



INVESTIGATING GENDER DIFFERENCES IN THE ATTITUDE AND ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS TOWARDS STEM EDUCATION IN PLATEAU STATE

Dawal, B. S.

Department of Science and Technology Education, University of Jos

blissingdawal2010@gmail.com

Abstract

The study investigated gender differences in the attitude and achievement of secondary school students towards STEM education in Plateau. The descriptive survey design was used to obtain information on the attitude of students towards science and ex-post facto design was used to obtain achievement scores of the students in science subjects. Out of the population of 391 schools, a sample of 298 senior secondary school students consisting 178 males and 120 females from 6 secondary schools in Plateau state were used. Two schools were selected from each of the three senatorial zones. The two instruments which are Attitude Towards Science Questionnaire (ATSQ) a five point Likert Scale and Students Achievements Scores (SAS) in science subjects were validated by experts. The reliability index of $r=0.83$ and $r=0.87$ of the instruments were obtained respectively using Cronbach's Coefficient Alpha. Two research questions were answered using descriptive statistics of mean and standard deviation and two hypotheses were tested using t-test at 0.05 level of significance. The results of the study revealed significant differences in the attitude of male and female students in favour of the males. The study also revealed that the achievement scores of male students in science were higher than their female counterparts. It is thus recommended among others that maximum efforts should be made by teachers to improve students' attitude towards STEM education.

Keywords: Investigating, STEM Education, Gender Differences, Attitude and Achievement

Introduction

Science, Technology, Engineering and Mathematics (STEM) has contributed in no small measure to the development and comforts of the modern world. Relzewki (2009) stated that for any nation to attain the status of self-reliance, STEM education must be an important component of the knowledge to be given to all citizens of that nation irrespective of race, creed or gender. Indeed, science is recognized as the foundation upon which bulk of the present day is built. Shaibu (2014) expressed the opinion that Nigerian citizens pursue Science, Technology, Engineering and Mathematics (STEM) education which is a process of learning that builds students towards national development in order to prevent Nigeria from being perpetual slave to the developed world. The prestige and political power of any nation also resides largely in its level of scientific achievement.

Investigating gender differences is a process to find out whether male and female enjoy the same opportunities for realizing their human rights and rights to contribute to all spheres of national development and benefits from such

development (Okoli, 2012). One of the cardinal points in the Nigeria's philosophy of education is need for equality of educational opportunities to all Nigerian children irrespective of male and female, each according to his/her ability (FRN, 2003). Gender became an important issue in science and technology in 1993 through the activities of the United Nations Commission on Science and Technology for Development. The gender dimension of science and technology came as a result of series of reports on International Conferences such as World Conference on International Women's year (2007), World Conference of the United Nations Decade for Women Equality, Development and Peace (2012), and Concerns expressed by Science, Technology, Engineering and Mathematics experts (2016) about the situation of women and the field of natural science, education, health, food and security. These reports all pointed to the fact that there are gender gaps in the field of Science, Technology, Engineering and Mathematics (STEM) Education.



Dawal, B. S.

Altitude is a mental and neural representation organized through experience, exerting a directive or dynamic influence on behaviour (Orunaboka, 2015). Also Yasar (2016) viewed attitude as relatively enduring organization of beliefs, feelings and behavioural tendencies towards socially significant objects, groups, events or symbols. However, attitude plays a very important role in the development and progress of human identity and values. They are formed by people as a result of some kinds of learning experience if the experience is favourable, a positive attitude is found and vice versa (Orunaboka, 2015).

Attitude towards science has gained a lot of attention in the field of STEM education especially from the perspective of teaching and learning. It has been noticed that students find science to be a very difficult and boring subject (Osborne, Simon and Collins, 2016). Research has shown that students manifest the highest level of positive attitude towards STEM before the age of eleven which significantly declines over the middle school and high school years (Sakariyau, Taiwo and Ajagbe, 2016). Thus, their interest in science declines as some of them view STEM education is for boys rather girls and that scientists are generally odd people. One of the reasons girls have negative attitude towards science education is due to the abstract nature and complexity of science (Boran, Aslander and Cakan, 2013). The researchers added that such negative attitude has led female students to not willing to take STEM class seriously because of their belief that it is difficult, boring, time consumption which only the male counterparts can do that. This affects their achievement in science, their ability to develop good problem solving skills and competencies, and their ability to develop confidence in learning science subjects.

With many secondary schools and students (boys and girls) developing possible attitude towards STEM, more people will develop interest in the Courses to higher levels and our economic growth and manpower production will be improved there will be less dependent on foreign products.

Nevertheless, in Nigeria, there is the problem of gender differences in the attitude and achievement of students towards STEM education especially in secondary schools.

Yahaya (2015), Emma (2016) and a host of others noted that gender has impact on the attitude and achievement of students towards STEM education. Male supremacy and gender stereotyping are factors among others that were identified to have influenced occupational choice. Hence Langka and Adebayo (2014) are of the opinion that science and technology is a male dominated subject and that females tend to shy away scientific and technological fields and that those that have ventured into it achieved less than their male counterparts. These researchers concluded that males therefore, appear to have a natural positive attitude to science and technological subjects and as such achieved better, while females show negative attitude and therefore achieved less. This negative attitude and presumptions that male students achieved better than female students in science and technology subjects appears to be due to the acceptance of the myth that males are better in the subject than females.

Gender differences in the attitude and achievement of student often reported in science subjects. Nwaswu and Audu (2015) reported that gender difference exists in the attitude and achievement of students towards biology, physics, chemistry and mathematics but that is reducing over the years Analysis of WAEC result of 2016, Kola (2016) reported that 7.32% and 6.42% of male and female students respectively obtained credit pass.

Most conversation in our country today are cantered on science and technology. Nigeria's need for Scientists and Technologists is broadcast over radio, television, read on magazines and newspapers and also seminars and workshops are organized on these issues the point now is how can these Scientist and technologist be produced without favourable attitude being developed towards student's achievement in science subjects? This means that students in secondary schools with many fears of Schooling from primary school to senior secondary schools are most likely to develop and exhibit attitude towards the study of STEM irrespective of their gender. In the present dispensation, this assertion needs to be investigated among students with close to fourteen years of schooling from the nursery school to their senior secondary school level



Dawal, B. S.

and beyond. This is necessary to ensure equal treatment of students in class at different educational levels, to ensure better achievement in STEM that can result from healthy competition among male and female students due to equal treatment from teachers and to ensure the development of high confidence in the learning of STEM subjects among the students. Therefore, this sets out to investigate gender differences in the attitude and achievement of students towards STEM education in Plateau State, Nigeria. The study sets out to investigate

1. differences in the attitude of male and female students towards physics, chemistry, biology and mathematics?
2. differences in the achievement of male and female students offering physics, chemistry, biology and mathematics?

The study sets out to find answers to these questions:

1. What is the difference in the attitude of male and female students towards physics, chemistry, biology and mathematics?
2. What is the difference in the achievement mean scores of male and female students in physics, chemistry, biology and mathematics?

The following null hypotheses guided the study:

1. There is no significant difference in the attitude of male and female student offering physics, chemistry, biology and mathematics?
2. There is no significant difference in the achievement mean score of male and female students in physics, chemistry, biology and mathematics?

Methodology

The designs for this study was the descriptive survey design and the ex-post facto design. The descriptive survey design was used to obtain information on the attitude of students towards science and ex-post facto design was used to obtain achievement scores of the students in science subjects which were

physics, chemistry, biology and mathematics. A sample of 298 senior secondary school students consisting 178 males and 120 females from six secondary schools in Plateau state were used. Out of the population of 17 boarding schools with a total of 4,761 (2,695 males and 2,066 females) senior secondary two students offering science subjects (physics, chemistry, biology and mathematics). The simple random sampling technique was used to select two public boarding secondary schools in each of the zones. Boarding schools were used because the students are always available in their schools. The instruments for data collection were the Attitude Towards Science Questionnaire (ATSQ) a free point likert scale and students' Achievement Scores (SAS) in science subjects. The ATSQ was made up of four sub-sections dealing with interest (seven items) motivation (seven items) enjoyment (seven items) and vaulting (three items). These constitute descriptions of gender differences in the attitude of students towards science. The items were drawn from a free point of strongly agree, agree, undecided, disagree and strongly with 5, 4, 3, 2 and 1 points respectively. The instruments were validated by two experts in the Department of Science and Technology Education and an expert in test and measurement evaluation in the Department of Educational Foundation, University of Jos. The reliability of the instruments were established using Cronbach's Alpha coefficient and reliability index of 0.83 and .87 were obtained respectively. This showed that the instruments were highly reliable. Research questions were answered using descriptive statistics of mean and standard deviation, while the hypotheses were tested using t-test at 0.05 level of significance.

Result

Research Question 1: What is the difference in the attitude of male and female students towards physics, chemistry, biology and mathematics?



Dawal, B. S.

192-200

Table 1: Mean Responses Differences in Male and Female Students towards Physics

S/No.	Variables	Male Mean	S.D	Female Mean	S.D	Mean Difference
1	Interest	3.42	1.40	3.30	1.32	0.12
2	Motivation	2.35	1.25	2.36	1.15	0.01
3	Enjoyment	0.86	0.66	0.79	0.62	-0.07
4	Valuing	1.04	.95	1.10	1.19	-0.06
Average Mean		1.92		1.89		0.03

Table 1 showed the mean differences in the attitude of students towards physics. The table revealed that the mean score of 3.42 and 3.30 with mean difference of 0.12 showed male students have interest in physics than their female counterparts. With mean of 2.35 and 2.36 with mean difference of 0.01, the table also revealed that female students are motivated into learning physics than their male counterparts. With the means of 0.86 and 0.79 with mean difference of -0.07, it was

revealed that males have enjoyment to physics than the females with means of 1.04 and 1.10 with mean difference of -0.06. The result showed female students value physics than the male students. With mean average of 1.92 and 1.89 with mean difference of 0.03, the result showed that males have higher attitude which signifies there is differences in the attitude of male and female students towards physics.

Table 2: Gender Differences in Attitude of Male and Female Students Towards Chemistry

S/No.	Variables	Male Mean	S.D	Female Mean	S.D	Mean Difference
1	Interest	3.53	1.04	3.27	1.51	0.26
2	Motivation	2.41	1.19	2.33	1.20	0.08
3	Enjoyment	0.96	0.65	0.75	0.63	0.21
4	Valuing	1.11	1.01	1.05	1.11	0.06
Average Mean		1.99		1.85		0.14

The table revealed that, with mean of 3.53 on male interest is higher than 3.27 with mean difference of 0.26 on female interest in chemistry, the males had interest in chemistry than their female counterparts. Also with a mean of 2.41 which is higher than 2.33 with mean difference of 0.08, signifies the same thing in terms of motivation. With mean of 0.96 and 0.75 with mean difference of 0.21,

shows the same in enjoyment. The same difference is obtained in valuing where male students value chemistry with mean of 1.11 than the females with 1.05 with mean difference of 0.06. With an average mean of 1.99 which is higher than 1.85 with a mean difference of 0.14 revealed that male students' attitude towards chemistry is higher than that of the females.

Table 3: Gender Differences in Attitude of Male and Female Students Towards Biology

S/No.	Variables	Male Mean	S.D	Female Mean	S.D	Mean Difference
1	Interest	3.30	1.32	3.42	1.40	-0.12
2	Motivation	2.35	1.15	2.36	1.25	-0.01
3	Enjoyment	1.10	1.19	1.04	0.95	0.06
4	Valuing	.79	.25	.86	0.66	-0.07
Average Mean		1.89		1.92		-0.03

Table 3 showed gender differences in the attitude of students towards biology. The table revealed the means of 3.30 and 3.42

with mean difference of -0.12 showed that female students have higher interest towards biology than their male counterparts. While means of 2.35 and 2.36 with mean difference



Dawal, B. S.

192-200

of 0.01, the result indicated that female students have high motivation than the males. Also with means of 1.10 and 1.04 with mean difference of 0.06 showed that female students have high enjoyment of biology than the male students. While the means of 0.79 and 0.6 with mean difference of -0.07 showed

that male students' mean averages of 1.89 and 1.92 with mean difference of -0.03, the results indicate that female students have high attitude towards biology than the male students. This signifies the difference in the attitude of students towards biology.

Table 4: Gender Differences in Attitude of Male and Female Students Towards Mathematics

S/No.	Variables	Male Mean	S.D	Female Mean	S.D	Mean Difference
1	Interest	3.53	1.04	3.27	1.51	0.26
2	Motivation	2.41	1.19	2.33	1.20	0.08
3	Enjoyment	0.96	0.65	0.75	0.63	0.21
4	Valuing	1.11	1.01	1.05	1.11	0.06
Average Mean		1.99		1.85		0.14

Table 4 result showed gender differences in the attitude of students towards mathematics. The table revealed that, with mean of 3.53 on male interest is higher than 3.27 with mean difference of 0.26 on female interest in mathematics, the males had interest in mathematics than their female counterparts. Also with a mean of 2.41 which is higher than 2.33 with mean difference of 0.08, signifies the same thing in terms of motivation. With mean of 0.96 and 0.75 with mean difference of 0.21, shows the same in enjoyment. The same difference is obtained in valuing where

male students value mathematics with mean of 1.11 than the females with 1.05 with mean difference of 0.06. With an average mean of 1.99 which is higher than 1.85 and a mean difference of 0.03 revealed that male students' attitude towards mathematics is higher than that of the females.

Research Question 2

What is the difference in the mean achievement scores of male and female students in physics, chemistry, biology and mathematics?

Table 5: Gender Differences in the Mean Achievement Scores of Male and Female Students in Physics

Gender	Mean	S.D	Mean Difference
Male	61.92	10.44	10.07
Female	51.85	8.54	

Table 5 result showed differences in the achievement mean scores of male and female students. With the mean scores of 61.92 which is higher than 51.85 with mean

difference of 10.07 revealed that male students achieved higher than the female students in physics.

Table 6: Gender Differences in the Achievement Mean scores of male and female Students in Chemistry

Gender	Mean	S.D	Mean Difference
Male	62.91	10.45	10.07
Female	52.84	8.55	

Table 6 showed gender differences in achievement of male and female students towards chemistry. With a mean of 62.91 which higher than 52.84 with mean

difference of 10.07 signified that mean achievement score of male students in chemistry is higher than the female students.



Dawal, B. S.

192-200

Table 7: Gender Differences in the Achievement Mean Scores of Male and Female Students in Biology

Gender	Mean	S.D	Mean Difference
Male	56.06	11.55	0.84
Female	56.90	10.24	

Table 7 revealed the differences between the achievement mean scores of male and female students in biology. The achievement mean scores of 56.90 which is higher than 56.06

with mean difference of 0.84 showed that female students achieve higher mean scores in biology than the male students.

Table 8: Gender Differences in the Achievement Mean scores of male and female Students in Mathematics

Gender	Mean	S.D	Mean Difference
Male	62.91	10.45	10.07
Female	52.84	8.55	

Table 8 showed gender differences in achievement of male and female students towards mathematics. With a mean of 62.91 which higher than 52.84 with mean difference of 10.07 signified that mean achievement score of male students in

mathematics is higher than the female students.

Hypothesis 1

There is no significant difference in the attitude of male and female students offering physics, chemistry, biology and mathematics.

Table 9: A t-test Analysis of Gender Differences on Attitude of Students Towards Physics

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	59.36	5.26	295	1.96	0.032	SIG
Female	120	57.26	6.65				

Table 9 revealed that the p-value (0.032) alpha value (0.05) while the calculated t-value- 1.96, thus the null hypothesis is rejected. Thus there is a significant difference

in the attitude of male and female students towards physics and in favour of male students.

Table 10: A t-test Analysis of Gender Difference in the Attitude of Students Towards Chemistry

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	59.90	10.24	295	0.862	0.008	SIG
Female	120	56.06	11.55				

Table 10 showed that the p-value (0.008) = alpha value (0.05) while the calculated t-value -0.862, hence the null hypothesis is rejected. Thus, there is significant difference

in the attitude of male and female students towards chemistry in favour of the male students.



Dawal, B. S.

192-200

Table 11: A t-test Analysis of Gender Difference in the Attitude of Students Towards Biology

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	52.89	10.45	295	11.016	0.000	SIG
Female	120	62.91	8.55				

Table 11 showed that the p-value (0.000) = alpha value 0.05, df=295 while the calculated t-value = 11.016 hence, the null hypothesis is

rejected. There is a significant difference in the attitude of male and female students in favour of female students.

Table 12: A t-test Analysis of Gender Difference in the Attitude of Students Towards Mathematics

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	59.90	10.24	295	0.862	0.008	SIG
Female	120	56.06	11.55				

Table 12 showed that the p-value (0.008) = alpha value (0.05) while the calculated t-value -0.862, hence the null hypothesis is rejected. Thus, there is significant difference in the attitude of male and female students towards mathematics in favour of the male students.

Hypothesis Two

There is no significant difference in the achievement, mean scores of male and female students in physics, chemistry, biology and mathematics.

Table 13: A t-test Analysis of Gender Difference in the Achievement Mean Scores of Students in Physics

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	49.76	16.46	275	0.219	0.032	SIG
Female	120	41.91	19.09				

The result of analysis in Table 13 showed calculated as 2.19 and p-value is 0.032 obtained at a- 0.05 of 295. Since p-value 0.032 is less than 0.05, this indicates a

significant difference in the mean difference in the mean achievement scores of male and female students in physics in favour of the male. Hence the null hypothesis is rejected

Table 14: A t-test Analysis of Gender Difference in the Achievement of Students in Chemistry

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	17.05	12.29	179	-2.05	0.042	SIG
Female	120	27.95	14.13				

Results analysed on table 14 showed t-cal as 2.05 and p-value is 0.042 obtained at a=0.05, df 295. Since p-value, 0.042 is less than 0.05;

this indicates a significant difference in the achievement mean scores of male and female students in favour of the males.

Table 15: A t-test Analysis of Gender Difference in the Achievement of Students in Biology

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	17.05	2.56	295	2.31	0.03	SIG
Female	120	18.80	2.24				



Dawal, B. S.

192-200

The results of analysis in table 15 showed t-cal as 2.31 and p-value 0.03 obtained at $\alpha=0.05$, df 295. Since p-value 0.031 is less than 0.05 indicates a significant difference in the

mean achievement scores of male and female students in biology in favour of female students.

Table 16: A t-test Analysis of Gender Difference in the Achievement of Students in Mathematics

Gender	N	Mean	SD	Df	t-value	p-value	Remark
Male	178	17.05	12.29	179	-2.05	0.042	SIG
Female	120	27.95	14.13				

Results analysed on table 16 showed t-cal as 2.05 and p-value is 0.042 obtained at $\alpha=0.05$, df 295. Since p-value, 0.042 is less than 0.05; this indicates a significant difference in the achievement mean scores of male and female students in mathematics in favour of the males.

Discussion

The findings of this study revealed that there are still gender differences in the attitude of male and female students with female students not having positive attitude towards STEM education. Male students have positive attitude towards science more in physics, chemistry and mathematics while the female students have positive attitude towards biology.

This is evidence that gender differences still exist in the teaching and learning of science subjects with less attention to the female folk. This is in line with the findings of Boran, Aslander and Cakan (2017) and Shaibu (2018) who discovered that there are differences in the attitude of male and female students in science subjects. The female students always shy away from science subjects complaining that it is difficult. Perhaps most female students still consider science subjects as more suitable for males. As discovered in this study and also stated by Okoli (2015) and Sakariyau, Taiwo and Ajagbe (2016) that if this trend is not urgently cursed, the realization of gender equality aspect of STEM education for national development may still remain farfetched. Lack of motivation and encouragement on the part of the teachers to the female students could also have contributed to their lack of interest in science. Information gathered in the course of this study through informal interview of the teachers revealed that even

some of the female students who did well in Junior secondary school (JSS) basic science are afraid to choose science subjects in senior secondary level because of the notion that science is difficult.

The current study further discovered that male students achieved higher mean scores than their female counterparts in physics, chemistry and mathematics, while the female students had higher mean scores than their male counterparts in biology. This outcome supported the results of Osborne, Simon and Collins (2015), Belzewski (2015), Orunaboka (2018) and Yasar (2016) who reported that male students performed higher than the female students in physics, chemistry and mathematics in tertiary institutions. This present study discovered that female students achieved higher in biology than their male counterparts. If female students are adequately encouraged right from primary schools, most of them who are afraid of science will definitely choose science subjects. This implies that female attitude towards science and achievement needs to be enhanced and motivated by both teachers and parents through building up their confidence, self-concept, and belief to take up any science task they are confronted with. Also Kola (2017) stated that urgent sensitization of female students to choose science subjects in schools especially those who have seen performing well.

Conclusion

This study has revealed that there is gender differences in the attitude and achievement of students towards science. Male student exhibited positive attitude towards physics, chemistry and mathematics than their female counterparts. However, it is interesting to note that despite the low attitude and



Dawal, B. S.

achievement of female students in physics and chemistry, the female students have positive attitude towards biology. The study also found that male students achieved higher than the female students in physics, chemistry and mathematics, while the female students achieved higher than the male students in biology. Hence there is gender differences in the attitude and achievement of students towards STEM education.

Recommendations

Based on the results of this study, the following recommendations are made:

1. Maximum efforts should be given to improve the attitude and achievement of students towards STEM education and also encourage the female students not to see it as a masculine subject.
2. Female science students should be motivated through awards and incentives by school administrators.
3. Teachers should be encouraged to play their role by teaching effectively without any gender differences.
4. Teachers should be sponsored by government, school authorities and agencies to attend workshops and conferences to enhance their pedagogical knowledge, skills and teaching strategies in STEM education.

References

Belzewski, A. (2015). Aecolonizing science education and the science teacher. A white teacher's perspective. *Canadian Journal of Science, Mathematics and Technology Education*, 9(1), 168-174.

Boran, A. I., Aslander, R. & Cakan, C. (2013). First grade pre-service teachers in Mathematics and their attitudes towards some variables. *Turkish Journal of Computer and Mathematics Education*, 4(1), 1-19.

Federal Government of Nigeria (2003). Workbook on innovative strategies for attaining gender equality in basic education. Abuja: NERDC Press

Kola, A. J. (2017). Uses of instructional material for teaching and learning physics. *International Journal of Research in Education*, 4(1), 74-78.

Nwaiwu, N. E. & Audu, B. (2015). Influencing factor in female engineering and technical education in Nigeria. *Knowledge Review*, 10(1), 8-11.

Ogborne, J., Simon, S. & Collins, S. (2016). Attitude towards sciences: A review of the literature and other implications. *International Journal of Science Education*, 25(9), 1049-1079.

Okoli, A. J. (2015). Enhancing gender equality in entrepreneurship education through science and technology in secondary schools in Nigeria. *Gender and Development Goals Journal*, 13(1), 26-34.

Orunabaka, T. T. (2016). Attitude of Nigeria secondary school students towards physical education as a predict of achievement in the subject. *Journal of Education and Practice*, 2(6), 1-8.

Sakariyau, A. O., Taiwo, M. O., & Ajagbe, O. W. (2016). An investigation on secondary school students' attitude towards science in Ogun State, Nigeria. *Journal of Education and Practice*, 7(28), 125-128.

Shaibu, A. Y. (2014). Science, Technology and Mathematics Education for National Development; The teacher is the key. *Journal of Science and Mathematics Education*, 1(1), 49-588.

Yasar, M. (2016). High school students' attitude towards Mathematics. *Eurosic Journal of Mathematics, Science and Technology Education*, 12(4), 931-945.