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Gender Differences in Attitudinal Variables towards Mathematics among Pre-Service Teachers in the Brong-Ahafo Region of Ghana

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Abstract:
The purpose of this study was to find out gender differences in attitudinal variables towards mathematics among Pre-service Teachers in the Brong-Ahafo Region of Ghana. A sample of one hundred students drawn by convenience sampling from the public College of Education was used for the study. The one hundred pre-service teachers (fifty males and fifty females) were conveniently selected from the second year form. The design for the study was a descriptive survey. The data were analysed using the t-test of Statistical Package for the Social Sciences (SPSS) programme to test the hypotheses in relation to the responses to the items in the questionnaire, which was based on the attitudinal variables (self-confidence, values, enjoyment and Motivation) towards mathematics. Based on the findings of this study, the main statistically significant difference occurred in the motivation to pursue mathematics in farvour of the male pre-service teachers. Finally, it was also recommended that administrators and mathematics tutors in the public Colleges of Education in the Brong-Ahafo Region should adopt strategies that suggest to students that they have what it takes to go through their mathematics studies successfully.

Keywords: *Attitudinal variables (self-confidence, values, enjoyment and Motivation), pre-service teachers, Ghana, Brong-Ahafo*

1. Introduction

The purpose of this study was to find out gender differences in attitude towards mathematics among pre-service teachers in the Brong-Ahafo Region of Ghana. The study was design to find out if statistically significant difference exist between male and female pre-service teachers in a public College of Education using the attitudinal variables (self-confidence, values, enjoyment and Motivation).

It is universally accepted that a strong foundation in mathematics is a prerequisite for many careers and jobs in today's increasingly technological society. This is because mathematics has numerous applications in various fields. As a result, mathematics educators and mathematicians are more concerned about effective teaching and learning of the subject in schools, so that students can identify the benefits of mathematics both in school and in their everyday life. Due to numerous application of mathematics, it can be argued that for any developing country like Ghana, advancement in industrial and technological development calls for a work force that is knowledgeable in mathematics.

Mathematics is therefore one of the compulsory subjects in schools and is one of the subjects that has the greatest number of contact hours per week for instruction. In addition, it is one of the subjects used for the selection of students from one level of educational system to another. Furthermore, sufficient knowledge in mathematics equips one to fit well into various scientific and technological fields in this modern world.

Aiken (1970), said attitude is a tendency on the part of an individual to respond positively or negatively to some goal, situation, concept or another person. Neale's study (as cited in Lianghuo, 2000), referred to attitude as "aggregate measure of a (dis)likeness to mathematical activities, a belief that one is good or bad at mathematics and a feeling that mathematics is difficult and useless or difficult but useful".

Suydam and Weaver's study (as cited in Schreiber 1997), illustrated that in theory and practice, teachers and other mathematics educators generally believe that children learn and perform better in mathematics if they like mathematics, hence continual attention should be directed towards creating, developing, maintaining and reinforcing teaching and learning of mathematics.

Zan (2003), stressed that studies aiming to change attitude actually end up in setting the objective of transforming a 'negative' attitude into a 'positive' one. The definition of 'positive' or 'negative' attitude toward mathematics clearly depends on the definition of attitude itself. According to the 'simple' definition, it is clear what a 'positive' or a 'negative' attitude is: a 'positive' attitude is a positive emotional disposition toward the subject; a 'negative' attitude is a negative emotional disposition toward the subject. If however, we choose the bidimensional (or multidimensional) definition, it is not clear what a 'positive' attitude should mean, but referring only to the emotional dimension is reductive, since we have to take into account the two (or three) dimensions, i.e. emotions, beliefs, behaviours and their interaction. What actually happens is that in most studies the choice of a definition for attitude, and consequently a characterization of 'positive'/'negative' attitude, not only is not explicitly made: often it is not made at all, and the assessment / measurement instruments used by the researcher implicitly end up by continuously wavering between various definitions within a single study.

Hannula (2006), suggested a new framework for analysing attitude and changes in attitude. After reviewing relevant findings in the field of psychology of emotions, he provided a new conceptualization for attitude. Four different evaluative processes were identified as aspects of attitude: emotions aroused in the situation, emotions associated with the stimuli, expected consequences, and relating the situation to personal values. The usefulness of the analytical framework was illustrated with an exemplary case study. An ethnographic case study of a student in the lower secondary school was analysed. The case study was described on the students' negative attitude towards mathematics, and then examined on how the negative emotions developed during the problem solving situations. Within half a year, the students' attitude towards mathematics changed dramatically to more positive.

Campbell, Jolly & Perlmans (2004), stated that for many years, there have been efforts to increase women's preparation for and participation in Science, Technology, Engineering and Mathematics (STEM). They further said, while sex differences in pre-college math/science course-taking and achievement have declined dramatically and the mathematics course-taking gap has almost closed, men, however, remain four times as likely to choose an engineering major. It is clear that women's STEM under-representation is more complex than earlier imagined and that a focus on any one factor, no matter how necessary, will not lead to success. Successful continuation appears to be related not to one, but to three interrelated factors: Engagement: Having an approach to STEM that includes such qualities as awareness, interest and motivation. Capacity: Possessing the knowledge and skills required to advance to increasingly rigorous STEM content. Continuity: Having institutional and programmatic opportunities that support advancement to increasingly rigorous STEM content.

Eshun (1999, 2000), also reported that in general, students had positive attitudes towards mathematics especially along the attitudinal variables, (usefulness of mathematics), (like mathematics) and (success in doing mathematics). They revealed that students are however least positive about effective motivation and confidence in doing mathematics. They concluded that students' low achievement in mathematics could partly be attributed to lack of motivation and confidence to learn the subject. It can be observed that attitude seems to play a substantial role in one's inclination towards mathematics.

According to Fredricks & Eccles (2002), Watt (2004) and Kessels & Hannover; (2007) literature on mathematics interest documented that boys are more interested in mathematics than girls and mathematics is still considered to be a male domain area

Nyala (2008), in testing whether there was any significant difference in attitudes towards mathematics of male and female Junior High School(JHS) students in Ghana, it was found that there was no statitically significant difference in attitudes towards mathematics of males and females at the JHS level. This indicated that both sexes of students have the same feelings towards mathematic.

The 1992 AAUW Education Foundation, reported that males are better in mathematics and that female questions, comments and answers are not inportant (Jewett, 1996). The Female Education in Mathematics and Science in Africa (FEMSA, 1997) project has shown that girls lack role models in that they come into contact with few women teachers handling science and mathematics. Another factor that seem to influence boys to elect or to take the mathematically related courses is the abundance of male mathematics teachers over females. In the review of mathematics education in the united kingdom in the late 1970s to early 1980s, the Assessment and Performance Unit(APU, 1985) report confirmed this. Outside the school, girls rarely see or hear of female mathematicians and scientists. Most parents consider girls as household bound and therefore should devote themselves to studies that are relevant to their future role as wives and mothers, FEMSA (1997) and APU (1985).

Mata et al.(2012) presented a paper which aimed at understanding how certain different but interrelated variables such as background, motivation, and social support could lead to an explanation of student attitudes towards math and to an understanding of the defining characteristics of these attitudes in the school environment. The study utilizes an adaptation of the "Intrinsic Motivation Inventory" assessing main determinants of intrinsic motivation. One section of the questionnaire—"In my Math Class"—also assesses student perceptions of teacher and peer support as well as student attitudes. The results revealed that, in general, students held positive attitudes towards mathematics and also highlighted the main effects of grade and math achievement on these attitudes. No gender effect was identified although the girls showed a continuous decline in

attitudes the further they progressed in school. A hierarchical analysis using structural equation modeling showed that motivation-related variables are the main predictors of attitudes towards mathematics and that teachers and the social support of peers are also highly significant in understanding these attitudinal variables.

According to Opolot-Okurut(2013), reported in a study in which secondary school students' attitudes towards mathematics were investigated. The sample consisted senior three students in nine secondary schools in three districts of Central Uganda. The data were collected using a Student Attitude Towards Mathematics Inventory on student mathematics anxiety, confidence to learn mathematics and motivation to mathematics. The data were analysed using the Rasch model. The results indicate significant differences in all the attitudes variables measured between the male and female students. The students in the high- performing schools indicated higher attitudes than the students in the low-performing schools. It is argued that student attitudes towards mathematics be addressed to improve student achievement in mathematics.

1.1. Statement of the Problem

Several studies (for instance, Aiken, 1970; Campbell, Jolly & Perlmans (2004); AAUW,1992; APU,1985; FEMSA,1997; Fredricks & Eccles,2002; Watt, 2004; Kessels & Hannover, (2007)) , have reported that there is generally a difference in attitude between male and female students towards mathematics. These studies appear to suggest that female students do not have positive attitudes and as such perform poorly in mathematics as compared to their male counterparts.

Unfortunately, none of these studies were conducted at the teacher training college level in Ghana (now called Colleges of Education). Therefore this study was designed to fill this apparent vacuum and to find out whether there is gender difference in attitudinal variables towards mathematics among pre-service teachers in a public college of Education in the Brong-Ahafo Region of Ghana.

1.2. Significance of the Study

This study is significant because it is intended to show whether there is a significant difference in attitudinal variables towards mathematics among male and female pre-service teachers, to help confirm or deny the impression that only men have positive attitude towards mathematics and to help develop the ability and desire of pre-service teachers to pursue mathematical ideas and skills independently.

2. Material and Methods

The type of study and design used for this research is the descriptive research design and it specifies the nature of a given phenomena. It determines and reports the way things are. It thus involves collecting data to test hypothesis or answer research questions concerning current status of the subject of the study, (Gay, 1992). The purpose of descriptive research is to observe, describe and document aspects of a situation as it naturally occurs. It sometimes, serves as a starting point for hypothesis generation or theory development. In descriptive research, the events or conditions either already exist or have occurred and the researcher merely selects the relevant variables for an analysis of their relationships.

According to Best and Khan (1998), descriptive research is concerned with the conditions or relationships that exist, such as determining the nature of prevailing conditions, practices and attitudes; opinions that are held; processes that are going on; or trends that are developed. Amedahe (2002), also maintains that in descriptive research, accurate description of activities, objects, processes and persons is the objective. The population was made up of all second year pre-service teachers from the public college of education in the Brong-Ahafo Region of Ghana.

The sample included hundred pre-service teachers selected from the public college consisting of fifty males and fifty females. Moreover, under the attitude towards mathematics, the number of responses for each variable differs depending on the number of questions answered under each variable. For example, for self confidence, the number of questions answered by the respondents were eight (8) in all. Hence the total responses obtained were eight hundred (800) i.e. there were hundred (100) responses for each questions.

A convenience sampling was used to select the pre-service teachers from the second year forms in the college. According to Castillo (2009), a convenience sampling is a non-probability sampling where subjects are selected because of their convenient accessibility and proximity to the researcher. The convenience sampling is useful because it allows the researcher to obtain basic data and trends regarding his or her study without the complications of using a randomized sample. It is also useful in documenting that a particular quality of a substance or phenomenon occurs within a given sample. The main disadvantage is that the units that are easiest to obtain may not be a representative of the population.

The instrument used in this study to measure students' attitude toward mathematics was constructed using four of the major factors reported to be important in research (see for instance, Wigfield and Meece, 1988; Thorndike-Christ, 1991; Randhawa, Beamer, and Lundberg, 1993; Terwilliger and Titus, 1995; Singh,Granville, and Dika, 2002). In addition, instead of a simple yes or no response, a four point Likert Scale was used for the responses. The Likert Scale is one of the most commonly used question format for finding out participants opinion on issues. Using a Likert Scale allows respondents to decide on their level of agreement or disagreement with a statement. For instance, on a five-point scale, respondents have the chance to indicate whether they Strongly Agree, Agree, Indifferent, Disagree, or Strongly Disagree. A four-point scale was used in this study so as to give respondents the chance to indicate whether they Strongly Agree, Agree, Disagree, or Strongly Disagree.

*2.1. Theory/*Calculation

The responses of the questionnaires were tallied in order to formulate the resulting frequency tables. The independent samples t-test was then used to analyse the responses from the questionnaires. The t-test was the best to be used because it is a parametric statistical test used to see whether a difference between the means of two samples is significant. The t-test provides an exact test for the equality of means of two normal populations with unknown but equal variances. Theoretically, the t-test can be used even if the sample sizes are very small, as long as the variables are normally distributed within each group and the variation of scores in the two groups is not reliably different.

3. Results and Discussions

The following section presents the results and discussions of the attitudinal variables of the pre-service teachers' according to gender.

3.1. Research Hypothesis

There is no difference in self confidence between male and the female pre-service teachers in mathematics.

Question Number	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Male	Female	Male	Female	Male	Female	Male	Female
1	18	13	23	27	7	7	2	3
2	22	17	22	23	5	8	1	2
3	15	9	24	17	6	19	5	5
4	10	10	19	16	15	18	6	6
5	10	23	25	24	11	2	4	1
6	2	4	2	6	25	27	21	13
7	5	8	11	21	12	13	22	8
8	5	9	3	4	20	23	22	14

Table 1: Raw Number Count on Self Confidence of Pre-Service Teachers

Table 1 shows the number of students who answered questions on Self Confidence.

	Sex	N	Mean	Standard Deviation
Self Confidence	Male	400	2.45	1.049
	Female	400	2.32	.972

Table 2: Group Statistics of Respondents

Table 2 shows the number of students who answered questions on self confidence, their mean and standard deviation.

Levene's Test for Equality of Variances							
		F	Sig.	t	Df	Sig.(2-tailed)	Mean Difference
Self Confidence	Equal variances assumed	6.014	.014	1.818	798	.069	.130
	Equal variances not assumed			1.818	793.426	.069	.130

Table 3: Results of the Independent Samples T-Test on Self Confidence of Pre-Service Teachers

From Table 3, the significant value is 0.014 and the alpha level is 0.05 which means that the significant value is less than the alpha level, hence means that the column labelled equal variances not assumed's t-value is chosen (as shown in table 3). The t-test conducted showed males (M = 2.45, SD = 1.049) do not have significantly higher level in self confidence than females (M = 2.32, SD = 0.972); t (798.426) = 1.818, P = 0.069 (two-tailed), d=.05. The possible reason could be that female pre-service teachers are no longer nervours, uneasy and do not see mathematics as difficult, hence there is no difference as recorded in this result. The result did not seem to support the 1992 AAUW Education Foundation that males were better in mathematics. The result showed that males do not differ in self confidence as their female countaparts. The result in this work therefore indicated that there was no statistically significant difference in response for males and females in self confidence.

3.2. Value of Mathematics

3.2.1. Research Hypothesis

There is no difference in the value of mathematics between male and the female pre-service teachers.

Question Number	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Male	Female	Male	Female	Male	Female	Male	Female
9	2	2	1	2	22	21	25	25
10	2	1	1	4	26	25	21	20
11	4	3	9	9	32	25	5	13
12	4	2	2	2	23	27	21	19
13	2	2	3	5	33	31	12	12
14	2	1	6	9	32	30	10	10
15	28	42	20	6	-	2	2	-
16	27	26	20	9	2	8	1	7
17	-	2	1	3	20	14	29	31

Table 4: Raw Number Count on Value of Mathematics of Pre-Service Teachers

Table 4 shows the number of students who answered questions on Value of Mathematics.

	Sex	N	Mean	Standard Deviation
Value of Mathematics	Male	450	2.82	1.011
	female	450	2.84	1.053

Table 5: Group Statistics of Respondents

Table 5 shows the number of students who answered questions on value of mathematics, their mean and standard deviation.

Levene's Test for Equality of Variances							
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference
Value of Mathematics	Equal variances assumed	.769	.381	-.161	898	.872	-.011
	Equal variances not assumed			-.161	896.534	.872	-.011

Table 6: Results of the Independent Samples T-Test on Value of Mathematics to Pre-Service Teachers

From Table 6, the significant value is 0.381 and the alpha level is 0.05 which means that the significant value is less than the alpha level, hence the column labelled equal variances not assumed's t-value is chosen (as shown in Table 6). The t-test conducted showed males (M = 2.82, SD = 1.011) do not have significantly higher level in value of mathematics than females (M = 2.84, SD = 1.053); t (898) = -0.161, P = 0.872, (two-tailed), d = .05. This result showed both male and female pre-service teachers value mathematics equally. This result contradict Lianghuo (2000), Aiken (1970), Schreiber (1997) revelation that there were some differences in attitude towards mathematics between boys and girls. The results in this study therefore indicated that males value of mathematics does not significantly differ from their female counterparts

3.3. Enjoyment of Mathematics

3.3.1. Research Hypothesis

There is no difference in the enjoyment of mathematics between male and the female pre-service teachers.

Question Number	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Male	Female	Male	Female	Male	Female	Male	Female
18	2	2	5	10	20	27	23	11
19	24	18	19	25	3	4	4	3
20	5	4	11	24	19	13	15	9
21	-	4	6	5	19	30	25	11
22	2	2	3	3	28	28	17	17
23	7	9	19	9	17	18	7	14

Table 7: Raw Number Count on Enjoyment of Mathematics of Pre-Service Teachers

Table 7 shows the number of students who answered questions on Enjoyment of Mathematics.

	Sex	N	Mean	Standard Deviation
Enjoyment of Mathematics	Male	300	2.83	1.010
	Female	300	2.72	.957

Table 8: Group Statistics of Respondents

Table 8 shows the number of students who answered questions on enjoyment of mathematics, their mean and standard deviation.

	Levene's Test for Equality of Variances						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference
Enjoyment of Mathematics	Equal variances assumed	.590	.443	1.286	598	.199	.103
	Equal variances not assumed			1.286	596.296	.199	.103

Table 9: Results of the Independent Samples T-Test on Enjoyment of Mathematics of Pre-Service Teachers

From Table 9, the significant value is 0.443 and the alpha level is 0.05 which means that the significant value is less than the alpha level, hence the column labelled equal variances not assumed's t-value is chosen. Also, the significant (2-tailed) value is 0.199 which implies that it is greater than the alpha level of 0.05; hence there is no statistically significant difference in enjoyment of mathematics for male and female pre-service teachers. The t-test conducted showed males (M = 2.83, SD = 1.010) do not enjoy mathematics more than their females counterparts (M = 2.72, SD = 0.957); t (598) = 1.286, P = 0.199, (t-tailed), d = .05. the results contradict Fredricks & Eccles (2002), Watt (2004) and Kessels & Hannover; (2007) literature on mathematics interest documented that boys are more interested in mathematics than girls and mathematics is still considered to be a male domain area. The results in this work therefore indicated that males enjoyment of mathematics did not statistically significant differ from their female counterparts.

3.4. Motivation to Pursue Mathematics

3.4.1. Research Hypothesis

There is no difference in motivation to pursue mathematics between male and female pre-service teachers

Question Number	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Male	Female	Male	Female	Male	Female	Male	Female
24	20	13	16	20	11	11	3	6
25	7	8	7	13	15	15	21	14
26	3	4	7	15	26	24	14	7
27	6	7	5	18	18	14	21	11
28	1	1	1	1	20	25	28	23
29	-	2	-	2	24	28	26	18
30	-	1	1	-	12	12	37	37

Table 10: Raw Number Count on Motivation to Pursue Mathematics of Pre-Service Teachers

Table 10 shows the number of pre-service teachers who answered questions on Motivation to Pursue Mathematics.

	Sex	N	Mean	Standard Deviation
Motivation to pursue Mathematics	male	350	3.11	.973
	female	350	2.93	.968

Table 11: Group Statistics of Respondents

Table 11 shows the number of students who answered questions on motivation to pursue mathematics, their mean and standard deviation.

Levene's Test for Equality of Variances							
		F	Sig.	t	df	Sig.(2-tailed)	Mean Difference
Motivation to pursue Mathematics	Equal variances assumed	.001	.978	2.492	698	.013	.183
	Equal variances not assumed			2.492	697.981	.013	.183

Table 12: Results of the Independent Samples T-Test on Motivation to Pursue Mathematics of Pre-Service Teachers

From Table 12, the significant value is 0.978 and the alpha level is 0.05 which means that the significant value is greater than the alpha level, hence the column labelled equal variances assumed's t-value is chosen. Also, the significant (2-tailed) value is 0.013 which implies that it is less than the alpha level of 0.05; hence there is statistically significant difference in motivation to pursue mathematics for male and female pre-service teachers.

In order to know the magnitude of the difference between the two groups, the eta squared was calculated using the formula below:

Eta squared (η^2) = $\frac{t^2}{t^2+(N_1+N_2-2)}$, where t represents the t-test statistics value and N_1 and N_2 represents the sample size for the groups.

This is therefore calculated below:

$$\eta^2 = \frac{(2.492)^2}{(2.492)^2 + (350 + 350 - 2)}$$

$$\eta^2 = \frac{6.210064}{6.210064 + 698}$$

$$\eta^2 = \frac{6.210064}{704.210064}$$

$$\eta^2 = 0.008818 \approx 0.009 = 0.9\%$$

The t-test conducted showed males (M = 3.11, SD = 0.973) are motivated to pursue mathematics related courses more than their female counterparts (M = 2.93, SD = 0.968); t (698) = 2.492, P = 0.013, (two-tailed), d = .05. The magnitude of the difference in the means was small (eta squared = 0.009). this result is in accordance with the literature most parents consider girls as household bound and therefore should devote themselves to studies that are relevant to their future roles as wives and mothers, FEMSA (1997) and APU (1985). The results in this work therefore indicated that there was statistically significant difference in the motivation of male pre-service teachers to pursue mathematics than their female counterparts.

4. Conclusions

The conclusion drawn from the results of the study indicated that, the difference in attitude towards mathematics between male and female pre-service teachers in the public college of education was not statistically significant in self confidence, value of mathematics and enjoyment in solving mathematical problems. However, on the part of motivation to pursue mathematics, the means for both male and female pre-service teachers were 3.11 and 2.93 respectively. It therefore shows that, male pre-service teachers are motivated to pursue mathematics related courses in the universities 0.9 percent more than their female counterparts. This study suggest that the only attitudinal variable that is in favour of the male pre-service teachers is motivation to pursue mathematics to the higher level. Hence, tutors of the colleges of education are expected to device strategies to help motivate female pre-service teachers to pursue mathematics related programes at the university level.

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