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Effects of Gender Related Factors on Students' Academic Performance in Chemistry among Senior Secondary Schools in Katsina Metropolis, Nigeria

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ABSTRACT

The study examined how gender affects chemistry performance in Katsina senior secondary schools. At 95% confidence, 336 respondents were chosen from 8,932 total. Sample size was chosen using simple random sampling. Simple percentage and mean were used to analyse study data. Respondent responses were compared to questionnaire items per research question. The data showed that Katsina senior secondary school boys and girls perform differently academically. The study suggested boosting teachers' numeration and fringe benefits to inspire them to work and improve academic performance of boys and girls in Katsina Metropolis' senior secondary schools. To change unfavourable classroom attitudes and behaviours towards females, instructors should get gender-sensitive workshop training. Last, the government should provide schools with desks, chairs, water lighting, and books to aid learning and teaching.

Keywords: Academic performance**,** Chemistry, Gender bias, Senior secondary schools**,** Students.

INTRODUCTION

The Global perception about sex differences and its implications on academic performance cannot be underestimated. Various views of scholars have been stated to support or counter this statement. In fact, it was said that the socio-economic background of any nation has a greater effect in female educational development than males[1]. It is on these reasons that this research project aim to study gender differences and its implication on academic performance of Chemistry students in accordance with chemistry education. Chemistry education is described as a comprehensive term used to study teaching and learning of chemistry topics, the effective utilization of teaching aids and reactions of individuals to the changes in nature[2]. Sex on the other hand can be described as a word used to describe the Biological nature of a person, animals or plants[3]. It is broadly described into male and female. However, the status and conditions for developmental processes of an individual is not complete if education activities is not included. This has become a standard statements agreed upon by various scholars in the educational industry. Education is the process by which children, youth, and adults are taught to develop and improve their abilities, attitudes, values, and other positive behaviours to help them improve themselves, others, and society [4]. A nation's development depends on its residents' education, especially in science and technology. Excellence in education is a key to national development [5]. Since an educational revolution is needed to change people's intellectual and social orientation, it is considered the most significant tool of change[6]. In Nigeria, secondary schools provide science disciplines like chemistry to prepare students for science and technology development [7]. Chemistry is an experimental science that examines organic, inorganic, and elemental matter composition, characteristics, and activities[8]. However, the West African Examination Council (WAEC) Chief Examiners report WAEC (2015) on Chemistry results shows that SSCE Chemistry students struggle with stoichiometry. The WAEC Chief Examiner

attributed students' poor performance to their unfamiliarity with simple laboratory equipment, inadequate exposure to laboratory techniques, lack of observational skills, omission of units in calculated values, inability to write chemical equations correctly, assign correct charges to ions, and inability to perform simple calculations. Ekeyi [9] remarked that demonstration is popular for teaching SSCE physical Chemistry concepts like Stoichiometry. The researcher said that demonstration approach is teacher-centered since students are not involved sufficiently. Functional education emphasises internalisation of real tasks that may be implemented in any scenario rather than regurgitation of knowledge and theories. Learning concrete activities involves using equipment. Weighing, measuring, demonstrating, testing/experimenting, and other activities can help pupils learn concepts like stoichiometry taught in senior secondary schools. In the ancient time, it is noticed that female education end up in her husband's house. Only female has less contribution to the economy of the society[10]. Hence, they do not participate much in normal and female education. It is a contrary view form today educational system where male and female learn under a single roof, where students who are ambitious funds their studies. Generally it was suggested that more male aspire higher than female student. From this statement it may be concluded that the high lead of aspiration by male student enable them to further their academic pursuit in various institutions of learning. It is on these note, that this research work will examine gender variable and its implication on academic performance of chemistry students.

The concept of Chemistry

Chemistry is one of the basic sciences whose teaching and learning are reliably effective when done simultaneously with suitable instructional tools and facilities inside and outside the lab. Chemistry is vital in biochemistry, medicine, nuclear radiations, thermolysis, physiotherapy, and molecular chemistry, so it has become a central focus in most human activities, including health, poverty eradication, natural resource management and conservation, biotechnology, ethics, various social vices, and lack of appropriate infrastructure. Science disciplines included in Nigerian senior secondary certificate exams include chemistry[11]. This subject is popular among students, and its popularity among science disciplines makes it a distinct choice for all students[12]. Chemistry is essential for studying medicine, agriculture, pharmacy, biotechnology, genetic engineering, and other science fields. Any society's economic, intellectual, sociological, human resource, and well-being depend on chemistry. Biotechnology and genetic engineering demonstrate their value for individual and societal development[13]. Based on these claims about chemistry's importance, secondary schools must appropriately teach it to boost student performance. Today, science affects man in all areas of life, including feeding, clothing, shelter, health care, communication, transportation, space exploration, and leisure. Science's medical and technological applications have had the greatest impact on health care, lifestyles, and society, according to Mayer[14]. Science shapes cultural worldviews, conceptions, and thinking habits in many modern countries. We must remember that science is useful now. Science affects almost every element of human life[15]. Science literacy is necessary for human comfort. This emphasises the necessity for scientific literacy in Nigerian education. One cannot overstate the importance of science in national growth. Waith and Neuma[16] agreed that scientific knowledge of subjects is essential for a nation to develop 21st-century technologies. Any nation's growth reflects its scientific progress. Science is taught in schools across Nigeria, and any nation that wants to progress must teach it[17]. Science courses include chemistry. The science of life is chemistry. It is a mandatory science course in all Nigerian senior secondary schools for science and arts students. Chemistry education helps pupils understand the world and produce a progressive society, according to Wanja and Silas[18]. The duo added that chemistry teaches students to apply science concepts and principles to everyday concerns.

Academic performance of boys and girls

In arts and sciences, sex inequalities in academic performance are contentious. The results are uneven even today, despite scholars becoming interested in the subject in the early 20th century. Some researchers blame methodological faults, while others say circumstances that benefit boys and girls' academic achievement, such as girls' dislike to physical sciences, may explain the inequalities. Nugru[19], who researched secondary school science, concluded that boys fared much better than girls and suggested that learning processes effect girls and boys differently. According to Oladejo et al. [20], many research have demonstrated that boys perform better in chemistry than girls. His study is outdated, but the current study examines if such a notion still holds. In integrated science at junior secondary school, Eseine [21] found that boys outperform girls. Male Nigerian secondary school chemistry students outscored female pupils in chemical problem solving, according to Adigwe [22]. Penner and Paret [23] found that boys and girls' achievement gaps in all subjects decrease

except in maths. Garetz and Karimi[24] say girls outperform boys in school. It is commonly known that girls outperform boys in reading examinations, but there is now evidence that the gender gap in maths and science, traditionally male-dominated fields, is decreasing.

Factors that lead to academic performance in boys and girls

Self- efficacy

Artino[25] stated that self-efficacy pertains to people's assessments of their behaviour capacities. Schunk & Gunn[26] also agreed that students' self-efficacy affects their actions, efforts, ability to persist, and tasks they can complete at a given time.

Teachers attitudes and behavior

Malik, Nadeem, and Tariq [27] suggest that teachers' attitudes towards teaching and female students affected student performance. According to Bohlmann and Weinstein[28], instructor expectations, attitudes, and classroom interaction affect females' math and allied science performance.

School facilities

Ngozi and Halima [29] argued that inadequate school amenities such teacher supplies, water, bathrooms, lab equipment, and basic instructional and demonstrational materials substantially affect student performance by gender.

Ability

Brotman and Mensah [30] advised girls to excel in maths to succeed in science. Chemistry skills are required for scientific and technological careers. Cook, Greenberg, and Kusche[31] discovered that girls blamed personal issues for failure, while boys blamed environmental factors.

Gender biases and stereotypes

Oswald[32] found that gender role assumptions, occupational stereotypes, gender bias in school, career counselling, low self-esteem, and low success expectations prevent women from taking chemistry and science courses.

Parental and family attitudes

Baiocco and Pistella[33] found that good attitudes about science help daughters succeed in science. They propose parents openly discuss their attitudes and performance. Porumbu and Necsoi[34] showed that parental attitudes towards their children affect resource allocation and parental engagement education. Negative attitudes regarding girls' education effect their household and school performance, participation, and time use.

Gender

According to Adigun et al.[35], gender composition affected secondary school pupils' academic performance in Edo state, Nigeria. His study was generic, but the current study will look at subject-level performance as well.

Attitudes and interest

Magallanes[36] science aversion Chemistry and technology caused poor performance, whereas positive attitudes towards SMTs helped students perform well. She said that chemistry attitude strongly predicts success in related professions. Ross, Scott, and Bruce[37] discovered that sex variations in chemistry beliefs cause the achievement gap between boys and girls. The brief literature agrees that some factors can cause boys and girls to perform differently, with various degrees and subject emphasis. Although the subject has been studied for decades, researchers in other nations, notably in the west, have found inconsistent and inconclusive results. Patriarchal structures strongly affect performance, and the school system reflects society's views on girl education. Educational provision for boys and girls favoured boys. Girls' school enrollment is remains low, especially in rural regions, despite the government's efforts in recent years. The country's education programme shows that the government is prioritising girl education.

Theoretical framework

John Dewey's cognitive theory underpinned the investigation. This theory believes that knowledge only arises when learners must draw it out of meaningful learning. Brain-based learning is explained by cognitive ideas beyond behaviour. Cognitivists study how memory aids learning. Cognitive theory educators value physiological processes of sorting and storing information and events into short-term and long-term memory. The locus of control over learning distinguishes gestaltists from behaviourists. Gestaltists prioritise learners over environments[38]. Dewey believed that education and learning are social and participatory processes and that the school as a social institution allows for social improvement. He views the classroom as a social setting where students can manipulate resources and establish a learning community. Dewey believed in one

constant: the organic relationship between education and human experience. He believed that each experience influences others and leads to constructive attitudes and understanding. Dewey thought that children thrive in an atmosphere where they may experience and interact with the material, thus all pupils should be able to participate in their own learning[39]. Greenwalt[40] stated that Dewey believed that educators' primary responsibility is to help students shape their experience by providing an environment that allows them to use their surroundings to build experiences that interact with their personal desires to learn. Dewey also stressed the importance of the kid and the curriculum (the subject matter) and that the curriculum should be given in a way that allows pupils to tie the information to prior experience to increase their understanding. Dewey advocated hands-on learning and taught that knowledge cannot be gained without objects that influence the mind. Dewey, a constructivist, thought that teachers/instructors help students construct their own learning and find meaning in the subject [41]. This study suggests that Dewey's theory requires pupils to participate in meaningful activities that help them apply their learning. Teachers should provide an environment for active learning, such as guided inquiry.

METHODOLOGY

Research design

The research design adopted for this study was descriptive survey design. This involved the collection of data or information from the school heads, chemistry teachers, chemistry students, as well as the chemistry laboratory attendants' within the study area and all the variables to be studied. The term survey actually refers to one, or some combination of two procedure(s): questionnaires and interviews.

Population of the study

The population of the study comprises all public secondary schools in Katsina metropolis of Katsina state, all the students in the senior sections of these schools were the population of this study. There are 11 schools in the area with a total number of 8,932 students. Therefore, the summary of the population of this study will be present in the table 1 below.

Table 1: Population of SSI male and female students

S/NO	Names Schools	Males	Females	Total
1.	Dikko College	298	149	447
2.	Family Support	83	42	125
3.	Gov't College Katsina Day	902	425	1354
4.	Gov't Day Kambarawa	511	200	711
5.	Gov't Sec. School D/safe	182	92	274
6.	Gov't School For Blind Katsina	65	33	138
7.	Gov't Sec. School K/kaura	775	398	1163
8.	Gov't Sec. School K/yandaka	1078	540	1618
9,	Government Day Dutsin-safe	512	200	712
10.	Katsina College Katsina (KCK)	942	417	1413
11.	Sir Usman Nagogo College of Arabic and Islamic Studies	678	339	1017
	Total	**5715**	**3146**	**8,932**

(Source: Zonal Education Quality Assurance Office Katsina Zonal, 2022)

Sample and sampling techniques

A sample size of 336 respondents were selected from the total population of 8,932 at 95% confidence level and 5% precision. The sample size selection was selected using stratified random and purposive sampling techniques.

Table 2: Sample of the study

S/N	Name of School	Population
1	Government Secondary School Batagarawa	106
2	Gov't Sec. School Dandagoro	118
3	Government Secondary School Kofar Yandaka	112
	Total	***336***

RESULTS

Table 3: Respondents' responses on the nature of academic performance of boys and girls

S/N	ITEMS	**SA** 4	**A** 3	**D** 2	**SD** 1	N		Decision
1.	Boys performed significantly better than girls do	180 720	92 276	38 76	26 26	336 1098	3.27	Accepted
2.	Girls Chemistry achievement is superior to that of boys	192 768	70 210	43 86	31 31	336 1095	3.26	Accepted
3.	Male students tend to score higher marks than females do in Chemistry	179 716	65 195	52 104	40 40	336 1055	3.14	Accepted
4.	Boys and girls grow up the differences they have in achievement in other subject diminish except in Chemistry	183 732	61 183	59 118	33 33	336 1066	3.17	Accepted
5.	Traditionally, shown that boys Chemistry achievement is superior to that of girls	180 720	92 276	38 76	26 26	336 1098	3.27	Accepted
6.	Girls perform much better than boys in many school subjects including Chemistry, and chemistry	179 716	65 195	52 104	40 40	336 1055	3.14	Accepted

Data from table 3 showed that high mean score items 1, 2, 3 and 4 had the mean values of 3.27, 3. 3.27, 26, 3.14, 3.14 and 3.17 respectively. The values were up to 2.5 and above which was interpreted as accepted, and therefore indicates that; boys performed significantly better than girls do, boys chemistry achievement is superior to that of girls, male students tend to score higher marks than females do in chemistry, and boys and girls grow up the differences they have in achievement in other subject diminish except in chemistry among chemistry senior secondary school in Katsina metropolis.

Table 4: Respondents' responses on the differences in academic performance of boys and girls

S/N	ITEMS	**SA** 4	**A** 3	**D** 2	**SD** 1	N		DECISION
1.	Girls outperform boys because they tend to work more conscientiously and word fluency	165 660	69 207	62 124	40 40	336 1031	3.07	Accepted
2.	I did not learn any of the Girls typically score higher on verbal items and boys on quantities	34 136	43 129	119 238	140 140	336 643	1.91	Rejected
3.	Spatial items in both intelligence and achievement tests	203 812	72 216	35 70	26 26	336 1124	3.35	Accepted
4.	Male student put up a superior performance as compared to female student	192 768	122 366	12 24	10 10	336 1168	3.48	Accepted
5.	In early years there no gender differences in achievement of boys and girls in early school	165 660	69 207	62 124	40 40	336 1031	3.07	Accepted
6.	Gender differences become more apparent in the higher classes with boys performing better than girls in the areas involving calculations	179 716	65 195	52 104	40 40	336 1055	3.14	Accepted

Data from table 4 showed that high mean scores were obtained for all the four listed items. Specifically, item 1, 3, and 4 had the mean values of 3.07, 3.35 and 3.48, respectively. The values were up to 2.5 and above which was interpreted as accepted, and therefore indicates that; girls outperform boys because they tend to work more conscientiously and word fluency, example, in item four out of 336 students almost 192 students strongly agreed that Male student put up a superior performance as compared to female student which is 57% of the students, only 3% were strongly disagree that Male student put up a superior performance as compared to female student. in item four, item 2 had the mean value of 1.91, the value were not up to 2.5 which was interpret as rejected, thus the students did not believe that male student put up a superior performance as compared to female student.

Table 5: Respondents' responses on the factors leads to academic performance between boys and girls

S/N	ITEMS	SA	A	D	SD	N		DECISION
		4	3	2	1			
1.	Parental and Family Attitudes.	198 792	89 267	30 60	19 19	336 1138	3.39	Accepted
2.	Teachers Attitudes and Behavior	188 752	92 276	33 66	23 23	336 1117	3.32	Accepted
3.	School Facilities	200 800	87 261	34 68	15 15	336 1144	3.40	Accepted
4.	Gender Biases and Stereotypes	197 788	95 285	40 80	4 4	336 1157	3.44	Accepted
5.	Environmental factors	198 792	89 267	30 60	19 19	336 1138	3.39	Accepted
6.	Nature of the subject	165 660	69 207	62 124	40 40	336 1031	3.07	Accepted
7.	Religious factors	165 660	69 207	62 124	40 40	336 1031	3.07	Accepted
8.	Socio-economic background of the parents	188 752	92 276	33 66	23 23	336 1117	3.32	Accepted

Data from table **5** showed that high mean scores were obtained from all the four listed items. Specifically, item 1, 2, 3, and 4 had the mean values of 3.39, 3.32, 3.40 and 3.44 respectively. The values were up to 2.5 and above which was interpreted as accepted, and therefore indicate that factors that leads to the academic performance between boys and girls are: gender biases and stereotypes, school facilities, teachers attitudes and behavior and parental and family attitudes.

DISCUSSION OF FINDINGS

Table 3 shows that boys performed significantly better than girls in senior secondary school in Katsina Metropolis in chemistry. The foregoing results coincide with Forrest [42], who discovered that boys scored much better than girls and suggested that learning processes alter girls and boys' understanding. Spiel et al.[43] found that boys performed higher on all levels than girls, and that classroom context explained the discrepancies. Table 4 shows that girls outperform boys due to their conscientiousness and word fluency. Girls score higher on verbal items and boys on numbers, spatial things in IQ and achievement exams, and Male students performed better than female students. The widely used cognitive tests rarely show differences between females and boys, according to Stumm and Plomin[44]. In IQ and accomplishment exams, girls score higher on verbal items and boys on numerical and spatial items. Girls get better grades than boys, however after fifth grade, boys match girls in Arts and Science. No substantial gender discrepancy was found in over 77,000 students in 19 industrialised and developing nations, supporting Stoet and Greary[45]. Cross-national heterogeneity in sex disparities in mathematics performance, the tendency towards less gender disparity in questions, and intrinsic masculine brilliance. Table 5 revealed that parental and family attitudes, instructors' attitudes and behaviour, school amenities, and gender biases and stereotypes affect boys and girls' academic performance in Katsina Metroplis Senior Secondary Schools. The above findings agree with Pajares and Valiante[46], who found that students' self-efficacy affects the activities they do, the effort they put into them, their ability to persist, and the tasks they can complete at a given time. Betz and Hackett[47] found that a woman's self-efficacy positively corresponds with her achievement in the direction she thinks her abilities are applicable.

CONCLUSION

The study found that average male students outperformed girls. Female Katsina literature language students outperformed male students. In chemistry, boys outscored girls. Boys did well in all secondary schools, according to students, directors of studies, and head teachers. Female level II and I pass rates were dropping while male rates were rising. Girls performed higher in Kiswahili, English, and literature, whereas boys scored higher in science areas like Chemistry and Mathematics, where performance differences were significant. The study revealed the following factors that explain gender academic performance gaps: negative instructor attitudes and actions, female student time-wasting, boys reading more than girls, inadequate facilities. Student absences diminish instructor motivation and

satisfaction. Student girls have minimal inferiority complexes. Multiple factors must interact to explain gender differences in performance. Most reasons indicate to girls' inferiority to boys. The study found that raising teachers' numeration and fringe benefits to motivate them would improve academic performance of boys and girls in Katsina Metropolis senior secondary schools. Instructors need gender-sensitive workshop training to change negative classroom practices towards women. Finally, the government should give schools tables, chairs, water, and books to boost education.

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