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Garba Sahabi Adamu, Ibrahim Musa Garba

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Investigation into the Gender Difference of Attitude and Achievement in Engineering Mathematics

Garba Sahabi Adamu

Department of Mathematics, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria.

Ibrahim Musa Garba

Department of Mathematics, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria.

Abstract

This study was carried out to investigate the students' attitude towards engineering mathematics. The sample consist of 502 (332 males and 170 females) year one, higher national diploma students, Waziri Umaru Federal Polytechnic, Birnin Kebbi. The study examined the difference in attitudes towards mathematics between male and female students. Pearson correlation, paired samples t-test and independent samples t-test were used to analyze the data using SPSS version 20.0. The results obtained showed a significant difference in attitude towards mathematics between males and females. Female students exhibit more positive attitude than males. No significant difference was observed between males and females in mathematics achievement. The study revealed a weak negative correlation between students' attitude towards mathematics and students' achievement.

Keywords: Attitude, Mathematics, Achievement, Gender Difference.

Introduction

Attitudes are defined as learned, global evaluation of person, object, place or issue that influence thought and action. In other words, attitudes are basic expressions of approval or disapproval, favorability or unfavorability, likes or dislikes. Perloff (2003). Aiken (1970), defined attitude as a learned disposition or tendency on the part of an individual to respond positively or negatively to some objects, situations, concepts or another person. Attitude can also be viewed as a mental predisposition to act that is expressed by evaluating a particular entity with some degree of favor or disfavor Scholl (2007). Students' attitudes towards mathematics can be seen as the emotional response either positive or negative associated with mathematics, confidence to succeed in learning mathematics, and strategies in coping with mathematical problems.

Attitudes of learners of mathematics affect their cognitive activities. When a student has positive attitude towards mathematics, he or she will feel that mathematics is important and so will try to improve mathematics learning achievement. Conversely, students who have negative attitudes to

may find it difficult to pay attention to mathematics. Mata *et al* (2012). Attitudes affect behavior, influence what the learner selects from the environment, how he reacts towards teachers, towards the material being used and towards the other students. This selection and the processing of the input information which follow it, are strongly influenced by attitudes. Mubeen *et al* (2013). According to Ajisuksmo and Saputri (2017), attitudes towards mathematics and meta-cognitive skills contribute to the changes of students' mathematics achievement by 25%. They found that positive attitude towards mathematics is needed to affect one's willingness to learn mathematics.

Research has shown a highly significant relationship between students' attitude towards mathematics and self efficacy. Kundu and Ghose (2016). Their findings revealed self efficacy in mathematics is strongly influenced by attitude towards the subject. This means students who are often seen to feel "helpless" when confronted by mathematical situations probably have a mind set of intimidation by mathematics. In a similar research, Han *et al* (2015) compared the mathematics attitudes between Taiwanese and United States college students. They found a significant difference between the two groups. The difference was observed to reflect the cultural belief system which has impacted students' decisions on educational practices and learning attitudes.

There are conflicting research findings as to what extent belief and attitude towards mathematics affect the achievement of the students. Some findings concluded that the attitude towards mathematics has no direct influence on statistics achievement score. Azar and Mahmoudi (2014). It also revealed a significant indirect effect of mathematics self efficacy and anxiety through the attitude towards mathematics on statistics score. Mathematics self efficacy has been shown to have a direct effect on mathematics attitude. Direct effect of mathematics self efficacy on mathematics anxiety as well as mathematics anxiety on mathematics attitude were confirmed. Kamalimoghaddam *et al* (2016). Several mathematics belief variables were significantly related to mathematical achievement. Students who attributed success in mathematics at school to hard work studying at home were more likely to have learned higher mathematics than those students who did not indicate that belief. Likewise, students who showed low mathematics test scores tend to indicate that mathematics was boring and to attribute success in mathematics at school to natural talent and good luck. House (2006), Wasike (2013). They suggested that students who feel more positive about their problem solving abilities, who actively seek out challenges and who are not easily discouraged by difficult problems are higher achievers in mathematics. Perceived usefulness of mathematics was another attitudinal component that differentiated the high achieving students from the low achieving ones as suggested by the research findings. Thus the link between positive attitude towards mathematics and achievement was shown to exist, are significantly and positively correlated.(Iben 1991, Kundu and Ghose, 2016).

A research has indicated a significant difference in the attitude of female students towards mathematics. Wasike (2013). It was also revealed that attitude of the students towards mathematics was determined in the lights of their gender. Female students showed more positive attitude than male students. This was also observed to affect success in mathematics courses where females are more successful in mathematics than male students. Arslan *et al* (2012). Female students tended to show better performance in mathematics examinations as compared to male students. A positive correlation between the attitude towards mathematics and mathematics achievement affects only female students. Mubeen et al (2013). However, some researches indicated students' achievement

and attitudes are not dependent on gender. (Olufemi and James 2014, Arhin and Offoe 2015, Ajai and Imoko 2015, Ajisuksmo and Saputri 2017).

Background of the Study

The role of mathematics in science, technology and engineering cannot be over emphasized. It is well known fact that engineering mathematics is crucial to all prospective engineers. Therefore, it is expected that all students of engineering to be competent in engineering mathematics for effective application. Personal experience has shown that some engineering students of Waziri Umaru Federal Polytechnic Birnin Kebbi do not give much emphasis to the study of mathematics during their quest for engineering career. This study seeks to examine the attitude of engineering students towards mathematics with special emphasis to gender stereotyping. Relationship between attitude towards engineering mathematics and achievement will also be investigated.

Research Hypotheses

Three hypotheses will be tested in this study;

- i. There is no significant relationship between students' attitudes towards mathematics and achievement in engineering mathematics.
- ii. There is no significant difference in attitudes to mathematics of male and female students
- iii. There is no significant difference in achievement of males and females in engineering mathematics.

Methodology

The population of this study is the entire year one, higher national diploma (HND I) students of colleges of engineering and environmental studies of Waziri Umaru Federal Polytechnic, Birnin Kebbi ($n < 2000$). A sample of five hundred and two (502) students was randomly selected using simple random sampling. The sample comprised 170 or 33.86% females and 332 or 66.14% males. The instrument used for data collection is questionnaire and semester examination results of the respondents. The questionnaire was an abbreviated mathematics attitude inventory (AMAI). The items were extracted from a mathematics attitude scale (georgina and Yemisi, 2014).

AMAI has sixteen items designed to be two dimensional instrument where eight items were worded positively and eight items worded negatively. Mathematics attitude scores were obtained by adding the individual scores of all items. The possible range of the scores was 16 – 80, after which the scores were converted to percentage. The questionnaire uses 5 point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) for positive items and 1 (strongly agree) to 5 (strongly disagree) for negative items. High score on AMAI indicates high positive attitude to mathematics and that is the reason the scores were reversed. The AMAI has Cronbach's alpha 0.88.

The Mathematics achievement scores were obtained from the second semester examination results that followed after the administration of AMAI. Matriculation numbers of the respondents were used for identification. The highest mark obtainable was 100. This is the reason for AMAI scored were converted to percentage.

Results

The analysis of data was done using SPSS version 20.0. The factors analyzed were:

Gender difference in mathematics attitude, mathematics achievement and relationship between mathematics attitude and mathematics achievement.

A. *Gender Difference in Mathematics Attitude.*

An independent samples t-test was conducted to determine whether there was a significant difference in mathematics attitude between males and females. The test showed a statistically significant difference between males and females ($t = -3.019$, $df = 500$, $0 < 0.01$). Females (Mean = 61.44, SD = 13.95) reported significantly more positive attitude than males (mean = 57.21, SD = 15.26).

B. *Gender Difference in Mathematics Achievement.*

An independent samples t-test was carried out to examine if a significant difference in mathematics performance exist between males and females. The results obtained showed a statistically insignificant difference in mathematics performance between males and females ($t = 0.688$, $df = 500$, $p > 0.01$). For males (mean = 44.29, SD = 12.78) and females (mean = 43.35, Sd = 15.43).

C. *Relationship between Students' Attitudes towards Mathematics and Students' Performance in Engineering Mathematics.*

A bivariate correlation test was carried out to calculate the Pearson correlation coefficient between students' attitude towards mathematics and mathematics performance. The results obtained indicated a weak negative correlation between students' attitude towards mathematics and students' performance in engineering mathematics ($r = -0.025$). Also, a paired samples statistics revealed a significant correlation ($t = 16.037$, $df = 501$, $p < 0.01$, $r = -0.025$). Students' attitudes towards mathematics (mean = 58.64, SD = 14.95), students' performance in engineering mathematics (mean = 43.94, SD = 13.73).

D. *Relationship between Students' Attitude towards Mathematics and Students' Performance in Engineering Mathematics for Male Students.*

Paired samples test and bivariate correlation test on the males' scores indicated a Pearson correlation coefficient ($r = 0.085$, $t = 12.41$, $df = 331$, $p < 0.05$). This shows a significant positive correlation between students' attitude towards mathematics and students performance in males.

E. *Relationship between Students' Attitude towards Mathematics and Students' Performance in Engineering Mathematics for Female Students.*

Paired samples t-test and bivariate correlation test on the females' scores revealed a Pearson correlation coefficient ($r = 0.068$, $t = 11.79$. $df = 169$, $p < 0.01$). This shows a significant positive correlation.

Discussion

The results obtained from the analysis of data indicated a statistically significant difference in mathematics attitude between males and females. The computed means and standard deviation revealed that female students showed better attitude towards mathematics than males. This contradicts the hypothesis that there is no significant difference between the attitudes to mathematics of males and females. This is opposed to the previous findings that reported attitude towards mathematics does not depend on gender. Olufemi and James (2012), Farooq and Shah

(2008). The finding also confirms the findings of Arslan *et al* (2012), Opolot-Okurot (2005) that female students exhibit more positive attitudes to mathematics than males.

The results of this study do not indicate any significant difference in mathematics performance of males and females. This enables us to accept the hypothesis that there is no significant difference between the achievement of males and females in mathematics. This finding contradicts the findings of Mubeen *et al* (2013) which revealed girls achieved better results as compared to boys. Correlation between students' attitude to mathematics and students' performance was observed to be very weak and negative. This means there is a very weak but significant relationship between the students' attitude towards mathematics and students' performance in mathematics. This contradicts the hypothesis that that there is no significant relationship between the students' attitude towards mathematics and students' achievement in mathematics. This also confirms the findings by Wasike (2013), Kundu and Ghose, (2016) that established attitude significantly affected students' performance with those having positive attitudes performing better than those with negative attitudes.

A separate analysis of the scores for males and females revealed a significant but weak positive correlation between attitude to mathematics and students' performance.

Conclusion

This study established a significant difference in attitude towards mathematics between males and females. Female students were observed to have more positive attitude towards mathematics than males. The study found no significant difference in the mathematics achievement between males and females. A relationship exists between students' attitude to mathematics and students' performance in mathematics. In other words, a negative weak correlation between students' attitude to mathematics and students' performance in mathematics. When the two groups were treated separately, there is a significant but weak positive correlation between students' attitude towards mathematics and students' performance.

This paper contributes to research in the sense that it reflects the perception and thoughts as it affects the academic performance of students. It gives an insight of the efforts of researchers and their advances in achieving gender equality in science and technology. Although gender stereotyping still exist in schools, the paper gives a ray of hope for females to make a difference in engineering and science.

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