

A META-ANALYSIS OF RESEARCHES ON SECONDARY SCHOOL STUDENTS' ATTITUDE TO AND ACHIEVEMENT IN SCIENCE SUBJECTS

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Abstract

Results from studies on secondary school students' attitude to science subjects are varied and there is a need to aggregate their outcomes and identify its direction. A meta-analysis of studies on Nigerian secondary school students' attitude to science subjects was carried out to find out whether they generally have positive or negative attitude to science subjects. Gender influences on students' attitude and relationship existing between their attitude to and achievement in science subjects were also studied. Out of 78 published research reports as well as supervised dissertations and theses on attitude to and achievement in science subjects reviewed, the survey method was adopted to purposively sample 18 research reports. These summarized and meta-analyzed with the use of percentage, t-test and Pearson Product Moment correlation coefficients to answer the three research questions raised. It was found that more than 50% of Nigerian secondary school students have negative attitude to science subjects while a greater percentage of male students demonstrated positive attitude to these subjects than their female counterparts. The results also revealed a mean Pearson's correlation coefficient of 0.71 between respondents' attitude to and achievement in science subjects. Based on these findings, it was recommended that teachers should demonstrate greater resourcefulness in science teaching while parents and teachers should be encouraged to be more aware of the importance of the attitude of students toward science subjects with the aim of promoting positive attitude.

Key words: Meta-analysis, students' attitude, science achievement

Introduction

Science and technology occupy the front burner in countries that are interested in development. It is therefore imperative for any nation intending to keep abreast with global trends in technological advancement to promote excellence in science education. Developing nations need to give a greater attention to science education if they must overcome their many problems and gain recognition from other developed countries. Ogunleye (1999) stated that effective living in this modern age of science and technology requires that every child be given the opportunity to acquire basic scientific knowledge. The Nigerian Federal Government in its National Policy on Education specified the objectives of science education to ensure that the country is not left behind in the quest for technological advancement and economic development (FRN, 2004).

Despite the implementation of the policy on science education and the huge resources committed to this enterprise in the school system, the nation has witnessed recurring poor performance at the senior secondary school level. Funds, human inputs like staff and students as well as material inputs such as textbooks, laboratories, workshops and instructional materials could account for students' performance. A significant amount of research in science education is

devoted to understanding ways we can improve quality of science education and increase students' achievement. Avoaja (1999) observed that no matter how good the material and financial resources committed to the teaching and learning processes may be, the attitude of secondary school students as a human input to science subjects could determine the extent of success of curriculum implementation. Akinyemi (2001) also stated that students' attitude to science is a potent factor in their learning of science and should thus constitute a major focus in the effort to improve their achievement. George (2006) also observed that, the key factors in learning science is students' attitudes and the development of positive attitudes toward science can motivate students' interest in science subject.

Studies linking attitudes of secondary school students to science subjects with their achievement have been documented in Nigeria. These include Ali (1983), Ato (1984), Odubunmi and Balogun (1985), Adebola (1990), Maduabum (1993), Catabis (1995), Mankhilic and Agbo (2001), Ahiakwo, (2002) and Yara (2009) among others. The general direction of research is that positive attitude of students support their learning of science subjects. Tekbiyik, Birinci Konur and Pirasa (2008) carried out a meta-analysis of 17 studies on the effectiveness of Computer Assisted Instruction on students' attitudes towards science courses in Turkey. From the 23 effect sizes analyzed, it was found that exposure to computer assisted instruction moved students' attitude to science up from the 50th to the 75th percentile.

The study carried out by Willson (1983) on science achievement and attitude featured no Nigerian case in the meta-analysis. Apart from this, thirty years' time lag warrants a survey of the direction of more current meta-analytic studies. Studies like that by Muhammad and Hafiz (2012) also support positive relationship between attitude to science and achievement. Though these studies also established relationship between students' attitude to science subjects and their gender, there is need to look at research findings on difference in their attitude to science subjects due to grade level, age, school type and future aspiration. Review of literature has also pointed out that direction of findings from many studies could be carried out by the use of meta-analysis.

Elvik, Amunden and Hofset (2001) stated that a meta-analysis helps to summarize scholarly research while Glass, McGraw and Smith (1981) defined meta-analysis as the analysis of analyses. It refers to the statistical analysis of a number of analyzed results from individual studies for the purpose of integrating the findings. In the process of conducting a meta-analysis, a researcher computed the averages of the results of the selected studies to get an overall index. Vockell and Asher (1995) stated that researchers who do a meta-analysis attempt to remedy the shortcomings of any particular study by statistically combining the results of several studies that were conducted on the same topic. A meta-analysis typically involves the same steps as primary research as follows:

- (i) The first step for the meta-analyst is to define the purpose of the review to be done. This is done by having a clear stated framework of practical or theoretical questions to guide the studies to be selected and the data collection exercise.
- (ii) Secondly, the process of sampling which is the application of specified procedures to locate studies that meet specified criteria for inclusion. Most of the time, meta-analyses involve making comprehensive reviews of relevant studies.
- (iii) The third step is the data collection process which could be done in two ways. This could be done by coding the study features according to the objectives of the review and transforming outcomes into a common index so that they can be compared. The typical index in educational research is the effect size often considered as the standardized difference between treatment and control group means in experimental studies (Glass, McGraw and Smith, 1981).

The following meta-analytic approaches are found in literature:

- (a) Vote-counting (Hunter and Schmidt, 2001).
- (b) Classical or Glassian meta-analysis (Glass, 1980).

- (c) Effect size (Glass, 1980).
- (d) Variations of the basic method (Hunter and Schmidt, 2001).
- (e) Test of homogeneity (Kulik and Kulik, 2000).
- (f) Psychometric meta-analysis (Hunter and Schmidt, 2001).

The purpose of this study is to statistically analyse the results of eighteen (18) studies that were carried out on attitude of Nigerian secondary school students to science subjects with the view to identify general direction of research outcomes, determine the influence of gender on their attitude and find out whether a correlation exist between students' attitude and their achievement in science subjects.

Research Questions

Data were gathered to answer the following research questions:

- (i) What is the direction of research outcomes on the attitude of Nigerian secondary school students toward the study of science subjects?
- (ii) Are there gender differences in the outcomes of research on attitude of Nigerian secondary school students to science subjects?
- (iii) What correlations were established by outcomes of research between secondary school students' attitude and their achievement in science subjects?

Methodology

The survey research method was adopted for this study. As a result of the fact that the study is meta-analytic, attempt was made to ensure a comprehensive review of studies on students' attitude to science subjects was carried out. As noted by Elvik et al (2001), a meta-analysis could only be considered valid if all the subsets of its population are represented.

The population of this study consisted of 78 published articles in academic and professional journals and unpublished higher degree dissertations and theses across Universities in Nigeria on attitude of Nigerian secondary school students to science subjects. As revealed through literature review, most studies reported students' performance in science subjects but few were on their attitudes. Therefore 18 of the research reports accessed by the researchers that focused on students' attitude to and achievement science subjects were purposively selected for this study.

The method used by White (1979), Cooper (1984) and Adeleke (1988) for summarizing data which were analyzed with the technique developed by Glass (1981) as reported in Elvik et al (2001). This technique analyses relationship between study characteristics and outcomes, and transforms reported statistics in the required unit into quantitative research using such statistics as percentage, t-test and Pearson's Product Moment Correlation coefficient.

Results

Research Question One: *What is the direction of research outcomes on the attitude of Nigerian secondary school students toward science subjects?*

Out of the 18 studies purposively selected due to their focus on attitude to and achievement in science subject, only five came up with results indicating the percentage of secondary school students demonstrating positive or negative attitude to science subjects. Only one of the studies indicated that students had neutral attitude to science. A summary of percentage of students demonstrating positive and negative attitude to science subjects including Mathematics, Biology, Physics and Chemistry was made and the results are presented in Table 1.

Table 1: Secondary School Students' Attitude to Science Subjects

Study	Locale	Year	Sample Size	% with Positive Attitude	% with Negative Attitude	% Neutral.
1.	Benue	1983	430	32.7	67.30	0
2.	Lagos	1974	315	45.7	54.3	0
3.	Ibadan	1976	141	60.25	18.8	20.95
4.	Ibadan	1976	94	62.0	38.0	0
5.	Enugu	1983	910	28.2	71.8	0
Grand mean				45.7	50.04	4.19

Table 1 shows the summary of the percentage of secondary school students that demonstrated positive and negative attitude to science subjects. Across the studies, 45.7% of secondary school students had positive attitude to science subjects while 50.04% had a negative attitude and 4.19% were neutral in their attitude. A larger percentage of secondary school students could therefore be said to be negative in their attitude to science subjects.

Research Question Two: *Are there gender differences in the outcomes of research on attitude of Nigerian secondary school students to science subjects?*

Seven studies used the t-test to establish whether significant differences existed between male and female secondary school students' attitude to science subjects. The results obtained by them were summarized on Table 2.

Table 2: Gender Differences in Students Attitude to Science Subjects

Study	Locale	Year	Sample Size	Calculated Value of t	Remark
6	Enugu	1985	1,430	3.875	$P > 0.05$ (N.S)
7	Calabar	2005	353	-5.393	$P < 0.05$ (s) *
8	Lagos	1983	154	0.95	$P < 0.05$ (s) *
9	Lagos	2004	180	-0.68	$P < 0.05$ (s) +
10	Ilorin	1990	200	0.6078	$P < 0.05$ (s) +
11	Anambra	1993	1,200	1.36	$P < 0.05$ (s) +
12	Taraba	1983	550	1.623	$P < 0.05$ (s) +
Grand mean				0.3347	

+ Male students had positive attitude than female.

* Female students had positive attitude than male.

Table 2 shows the results from the test for difference between male and female secondary school students' attitude to science from studies that used t-test for their analysis. An overall mean t-value of 0.3347 was obtained. Though five of the six studies established significant difference between male and female secondary school students' attitude to science subjects, only four of the studies indicated that the male students demonstrated significantly positive attitude while two indicated that female students demonstrated significantly positive attitude.

Table 3: Distribution of Students' Attitude to Science subjects by Gender

Study	Locale	Year	Sample Size	% of male with positive attitude	% of male with negative attitude	% of female with positive attitude	% of female with negative attitude
1.	Benue	1983	430	40.8	59.2	58.2	41.8
2.	Lagos	1974	315	49.8	50.2	50.2	49.8
3.	Ibadan	1976	141	62.93	37.07	37.07	62.93
5.	Enugu	1983	910	73.24	26.76	26.76	73.24
Grand mean				56.69	43.31	43.06	56.94

Table 3 shows the percentage of male and female secondary school students with positive attitude to science subjects. With an overall percentages of 56.6% and 43.06% of male and female secondary school students respectively showing positive attitude to science subjects, it could be concluded from the review of these studies that more male students demonstrated positive attitude to science subjects compared to their female counterparts.

Research Question Three: *What correlations were established by outcomes of research between secondary school students' attitude and their achievement in science subjects?*

Eight studies correlated students' attitude to science subjects with their achievement. These are summarized on Table 4.

Table 4: Relationship between attitude and students' achievement in science

Study	Locale	Year	Sample Size	Correlation Coefficient	Remark
13.	Umuahia	1995	60	0.64	S
14.	Ilorin	1984	300	0.23	N.S
15.	Southern & Northern Nig.	1996	2,400	0.84	S
16.	Ibadan	1998	280	0.74	S
11.	Anambra	1993	1,200	0.81	S
12.	Gongola	1983	550	0.64	S
17.	Lagos	1997	620	0.78	S
18.	Cross River	1986	200	0.90	S
Grand mean				0.71	

S: Significant

NS: Not significant

Data on Table 4 revealed a mean correlation coefficient of 0.71 seven of the studies reported significant relationship between students' attitude to science subjects and their achievement in them.

Discussion

Results from this meta-analysis indicate that a greater percentage of Nigerian secondary school students demonstrate negative attitude to science subjects. Five studies presented percentage distributions of students with positive and negative attitudes to science subjects with only 2 of these showing that those with positive attitude were more than 60% of their selected respondents. On the other hand, 3 studies came with findings of a higher proportion of students with negative attitude to science subjects. This agrees with findings by Olarewaju (1976) and Odunusi (1984). The observation in these studies that secondary school students have negative attitude to science subjects and especially in Mathematics could be due to the generally held view that only very brilliant students could offer the subjects and do well. With many schools lacking qualified teachers and other resources that could enhance teaching and learning of

science subjects, there is the tendency that students could develop negative attitude to these subjects.

The findings also revealed that there was a significant difference in the attitude of male and female secondary school students to science subjects. Seven studies used the t-test for their analysis for establishing whether significant differences existed between the male and female and female secondary school students' attitude to science subjects. Only six (6) of these found significant differences and four of these showed that male students tends to demonstrate positive attitude than their female counterparts, while the remaining two (2) studies showed that female students tends to be more positive. Four of other studies used the frequency distribution to indicate the proportion of male and female secondary school students with positive and negative attitude to science subjects. The grand mean indicated that a higher proportion 56.69 percent of male students had positive attitude to science subjects than their female counterparts. Anna (1983), Ato (1984) and Weinburge (2005) reported significant difference in the attitude of male and female secondary school students to science subjects with more males having positive attitude than females. Majority of the teachers of science subjects in senior secondary schools are males. This may increase the motivational level of male students and lead to their cultivation of positive attitude to science subjects.

Eight studies on relationship between secondary school students' achievement in and attitude to science subjects revealed a general high and significant correlation between the two variables with a mean correlation coefficient of 0.71. In a similar vein, Willson (1983), and Steinkamp and Machr (1983) found significant relationship between attitude to and achievement in science subjects. It could be observed that attitude is a good predictor of senior secondary school students' academic performance in science subjects.

Conclusion

The studies that focus on students' attitude to science subjects at the senior secondary school level are few in spite of the importance of this variable and the strong relationship it has with achievement. From this meta-analysis, it could be concluded from the studies reviewed that Nigerian secondary school students generally have negative attitude to science subjects, a greater percentage of male secondary school students have positive attitude to science subjects than female students, and a significant relationship exists between secondary school students' attitude and their achievement in science subject.

Recommendations

In the light of the findings of this study, it is recommended that concerted efforts should be made to encourage parents and teachers to be more aware of the attitude of students toward science subjects. They should also make conscious effort to create a conducive home and school environment for students to cultivate positive attitude to science subjects.

Teachers of different science subjects particularly need to be more resourceful in their roles which should be used to help students to cultivate positive attitude to their subjects. Resources that could help achieve this should also be available either through improvisation by teacher, use of access to Education Resources Center (ERC) in each state or provision by school authorities for the teaching and learning of the sciences.

Whatever predisposes senior secondary schools to gender inequality should be checked and all categories of students should be motivated to have more interest in science subjects. Involvement of female students should be improved and their motivation level boosted through scholarship and guidance and services.

The studies reviewed were essentially survey in their design due to the dearth of experimental studies on students' attitude to science subjects at the senior secondary school level. There is need to give attention to this so that cause and effect relationship could be established between attitude, achievement and other key variables that are relevant to learning.

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