
	032	2719	0.15	0.1469
	033	2443	0.23	0.2249
	057	1729	0.35	0.3499
7-9th Grades	008	1958	0.35	0.3499
	032	606	0.30	0.2998
	040 (a)	217	0.05	0.0499
	(b)	226	0.12	0.1198
	057	2520	0.23	0.2298
9-12 Grades	019	150	0.30	0.3027
	004 (a)	540	0.11	0.1087
	(b)	488	0.14	0.1436
	(c)	644	0.26	0.2637
	031 (a)	3258	0.10	0.1034
	(b)	3100	0.16	0.1575
	(c)	2822	0.10	0.0993
	032	2719	0.15	0.1469
	033	2443	0.23	0.2249
	057	1729	0.35	0.3499

TABLE 93

EFFECT SIZES: ATTITUDES TOWARD SCIENCE LEARNING RELATIONSHIPS WITH STUDENTS' GRADES BROKEN DOWN BY METHODOLOGICAL VARIABLES

Study Variable	Study Code	Sample Size	r	E.S.(r)
Form of Publication				
Journal	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495
Book	none			
Dissertation	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	039	168	0.14	0.1439
Paper	none			
Length of Study				
Less 1 month	039	168	0.14	0.1439
1-3 months	none			
3-6 months	none			
more than 6 m.	none			
Status Study	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495

TABLE 93 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Assignment of Students				
Random	none			
Self-Selected	019	185	0.36	0.3586
	039	168	0.14	0.1439
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
Intact Groups	none			
Representative	003	312	0.35	0.3495
	023	1450	0.20	0.2039
	064	261	0.45	0.4495
Other	none			
Type of Study				
Correlational	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	049	1504	0.20	0.1958
	064	261	0.45	0.4495
Quasi-exper.	039	168	0.14	0.1439
Experimental	062	550	0.16	0.1550
Other	none			

TABLE 93 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
<u>Rated Internal Validity</u>				
Medium	003	312	0.35	0.3495
	019	185	0.13	0.1286
	023	1450	0.20	0.2039
	039	168	0.14	0.1439
	049	1504	0.20	0.1958
High	062	550	0.16	0.1550
	064	261	0.45	0.4495
<u>Design Rating</u>				
Medium	003	312	0.35	0.3495
	019	185	0.13	0.1286
	023	1450	0.20	0.2039
	039	168	0.14	0.1439
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495
High	none			

TABLE 93 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Method of Calculating "r"				
r-value	003	312	0.35	0.3495
	019	185	0.13	0.1286
	023	1450	0.20	0.2039
	039	168	0.14	0.1439
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495
F-test	none			
t-test	none			
p-value	none			
d-value	none			
Community Type				
Urban	064	261	0.45	0.4495
Suburban	003	312	0.35	0.3495
	019	185	0.36	0.3586
	049	1504	0.20	0.1958
Rural	none			
Mixed	023	1450	0.20	0.2039
	039	168	0.14	0.1439
	062	550	0.16	0.1550

TABLE 93 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Socioeconomic Status				
Low	049	1504	0.20	0.1958
	064	261	0.45	0.4495
Medium	003	312	0.35	0.3495
	023	1450	0.20	0.2039
High	062	550	0.16	0.1550
Mixed	019	185	0.36	0.3586
	039	168	0.14	0.1439
Disciplinary Focus of the Study				
Biology	019	185	0.36	0.3586
	023	1450	0.20	0.2039
Chemistry	none			
Physics	003	312	0.35	0.3495
Earth Science	039	168	0.14	0.1439
Life Science	none			
General Science	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495

TABLE 93 (cont.)

Study Variable	Study Code	Sample Size	r	E.S.(r)
Age Levels				
a. 11-13	039	168	0.14	0.1439
b. 14-16	003	312	0.35	0.3495
	019	185	0.13	0.1286
	023	1450	0.20	0.2039
	049	1504	0.20	0.1958
	062	550	0.16	0.1550
	064	261	0.45	0.4495
c. 17-19	none			
Grade Level				
7th Grade	039	168	0.14	0.1439
8th Grade	064	261	0.45	0.4495
9th Grade	none			
10th Grade	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
11th Grade	062	550	0.16	0.1550
12th Grade	none			
7-9th Grades	039	168	0.14	0.1439
	064	261	0.45	0.4495
10-12 Grades	003	312	0.35	0.3495
	019	185	0.36	0.3586
	023	1450	0.20	0.2039
	049	1504	0.20	0.1958
	062	550	0.16	0.1550