

Gender and Developmental Differences in Attitudes toward Science between Grade 7 and Grade 9 Pupils

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Abstract

This study aimed at investigating gender differences in attitudes toward science in Ghanaian schools. It also attempted to study developmental differences in attitudes toward science between pupils when they were in grade 7 and when they got to grade 9 two years after. A stratified random sample (N=248) was obtained and studied using gender and grade level variables as independent ones and the attitude to science as the dependent variable. T-test was employed in data analysis at 0.05 level of significance. The results reflected clearly that female pupils in both grade 7 and grade 9 expressed positive attitude toward science. However, male pupils in both grade 7 and grade 9 expressed higher positive attitude toward science than the female pupils. Regarding whether there were developmental differences in attitude toward science between the pupils when they were in grade 7 and when they got to grade 9, the findings indicated no significant differences. The fact that the females expressed positive attitudes toward science is an indication that when classroom environments are made conducive to both boys and girls, and girls are frequently exposed to women role models, more girls will take up to study science at the higher levels.

Keywords

Introduction

In recent times, gender differences toward science have received much attention. A large number of articles in journals and periodicals, books and other resources have been published on attitudes of pupils from grades 7 to 9 towards science. In a study conducted by Tamir (1987), the result indicated that boys have more positive attitudes towards science, achieve better, and have a higher preference for physics and chemistry. However, other studies have found negative attitudes of girls to science. For example, Hadden (1982) investigated the attitudes of primary and secondary Scottish students toward science. His results revealed negative attitudes of girls toward science. Scottish girls believe that science is a male discipline. In contrast, boys possess positive attitudes towards science and positive expectations of science in relation to job prospects.

In Ghana, Mensah (2004) in a study of the factors that influence Junior Secondary School students' decision to study science in Senior Secondary School in the Central Region of Ghana found that girls' lack of interest to study science at the higher level was due to parental influences, especially their mothers. Hofstein and Ben Zvi (1985) compared the attitudes of eighth and eleventh grade, boys and girls toward science. The data showed no differences in attitudes to science at both grade levels. However, boys attitudes were more positive, than girls, regarding extra-curricular activities, interest in studying science, and choice of science career.

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The influence of family was a primary consideration in students' attitudes about the confidence in their ability to do science (Hembree, 1990; Tobias, 1993). This would point to a real value in deliberately involving families in what is happening in the classroom and identifying quality ways that family members can be involved with the content and processes promoted in science programs. Some suggestions for involving family members are:

1. Develop Family Science session (Heil, Amorose, Gurnee, & Harrison, 1999).
2. Invite parents in direct classroom involvement with students in the classroom activities, in field trips, and in special projects, such as science project competition or science quiz competitions (Hembree, 1990)
3. Use regular newsletter and e-mail communications to inform parents about what their child is learning, how the content is being used, why teaching strategies may differ from previous strategies, and ways to support and encourage their child's interest in the content areas (Hembree, 1990; Tobias, 1993)
4. Invite family members into the classroom to discuss their careers in science, or how they use science in their careers (Heil, Amorose, Gurnee, & Harrison, 1999). This is also an opportunity for students to see family members as role models for learning science.

Studies conducted to assess students' predisposition toward science and mathematics using their autobiographical accounts captured anxieties and internalized messages (positive and negative) affecting their attitudes and confidence to engage in mathematics and science, developed through influences of teachers, classmates and family (Hembree, 1990; Tobias, 1993). They also described the impact of perceived relevance of content, how content was presented, how content was valued by adults, and how they were treated as learners as affecting their attitudes and success with these subjects (Bulmahn & Young, 1982; Jackson & Leffingwell, 1999).

The results of the autobiographical studies not only identified attitudes but they also provided in-depth reasons for these attitudes and for transitions in attitudes and confidence, as described by some students. Study findings also demonstrated that students' attitudes and confidence are being affected at all levels, from elementary to college, and that praise or blame for student attitudes and confidence level cannot be placed at the doorstep of any one level of education. It is quite clear from the autobiographical accounts that an individual teacher has the opportunity to change student perceptions about and confidence in learning science or mathematics. It is also clear that students can carry attitudes over time and, in the case of negative attitudes, can make learning choices based solely on avoidance of a particular subject unless that attitude or confidence level is counteracted by a successful experience. It is the responsibility of educators at all levels to assess their practice in order to

provide an environment that challenges and nurtures the learner, particularly as it relates to the study of science.

Entwistle and Duckworth (1977) acknowledged the importance of teachers in affecting students' attitudes to subjects in guiding the process of choices. Ormerod and Duckworth (1975) documented a large number of researchers that have found that the attitude of the teacher toward science did affect the attitudes of the pupils. Efficiency, style, and personality of science teachers, they claim, could in a variety of ways influence the attitudes of students toward science.

Matyas (1987) argued that elementary students of both sexes like science, and hope to study science. Starting grade nine onward, boys express slightly more positive science attitudes and greater interest in studying science and in choosing a science career. Other studies have also confirmed the notion that girls have less confidence in their science abilities, and are less likely to participate in extracurricular science activities (Stake, 1984).

Women scientist role models have been found to be effective in changing girls' attitudes toward science and scientists when used in intervention programmes (Evans, Whigham & Wang, 1995; Huber & Burton, 1995; Humphreys, 1982; Schmidt & Nixon, 1996). For example, 73% of participants in science career conferences said that contact with role models was the most important part of the programme (Humphreys, 1982). An intervention project found that female role models were effective in changing the attitudes of ninth-grade male and female students toward science, mathematics, and technical careers (Evans, Whigham & Wang, 1995).

Theoretical Framework

Attitudes are judgments which are developed on the ABC (affective, behaviour and cognition) model (Loewenstein, 2007). The affective response is an emotional response that expresses an individual's degree of preference for an entity. The behavioural intention is a verbal indication or typical behavioural tendency of an individual. The cognitive response is a cognitive evaluation of the entity that constitutes an individual's beliefs about the object (Loewenstein, 2007). Most attitudes are the results of either direct experience or observational learning from the environment.

Attitudes are positive or negative views of a person, place, thing or event – this is often referred to as the attitude object (Crano & Prislin, 2006). People can also be conflicted or ambivalent toward an object, meaning that they simultaneously possess both positive and negative attitudes toward the item in question (Crano & Prislin, 2006).

This study attempted to investigate gender differences in attitudes toward science. It also attempted to study developmental differences in attitudes toward science between pupils when they were in grade 7 and when they got to grade 9, in Central Region of Ghana. Specifically the study was intended to seek answers to the following questions:

- (a) Is there a significant difference in attitudes toward science between girls and boys in grade 7?
- (b) Is there a significant difference in attitudes toward science between girls and boys in grade 9?
- (c) Is there a significant developmental difference in attitudes toward science between pupils when they are in grade 7 and when they get to grade 9 ?

Method

Participants

Two hundred and forty - eight grade 7 pupils took part in the study. These were made up 122 boys and 126 girls. Subjects were purposively and randomly selected from grade 7 pupils from two male schools and grade 7 pupils from two female schools in Cape Coast Municipality in Central Region of Ghana. The age range of the pupils was between 12.9 years and 15.8 years when they were in grade 7.

Research Design

This study utilized panel design to collect data for the study. This design studies the same individuals at different times (Vogt, 1998, p. 205). The major variables were gender, grade level and attitude toward science.

Instrument

To obtain information about the attitudes of pupils towards science when they were in grade 7 and when they got grade 9, a survey instrument, adapted from attitude scale developed by Fennema-Sherman (1986) was used to gather pupils' responses to 48 items. The instrument reliability was determined using the Cronbach alpha formula and gave a value of 0.83. Since the alpha value was more than 0.70, the instrument was considered reliable for data collection and the purposes of this study.

Procedure

Data for the study were collected at two different times. The first set of data was collected on March 20, 2008 when the pupils were in grade 7 and the second set was collected on March 19, 2010 when the pupils got to grade 9. After receiving permission from the head of the schools to conduct the study, the questionnaire was distributed to the students during regular class sessions. Participants were instructed to fill in the information required (sex and grade level) and to read each item carefully, and then to respond to the five-point attitude scale. In each school, the questionnaire took less than 30 minutes to complete. All the participants in each class completed the survey.

Results

Grade 7 male and female pupils on attitudinal difference toward science

Two hundred and forty-eight (248) grade 7 pupils responded to the test items. The result is presented in Table 1 which shows means, standard deviations, and t-value for test of significance at 0.05 level between grade 7 males and females scores.

Table 1 Independent means t-test results between grade 7 male and female pupils on attitudinal difference toward science

Sex of pupils	N	Mean	SD	t	P value
Male	122	168.35	23.08	3.71*	.000
Female	126	160.62	23.20		

*p <.05

Table 1 shows that the results of the independent means t-test analysis indicated significant difference in attitude toward science between the two groups of pupils as a function of sex, $t(246) = 3.71, p < .05$. The male students scored significantly higher than the female students on the attitude scale.

Since the attitude scale consisted of 48 items with five points each, then the neutral attitude score was 144. T-test was used to test the difference between females' mean score (160.62) and the neutral score. T-value (23.52) was found to be highly significant. This means that grade 7 female pupils expressed positive attitudes toward science. However, one can say that boys expressed higher positive attitudes toward science. This result confirmed the findings of Hofstein and Ben Zvi (1985) which stated that boys attitudes were more positive than girls', regarding extra-curricular activities, interest in studying science, and choice of science career. The findings could be attributed to various reasons.

Firstly, most parents in Ghana, especially the mothers, believe that science and science – related programmes take longer time to complete as compared to non science programmes, and when pursued by girls could delay their marriage and even their childbirth (Mensah, 2004). Mothers therefore encourage or persuade their daughters to do courses that would lead them to non – science programmes in the areas such as administration, secretarial duties, literature, philosophy and humanities (Mensah, 2004). Secondly, most girls believe that pursuing science in Senior Secondary School would lead one to study what they term 'male related' professions such as engineering, architecture, building technology in higher institution which have nothing to do with their future profession such as administration and secretarial duties. Thirdly, most girls still believe that science is a male discipline and that boys can study science better than girls (Crano & Prislin, 2006).

Grade 9 male and female pupils on attitudinal difference toward science

Two hundred and forty-eight (248) grade 9 pupils responded to the 48 – item survey in order to provide information on their attitudes toward science. The result is presented in Table 2, which shows means, standard deviations and t-value for the test of significance at .05 level between grade 9 male and female pupils scores.

Table 2 Independent means t-test results between grade 9 male and female pupils on attitudinal difference toward science

Sex of pupils	N	Mean	SD	t	P value
Male	N	Mean	SD	2.97*	.021
Female	125	169.02	24.52		

*p<.05

Table 2 reveals that the results of the independent means t-test analysis indicated significant difference between male and female grade 9 pupils in their attitudes toward science, $t(246) = 2.97, p < .05$. Grade 9 male pupils scored significantly higher than their female counterpart on the attitude scale. T-test was used to test the difference between females mean score (160.86) and the neutral score (144). T-value (23.78) was found to be highly significant. This means that grade 9 female pupils expressed positive attitudes toward science. However, one can say that grade 9 male students expressed higher positive attitudes toward science. This result confirmed that of Hofstein and Ben Zvi (1985).

Grade 7 and grade 9 pupils on attitudinal difference toward science

Two hundred and forty-eight pupils, when they were in grade 7 and when they were in grade 9, responded to the 48 item survey. The results, showing means, standard deviations and t-value for test of significance at .05 level between the scores of the two grades, is presented in Table 3.

Table 3 Independent means t-test results between grade 7 and grade 9 pupils on attitudinal difference toward science

Grade level	N	Mean	SD	t	P value
Grade 7	248	163.26	23.21	0.65	.528
Grade 9	248	163.97	23.52		

Table 3 indicated that the mean scores for the pupils when they were in grade 7 (163.26) and when they got to grade 9 (163.97) were very close. Hence, there was no significant difference between the grade 7 pupils' and grade 9 pupils' attitudes toward science, $t(494) = .65, p = .53$.

This result is similar to that of Hofstein and Ben Zvi (1985) concerning the attitudes of eighth and eleventh grades toward various aspect of science. However, this finding is inconsistent with the findings of Matyas (1987) that, starting ninth grade onward, boys express more positive attitudes toward science.

Discussion

Strictly speaking, the findings of the first two analyses (gender differences in attitudes toward science, for grade 7 and grade 9 pupils) were interesting in that, although boys expressed higher attitudes to science, girls possessed positive attitudes toward science in both grade 7 and grade 9. Apart from biological differences, gender differences in attitudes toward science are shaped by social, cultural and parental determinants (Mensah, 2004).

With regard to the third analysis, concerning the absence of developmental differences between grade 7 and grade 9 pupils in their attitudes toward science, the finding was unexpected. This is because of the notion that attitudes are embodied in socio-cultural factors and are subjected to variations with physical and cognitive development, especially at the critical stage of adolescence which characterize grade 9 pupils. However, the non-significant developmental differences in attitudes toward science between grade 7 and grade 9 pupils imply that the development of attitudes toward science is a complex function of cultural, biological, psychological, educational and social factors.

Conclusion and recommendations

It is evident from the study that, on the whole, male students in both grade 7 and grade 9 expressed higher attitudes toward science than their female counterparts. However, female students in both grade 7 and grade 9 also possessed positive attitudes toward science.

Since the development of attitudes toward science is a complex function of cultural, biological, psychological, educational and social factors, it is recommended that an integrated approach should be adopted for investigating gender and developmental differences in attitudes toward science. Again, it is recommended that a national sample should be used for future research to give a national picture of both gender and developmental attitudes toward science. Finally, the fact that the females expressed positive attitudes toward science, it is recommended that when classroom environments are made conducive to both boys and girls, and girls are frequently exposed to women role models, more girls will take up to study science at the higher levels.

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