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Abstract

The purpose of this study was to examine the relation between the attitudes and components of attitude of the students towards algebra with their algebra achievements. The population for this study consists of all government tenth grade students and their mathematics teachers in Addis Ababa city administration. Sixteen tenth grade sections were selected from Addis Ababa secondary schools using multistage sampling and all students and mathematics teachers in the selected sections are considered. There were weak relationships between algebra achievement and each of the five components of attitudes including the attitude in algebra. The contribution of all components of attitude in algebra collectively significantly affected (but low) the achievement of students in algebra. The contribution of confidence was significant on the variable algebra achievement, but the other components usefulness, Enjoyment, subject is perceived as a male domain and teacher expectations were not significant on the variable algebra achievement. The highest contribution for the knowledge, comprehension and application parts of achievement of algebra was by confidence.

Key words: Attitude, Components attitude, Achievement, Algebra.
Relation between Tenth Grade Students’ Attitude and Components of Attitude in Algebra with Algebra Achievement of Addis Ababa Secondary Schools, Ethiopia

Introduction

The study investigated the relationship between the attitude of a sample of grade ten students towards geometry and their achievement in geometry. A great concern amongst Ethiopian mathematics educationists were the poor performance of students in geometry. Similarly, despite its importance, mathematics seemed to be an unpopular subject among most of Ethiopian students. Five dimensions of attitude namely: students’ confidence about the performance in geometry, students’ belief on the usefulness of geometry, the degree of students enjoying working geometry, the beliefs of students on ability and performance on gender bases in geometry, the beliefs and expectations of teachers have on the students’ ability and performance in geometry.

Several studies have shown that positive attitudes are conducive to good performance (Schreiber, 2000). A number of researchers have demonstrated that there is a significant correlation between attitude and achievement (Papanastasiou, 2002). However it cannot be concluded that positive attitude always causes high achievement in mathematics. For example, Kiely (1990) showed that on average a small number of pupils who were not good enough in mathematics obtained high scores in the attitude test. Another study suggested that extremely positive or negative attitudes tend to predict mathematics achievement better than more neutral attitudes (Bergeson, Fitton, & Bylsma, 2000). Alrwais (2000) examined the relationship among the factors students’ attitude toward learning mathematics, students’
mathematical creativity and students’ school grades and their effect on achievement in mathematics. He found out that the best predictor was the students’ attitude toward learning mathematics. Ghanbarzadeh (2001) and Scott (2001) have reported that although there is a relation between attitude and achievement, this relation should not be considered definite. Hence, being merely aware of an individual’s attitude towards a subject is a week predictor of his subsequent performance (Ghanbarzadeh, 2001; Ibe, 1994). Accordingly, several researchers have reported no relation between attitude and achievement.

Abu-Hilal (2000) found that students’ perceptions regarding the importance of mathematics exerted a significant effect on achievement and that mathematics achievement then increased self-concept. Bandura (1997, p. 215) concluded, “Students may perform poorly either because they lack the skills or because they have the skills but lack the perceived personal efficacy to make optimal use of them.” Pajares and Graham (1999) found that mathematics self-efficacy was significantly associated with the achievement of middle school students.

In studies of mathematically gifted United States 13- and 14-year-old students, girls believe more strongly in the gender-neutrality of mathematics than do boys (Fox et al., 1985). Similar findings are reported for samples of Sydney youth (Phillips, 1979) and for United States high school students (Fennema & Sherman, 1977). Males, more than females, perceive mathematics as an appropriate activity for males by stereotyping mathematics as a male domain (Fennema, 1977).

Student's prior achievement had the strongest direct effect on mathematics achievement (Ibe, 1994; Bandura, 1997). Prior achievement has a significant indirect effect on mathematics achievement, influencing not only students' participation in mathematics learning, but also
their confidence in understanding mathematical concepts and time spent on mathematics homework (Ibe, 1994). However, the mathematics ability may not, by themselves, serve as sufficient predictors of mathematics achievement (Rhodes, 1992).

**Statement of the Problem**

Developing countries of the world, in their attempts to achieve modernity and promote industrialization, have placed a heavy emphasis on science based education. This emphasis, they hope, will instill in their young favorable attitudes toward the use of science. This fact is particularly true in the teaching of mathematics—the foundation for general scientific advancement. Frequently, in functioning under severe economic and personnel constraints, where educational equity within a nation is improbable, decisions must be made as to the allocation of educational resources in order to ensure an efficient nurturing of human scientific potential. In such situations, a paramount decision is just which particular subpopulations would supply the most attractive returns for the educational investment. The main questions being asked in this study were:

1) Is there a relationship between the attitude and components of attitude of tenth grade students in algebra with their achievement in algebra?

2) Is the contribution of each of the components of attitude of students in algebra on the achievement of students in algebra significant?

**Hypothesis**

In order to answer the research questions the following hypothesis was used; that is, the study tests the following hypothesis; where the null hypothesis was:
H₀[1]: There is no correlation between the attitudes and components of attitude of tenth grade students in algebra with their achievements in algebra.

H₀[2]: There is no significant difference in the contribution of each of the variables the attitudes and components of attitude of tenth grade students in algebra on their achievements in algebra.

As shown above, the hypotheses were defined in the null form. They would be tested at the level of significance α = 0.05.

**Sampling Method and Participants**

Sixteen tenth grade sections were selected from twenty two Addis Ababa secondary schools using multistage sampling. That is, out of ten sub cities eight sub cities were selected randomly by cluster sampling; one school is selected from each of the selected sub cities randomly using cluster sampling. Since the students were arranged or assigned in their sections randomly without any discrimination, then two sections were selected from grade ten sections of each selected schools by using cluster sampling. The researcher considered all students and mathematics teachers in the selected sections. The participants of the study were 632 students and 8 teachers where all are the members of the above selected schools and selected sections.

**Instruments**

Algebra attitude scale, algebra achievement test, closed-ended questionnaire, interview questions and document were used for this study. The algebra attitude scale was used to assess the tenth grade students' attitude towards algebra. The Fennema-Sherman Mathematics Attitude Scales which was prepared by Fennema and Sherman and it was modified to algebra
for this study. The scale contains 49 items; that is, the questions were contained in the main
title of confidence, usefulness, enjoyment, subject is perceived as a male domain, and teacher
expectations. The scale scored on a 1-5 Likert-type scale and half of the questions are positive
scales and the others are negative scales. The respondents were asked to respond to each item
using a five point scale such as strongly agree, agree, undecided, disagree and strongly
disagree. Algebra achievement test (GAT) were selected (and modified) from the latest five
years of tenth grade Ethiopian national examination by the researcher. The test items were
classified at three cognitive levels (knowledge, comprehension and application). The selected
and modified test items were used to determine the students’ algebra achievement and to
assess the students’ degree of attainment of the courses objectives. The type of question was
all multiple choice (closed ended). The purpose of the algebra achievement test was to
determine the students’ algebra achievement and to assess the students’ degree of attainment
in algebra course objectives. The second type of questionnaire contained 15 questions which
were closed ended and were useful to determine the factors that affect the attitude of tenth
grade students in algebra. The interview questions were prepared for secondary school
teachers which were open ended questions and the number of questions was 13. The purpose of
the questions was to find the factors that affect the attitudes of students in algebra.

The algebra attitude scale, algebra achievement test, closed ended questionnaire and interview
questions were reviewed based on the comments of professionals and the result of the pilot
study for the face and content validity. A pilot study was conducted to determine the validity
and reliability of the attitude scale, algebra achievement test and closed ended questionnaire.
One hundred and twenty tenth grade students were chosen randomly from three schools for
the pilot study. From the pilot study construct validity was established by calculating
correlations between the algebra attitudes in terms of confidence, usefulness, enjoyment, subject is perceived as a male domain and teacher expectations and algebra achievement test. Therefore, there is a correlation between the algebra achievement and algebra attitude including confidence, usefulness, enjoyment, subject is perceived as a male domain and teacher expectations in algebra and the correlations are significant at 0.05 level of significance. The alpha coefficient of Cronbach yielded 0.83 for the closed ended questionnaire, 0.809 for the confidence, 0.813 for usefulness, 0.816 for enjoyment, 0.716 for the subject is perceived as a male domain, 0.779 for the teacher expectations, and 0.921 for the attitude scale in algebra, and 0.934 as the internal consistency coefficient for the algebra achievement test. Cronbach Alpha Coefficients of reliability for the five variables including the attitude scale, algebra achievement test and closed ended questionnaires in algebra indicate that they have high internal - consistency reliability.

Method of Analysis

The data analysis techniques for this study were correlation and t-test, regression analysis and descriptive method.

Result and Discussion

The average of the components of attitude of students and students’ attitude; and the achievements of students in terms of knowledge, compression and application and total achievements on the subject algebra are given by Table 1 and 2 respectively. The Pearson correlation coefficient between the components of attitude and the attitude of students (Att) in algebra with the achievement of students in algebra (Ach); and the relationship between each of the components of variables in algebra with each other and with the variable algebra achievement and the significance of their correlation are given by Table 3 and 4 respectively.
Table 1: Descriptive Statistics for the Attitude and Components of Attitude of Students in Algebra

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Average Attitudes and Components of Attitude of Students (Out of 5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
</tbody>
</table>

Table 2: Descriptive Statistics for the Average Achievement of Students in Algebra and Achievements in each Cognitive Level such as Knowledge, Comprehension and Application.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Average Achievements of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K</td>
</tr>
<tr>
<td>Algebra</td>
<td>58.602</td>
</tr>
</tbody>
</table>

Table 3: The Pearson Correlation Coefficient between the Variables

<table>
<thead>
<tr>
<th>Component</th>
<th>Correlation of the variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>U</td>
<td>.562*</td>
</tr>
<tr>
<td>E</td>
<td>.658*</td>
</tr>
<tr>
<td>M</td>
<td>.211*</td>
</tr>
<tr>
<td>T</td>
<td>.477*</td>
</tr>
<tr>
<td>Att.</td>
<td>.798*</td>
</tr>
<tr>
<td>Ach.</td>
<td>.231*</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.05 level (2-tailed).
Table 4: Regression Analysis for the variables C, U, E, M and T

| Algebra |
|-----------------|-----------------|-----------------|-----------------|
| Multiple R = 0.244 | R² = 0.060 | Adjusted R Square = 0.052 | Std. Error of the Estimate = 10.60446 |

ANOVA Table

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>5% F table value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4474.348</td>
<td>5</td>
<td>894.870</td>
<td>7.958*</td>
<td>F(5, 626) = 2.21</td>
</tr>
<tr>
<td>Residual</td>
<td>70396.579</td>
<td>626</td>
<td>112.455</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>74870.926</td>
<td>631</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Variables in the Equation

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>5% table t - value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>2.588</td>
<td>.831</td>
<td>.167</td>
<td>3.113*</td>
<td>1.96</td>
<td>.002</td>
</tr>
<tr>
<td>U</td>
<td>1.278</td>
<td>.980</td>
<td>.078</td>
<td>1.305</td>
<td>1.96</td>
<td>.192</td>
</tr>
<tr>
<td>E</td>
<td>.243</td>
<td>1.094</td>
<td>.015</td>
<td>.222</td>
<td>1.96</td>
<td>.824</td>
</tr>
<tr>
<td>M</td>
<td>-.623</td>
<td>.840</td>
<td>-.031</td>
<td>-.742</td>
<td>1.96</td>
<td>.458</td>
</tr>
<tr>
<td>T</td>
<td>.648</td>
<td>.817</td>
<td>.036</td>
<td>.792</td>
<td>1.96</td>
<td>.428</td>
</tr>
</tbody>
</table>

Note: The symbols in the tables are:

C: Students’ confidence and self-concept of their performance in algebra.

U: Students’ beliefs on the usefulness, relevance and worth of algebra in their life now and in the future.

E: The degree to which students enjoy working algebra and algebra classes.

M: The beliefs and expectations of students in terms of gender about ability and performance in algebra.

T: The beliefs and expectations teachers have of the students’ ability and performance in algebra.
K: Items Testing Knowledge that are recognition and recall of memorized information

Co: Items Testing Comprehension that are using what has been learnt

A: Items Testing Application Aspects that are applying past learning in a new situation

Att: Students’ attitude scores on the “Algebra Attitude Scale”

Ach: Students’ achievement scores on the “Algebra Achievement Test”

Table 1 indicates confidence, usefulness, enjoyment, subject is perceived as a male domain, teacher expectation and the attitude of students in the subject algebra were around the average value. The average of the attitude of the students in terms of confidence in algebra was the least average from all the components. The others in the order of increment from the lowest to the highest were teacher expectation, enjoyment, subject is perceived as a male domain and usefulness for the subject. The attitude of students in algebra from the above table was 3.5664 (out of 5) which is almost average or neutral attitude.

The problems of getting a positive attitude or components of attitude in algebra might be due to the curriculum in which students learned algebra, the time allotment for algebra was not sufficient, the mathematics text book design did not develop the confidence of the students in algebra, the usefulness of algebra is not explained in the text and also it lacked enjoyment, the method of teaching algebra, not applying teaching aids, students were absent from the class regularly due to many reasons, students lacked or not well developed the problem solving skills in algebra, the feeling of every body even females that females are not good in science and algebra/mathematics, teachers feeling on the subject algebra /mathematics is a hard subject and students can not do well.
From table 2, the average of the achievement of students in algebra out of 100 was 42.887 and it indicates that there was a problem on the achievement of students in algebra. It indicates also there was a serious problem of the students in the application test part of algebra that is very low result in analyzing and solving algebra problems, applies elementary algebra concepts and processes, etc. They had highest average in the knowledge test part in the comparison of the other cognitive levels but it was an average result in recalling and recognizing definitions, principles, conventions, axioms, processes, properties, etc. and less average in the comprehension test part that is in comparing and contrasting of related concepts, instruments, in simple calculations using formulae, interpretation of graph or a diagram, etc.

The poor performance of students in algebra might be due to the absence of students from the class, lack of attitude of students, the portion is not covered or covered with in a short period of time, the methodology of teaching algebra, shortage of instructional materials, teachers qualification, teachers’ method of assessment, the nature of the subject, teachers attitude to their profession, lower income of the family of the students, shortage of time for the study, shortage of reference books in the library, etc.

In order to test the hypothesis $H_0[1]$, the correlation coefficients and t-test were used. Table 3 indicates that there were weak (C, Att) and very weak (U, E, M, T) relationships between achievement in algebra and each of the five variables including the attitude of algebra. That is, the correlation between the achievement of students and the variables confidence, usefulness, enjoyment, teacher expectations and attitude were statistically significant for algebra, but subject is perceived as a male domain for algebra were not statistically significant at 0.05 level. The common relationship between achievement in algebra and the variables confidence
(5.336%), usefulness (3.46%), enjoyment (3.57%), subject is perceived as a male domain (0.2116%), teacher expectations (2.13%) and the attitude of students in algebra (4.75%) were low.

Thus, this weak relationship between algebra attitude of students and algebra achievement was due to the weak or very weak relationships between algebra achievement and each of the five components of attitude in algebra. In general, students showed a better attitude towards algebra than what one would expect from their achievement in algebra.

To test the hypothesis $H_0[2]$, we use The ANOVA table (Table 4). The ANOVA table $F$ value indicates that the multiple correlations $R$ were significant that is the contribution of all components confidence, usefulness, enjoyment, subject is perceived as a male domain, and teacher expectations (C, U, E, M and T) collectively were significantly affected the achievement of students in algebra. Similarly $t$ values indicate that the contribution of confidence in algebra was significantly affected the algebra achievement, but each of the components usefulness, enjoyment, subject is perceived as a male domain and teacher expectations in algebra were not significantly affected the algebra achievement. From the above ANOVA table, since $R^2 = 0.060$ then the five variables confidence, usefulness, enjoyment, subject is perceived as a male domain, and teacher expectations in algebra had 6% effect or contribution on algebra achievement.

Next Beta was used in order to compare the contribution of each of the components on achievements; that is the highest contribution for the algebra achievement was by confidence. The percent of effect or contribution of each component confidence, usefulness, enjoyment,
subject is perceived as a male domain and teacher expectations (C, U, E, M and T) on the achievement of students in algebra is

\[ R^2 = \beta_{C}r_{XC} + \beta_{U}r_{XU} + \beta_{E}r_{XE} + \beta_{M}r_{XM} + \beta_{T}r_{XT} \]

\[ (R^2 = \beta_{C}r_{XC} + \beta_{U}r_{XU} + \beta_{E}r_{XE} + \beta_{M}r_{XM} + \beta_{T}r_{XT}) \times 100\% \]

\[ 6\% \approx 3.86\% + 1.45\% + 0.2835\% - 0.1426\% + 0.5256\% \]

Therefore, the contribution of confidence in algebra enhanced the achievement of algebra by 3.86\%, the contribution of usefulness of algebra enhanced the achievement of algebra by 1.45\%, the contribution of enjoyment of algebra enhanced the achievement of algebra by 0.2835\%, the contribution of subject (algebra) is perceived as a male domain declined the achievement of algebra by 0.1426\% and the contribution of teacher expectation in algebra enhanced the achievement of algebra by 0.5256\%.

The remaining 94\% of the achievement of algebra were affected by other variables which was not included in the attitude scales of algebra of this study. That is they might be affected by 

*Cognitive factors* (L. R. Aiken, 1971; J. P. Guilford, R. Hoepfner, and H. Peterson, 1965; Aiken, 1971; Fennema, 1975; Sherman, 1967) like logical thinking, spatial perception, verbal ability and problem solving ability, etc; *Affective factors* (Boswell, 1985; Guilbert, 1986; Aiken, 1972, 1974; Armsbong, 1985; Patel, 1984) like family influences and personality variables, namely, self reliance, sense of personal freedom, feeling of belongingness, withdrawing tendencies, nervous symptoms, social skills, general anxiety and test anxiety, parental profession, etc; *Educational environment factors* (cf. Fennema, 1978; Leder, 1987, 1990 and Becker, 1991; Gwizdala and Steinbach, 1990; Fennema & Peterson, 1985) like attitudes of teachers, textbooks, co-educational school organization, classroom environment, the relationship between teacher behavior and student learning, teachers'
qualifications, class size, encouragement to teacher by the head, use of audio-visual aids, feedback, imparting of limited knowledge, blind use of rules, defective textbooks, insufficient drill work, inadequate coverage of the syllabus, inadequate attention to difficult topics and a personal factor, namely, lack of motivation, student characteristics (e.g., use of learning strategies), home environment (e.g., occupation of parents), and school context (e.g., quality of instruction), etc.

**Conclusion**

The purposes of this study were to examine the relationship between tenth grade students’ attitudes and components of attitude towards algebra with algebra achievement of Addis Ababa secondary schools, in addition the study showed the contribution of each components of attitude in algebra on the parts of algebra achievement, that is on the achievements of students in algebra in each cognitive level such as knowledge, compression and application.

Therefore, from the result and discussion the following findings were obtained:

1) The attitudes and component attitudes of students in algebra were around the averages.

2) Generally the results of the students in the achievement test of algebra were very low.

   There was a serious problem in application test part of algebra that is very low result in analyzing and solving algebra problems, applies elementary algebra concepts and processes, etc.

3) In the relationship between the attitude and achievement of students in algebra the following results were obtained

   a) There were weak relationships between achievement in algebra and each of the five components of attitude such as confidence, usefulness, enjoyment, subject is perceived as a male domain, and teacher expectations including the attitude in algebra.
b) The contribution of all components collectively that is confidence, usefulness, enjoyment, subject is perceived as a male domain, and teacher expectations in algebra significantly affected (but low) the achievement of students in algebra. The contribution of confidence was significant on the variable achievement, but the other components usefulness, enjoyment, subject is perceived as a male domain and teacher expectations were not significant on the variable achievement.

**Recommendations**

In order to improve the attitude, components of attitudes and achievements in algebra; and in addition to improve the relationship between the algebra achievement and each of the five components of attitude the following recommendations were proposed.

1) The school administration or government should solve the problems of the students in order the students attend the class regularly.

2) The curriculum should be regularly evaluated and should be designed by appropriate professionals that have sufficient knowledge in mathematics and pedagogy. Enough time should be given for the algebra contents.

3) The text book of mathematics should also be prepared by professionals who have sufficient knowledge in mathematics and pedagogy; the usefulness of algebra and algebra sub topics should be clearly stated, appropriate method should be applied in order to improve the confidence of the students, it should contain some games, tricks, puzzles, quick activities and applied word problems in the real world in order to increase the enjoyment of algebra for the students.

4) The appropriate method of teaching should be applied in order to improve the attitude and achievement of students in algebra. That are question & answer, individual
project, peer and group discussion, time on-task activities, presentation, cooperative learning, individual learning and guided discovery methods of teaching should be applied. In addition algebra should be presented by a combination of deductive & inductive method, analytic & synthetic method, heuristic method, demonstration method, laboratory method in the appropriate topic. Tutorial should be given to supplement the class every week.

5) Continuous assessment should be given to the students.

6) The teachers’ quality in terms of subject content, pedagogy knowledge and language proficiency should be improved.

7) The class size should be reduced to an optimum number of around 40 students in a class.

8) Sufficient budget for secondary schools should be allocated for instructional materials such as computers, mathematics laboratory materials and mathematics reference books in the library.

References


