Exploring the Mathematical Proficiency of Public Senior Secondary School Students in Connection with Gender and Achievement in Mathematics in Nigeria

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Abstract

Proficiency in mathematics is necessary for anyone who intends to be a functional member of the society to which he belongs. The study therefore assessed students' mathematical proficiency in connection with gender and achievement in mathematics using 394 public school's students from Education Districts I and IV in Lagos State, Nigeria. The study adopted an exploratory design using quantitative methods. Mathematical Proficiency (MP) was considered as a sum of all its five strands: Adaptive Reasoning (AR), Conceptual Understanding (CU), Procedural Fluency (PF), Productive Disposition (PD) and Strategic Competence (SC). Six instruments; Students' Mathematical Conceptual Understanding Checklist (SMCUC), Students' Mathematical Procedural Fluency Checklist (SMPFC), Students' Mathematical Strategic Competence Checklist (SMSCC), Students' Mathematical Adaptive Reasoning Checklist (SMARC), Students' Mathematical Productive Disposition Questionnaire (SMPDQ) and Mathematics Achievement and Skills Test (MAST) were used to collect data. Data collected were analyzed using descriptive statistics of frequency, mean, percentage and standard deviation and inferential statistics of independent samples t-test and correlation analysis. Findings showed that: students' levels of proficiency were low generally and in each of the five strands of mathematical proficiency. Gender had significant influence on students' MP (combined) and strand-wise only on CU, PF and PD. Also, all strands of MP were highly positively and significantly related to mathematics achievement. It was recommended that mathematics teachers should pay attention to developing students' mathematical proficiency in relation to its strands and also carry out periodic assessment of students' mathematical proficiency as these will result to holistic improvements in students' achievement in mathematics.

Keywords: *Mathematical proficiency, Gender, Achievement, Relationship*

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Background to the Study

Mathematics is a subject whose usage cuts across many spheres of human endeavor and the basic knowledge of mathematics is necessary for anyone who intends to be a functional member of the society to which he belongs. Kilpatrick, Swafford and Findell (2001) maintain that mathematics is one of humanity's great achievements which has enhanced the capabilities of the human mind and facilitated the development of science, technology, engineering, business, and government through its great sophistication and beauty that epitomize the power of deductive reasoning. The learning of "mathematics enables the individual to acquire skills, knowledge, aptitude, abilities and attitudes capable of making the individual functional and productive for effective developmental goals" (Ugwuanyi & Ezeh, 2013). The main aim of teaching mathematics in the secondary schools is to produce individuals who can solve societal problems using mathematics and its methods. Many school graduates are not always able to apply the mathematics learnt in school in solving mathematical and other related problems (Ezenweani, 2010). This is the result of learning mathematical concepts, facts, skills, procedures and processes in robotic ways without in-depth understanding (Imoko & Anyagh, 2012). As a result, students produced from such instructions can only boast of basic mathematical knowledge not proficiency in mathematics. In many real life cases however, not being mathematically proficient makes one unable to function.

Proficiency means the quality of being skilled and demonstrating competence in handling something. According to Kilpatrick, Swafford and Findell (2001), mathematical proficiency captures what it means for anyone to learn mathematics successfully and has five strands:(1) conceptual understanding (CU); (2) procedural fluency (PF); (3) strategic competence (SC); (4) adaptive reasoning (AR) and (5) productive disposition (PD) which are interwoven and interdependent. They defined conceptual understanding as the comprehension of mathematical concepts, operations and relations; procedural fluency as possessing the skills in carrying out procedures flexibly, accurately, efficiently and appropriately while strategic competence is the ability to formulate, represent and solve mathematical problems correctly by relating and connecting previous knowledge or solved problems to present problem or situation. Adaptive reasoning is having the capacity for logical thought, reflection, explanation and justification and productive disposition is the habitual inclination to see mathematics and its activities as sensible, useful and worthwhile coupled with a belief in diligence and one's own efficacy.

As Schoenfeld (2007) notes, cognitive revolution in the U.S. produced a fundamental shift from an exclusive emphasis on what the student knows to a focus on what the students know and can do with their knowledge (how proficient are the students?). In cognizance of the need for students to be mathematically proficient, many countries like Australia and Singapore (Grove, 2012), South Africa (Ally, 2011), Malaysia (Khairani & Nordin, 2011), the US (Schoenfeld, 2007), China (Wu, 2008) and Sweden (Samuelsson, 2010) have keyed into the mathematical proficiency goal and studies in line of mathematical proficiency have begun to be made. Study committees such as the National Research Council's Mathematics Learning Study Committee (Adding It Up, 2001), the RAND Mathematics Study Committee

(Mathematical Proficiency for All Students, 2003), the Harvard's Programme on Education Policy and Governance (PEPG) and the National Mathematics Advisory Panel (NMAP) which were established to assess, monitor and seek ways of improving students' mathematical proficiency were outcomes of the quest for such shift. Students' mathematical proficiency not just achievement has become the focus of high stake mathematics assessments, research and instructions.

According to Kepner and Huinker (2012), attempts to produce assessments that include a balance of mathematical tasks across the various strands of mathematical proficiency have begun to be made. The duo opine that the assessments of mathematical proficiency are used as leverages which provide opportunities to ensure that teachers nurture, observe and monitor important student behaviours; the strands of mathematical proficiency. Fortunately, research findings (Suh, 2007; Essien & Setati, 2007; Gray, 2014) have shown that gender gaps are reducing in proficiency focused classes. Unfortunately, on the other hand, research findings (Popoola & Ajani, 2011; Imoko & Anyagh, 2012) have also confirmed that gender gaps still exist in only achievement driven classes. The question is currently on whether any of the two sexes really possesses higher mathematical abilities in terms of mathematical proficiency strands.

In Nigeria, one cannot categorically assert that teachers are not aware of the current global shift from instructions focused on students' numeric achievement only to one that also encompasses mathematical proficiency. However, one can say with a degree of confidence the case of most mathematics instructions in schools still only achievement driven observed by Borovik & Gardiner (2006) in the UK is same in Nigeria today and that ought not to be. If the expected objective that school graduates will be able to solve mathematically related societal problems is to be achieved, then students' proficiency in the subject must indeed become the goal of all mathematics instructions in Nigeria. This in turn could reduce the gender performance gaps which exist in conventional mathematics classes. There is therefore the need to assess and ascertain students' level of mathematical proficiency and thereafter seek ways of helping the students improve in mathematical proficiency through effective proficiency focused instructional approaches.

Statement of the Problem
The major problem is that many Nigerian mathematics teachers are not abreast with the current global shift from instructions focused on achievement alone to one that also encompasses students' proficiency in the subject. Many of such teachers endeavor to 'cover the syllabuses and mark only students' final answers. In covering the syllabus and marking only final answers, in-depth mathematical understanding is covered (hidden) from the students, students' mathematical proficiency is underplayed and wholesome assessments of the mathematical procedures and processes which yielded those answers and connote proficiency in mathematics are totally ignored. Thus, assessments are only achievement driven and gender performance gaps continue to widen with the male students often times as the mathematically superior specie.

Unfortunately, since teachers do not assess mathematical proficiency particularly with respect to the strands, students' levels of proficiency in the strand of mathematical proficiency remain unknown and students can hardly be helped to learn mathematics productively. To crown it all, the national objectives for teaching and learning mathematics in senior secondary schools canhardly be achieved if things continued the way they are. Also, research with respect to mathematical proficiency in the light of its strands is in its infancy in the Nigerian context.

Objectives/Purposes of the study
The main objective of the study was to simply explore students' mathematical proficiency in connection with gender and mathematics achievement in the Nigerian context using skills-based assessment. Specifically, three purposes of the study were delineated.
1. Assess the mathematical proficiency (strands-wise and combined) of senior secondary school students from Nigerian public schools and ascertain the proficiency levels.
2. Examine the influence of gender on mathematical proficiency and
3. Determine the relationship between mathematical proficiency and mathematics achievement (strands-wise and combined).

Research Questions
The following were the research questions that guided the study:
1. What is the mathematical proficiency level of senior secondary school students from Nigerian public schools (strands-wise and combined)?
2. How does gender influence Nigerian senior secondary school students' mathematical proficiency?
3. To what extent is each strand of mathematical proficiency related to achievement in mathematics?

Research Hypotheses
The following null hypotheses were raised in the study and tested using the study data.
1. There is no significant influence of gender on students' mathematical proficiency (strand-wise and combined).
2. There is no significant relationship between each strand of mathematical proficiency and achievement in mathematics.

Scope and Delimitation of the Study
The scope of the study was delimited to senior secondary school year 2 mathematics students in Lagos State. This was so because the population, nature and mix of students in Lagos State public secondary schools are believed to be very good representations of the Nigerian senior secondary students' niche. Senior secondary year two was chosen because it is believed that students in the class level would have developed the fundamental basis of mathematical concepts that can guarantee the assessment of their mathematical proficiency and are free from any form of external examination that may interfere with the research process. The mathematics content coverage was delimited to three basic areas of mathematics; algebra, geometry and number and numeration because these are the only themes that run from SS I to

SS III in the senior secondary school mathematics curriculum. Gender was the only moderating variable because of inconsistencies of results with respect to gender and the fact that mathematical proficiency research relating to gender is at its infancy in Nigeria. The sample was limited to 394 students because of the rigour involved in such wholesome skills based assessment of students' mathematical proficiency. Generally, the study only explored students' mathematical proficiency as influenced by gender and related to mathematics achievement in public schools.

Significance of the Study
The study is significant to all stakeholders of mathematics education: mathematics teachers, mathematics curriculum developers, mathematics supervisors, students, parents, the government and the society at large. The study equips teachers with the basic knowledge of the need for the assessment of students' proficiency in mathematics. Furthermore, it guides teachers on the areas to emphasize and pay particular attention to in the development of the students' mathematical proficiency (i.e. the five strands, AR, CU, PF, PD and SC). The study provides mathematics supervisors with insights on the need for assessing students' mathematical proficiency and so have teachers' involvement in such assessment as a curriculum implementation activity to supervise. Students are provided with the level of proficiency attained in the respective strands of mathematical proficiency and the need for improvement. The study forms a basis for further research as it contributes to the knowledge base in mathematical proficiency research in relation to gender which is still in its infancy in Nigeria.

Empirical Review
Literatures reviewed support the fact that teachers' classroom activities which include the assessment practices impact instructional learning outcomes. The use of formative assessments or other diagnostic efforts within classrooms provides information that should help facilitate improved pedagogical practices and instructional outcomes understanding (Dunn & Mulvenon, 2009). It also help teachers determine to what extent students have acquired additional knowledge and how much of lessons objectives have been achieved and plan developmentally and individually appropriate activities that help raise children's level of understanding (Bhargava & Kirova, 2002; Helm, Benkee & Steinheimer (1997) in Bhargava & Kirova (2002)).

A study conducted in South Africa by Jojo, Dhlamini, Phoskoko and Ngoepe (2013) to explore the result of the mathematical proficiency of Grade 6 teachers on students' outcome found that teachers' mathematics proficiency affected students' mathematical proficiency. The study conceptualized teachers' mathematical proficiency as a multi-faceted notion having teacher knowledge, instructional practices, assessment practices and contextual factors as its dimensions. The results of the study showed that the study participants- teachers were proficient in terms of mathematics knowledge, appropriate assessment techniques and in the ability to handle intended educational and socio-economic challenges but were not proficient in handling unintended educational and socio-economic challenges. Because of the persistent emergence of unintended educational and socio-economic issues, the teacher's proficiency

was downplayed. Consequently, students leave the instructional encounter not being proficient themselves because the teacher is an important factor in determining the outcome of any instructional encounter.

In short, an instructional encounter with proficiency in appropriate assessment techniques but no proficiency in handling unintended educational and socio-economic issues failed to achieve its full potential. Evidently, an instructional encounter with not proficient in both appropriate assessment techniques and handling unintended educational issues cannot but fail woefully in achieving its full potential. This is an indication that the failure of most mathematics instruction encounters in achieving the long term objectives of producing mathematically proficient students could be partly hinged on the lack of assessment of students' mathematical proficiency.

Furthermore, from literatures reviewed, inconsistent outcomes of achievement exist in the gender context. In particular, Adaramola and Obomanu (2013) compared students' achievement based on gender using the six subcategories of the Bloom's taxonomy of cognitive domain. The males were found to be significantly better than the females in the knowledge, comprehension, application and synthesis while the females were significantly better than the males in the analysis and evaluation. In a similar manner, Noureen and Sheikh (2016) which sought to find out the gender differential mathematics performance of students in grade VI found that while boys and girls showed equivalent problem solving proficiency in mathematics area strands like whole numbers, integers, ratio and proportion, algebra, area and perimeter, volume and surface area, handling information and simplification, girls significantly performed better than boys in factors and multiples, geometry and linear equation.

However with respect to the strands of mathematical proficiency as it may relate to gender, the establishment of proficiency differences by previous studies is in its infancy. A study similar to the present one was carried out by Awofala (2017) and assessed senior secondary school students' mathematical proficiency as related to gender and performance in mathematics in Nigeria using 400 students from 10 elitist schools in Lagos State. Results revealed that the study students had high mathematical proficiency. Also, students' performance in mathematics was found to be significantly positively correlated with each strand of mathematical proficiency and there was no significant difference in male and female students' proficiencies across all strands of mathematical proficiency.

The high proficiency obtained in the Awofala's (2017) study might have been influenced by the schools used being elitist schools. In public schools where the majority of Nigerian students are and performance in mathematics has remained dismal, totally different results might be obtained. This necessitated the use of public secondary schools in the present study.

Theoretical Framework
The study was based on the following two theories:
1. **State-Operators-Architecture-Result (SOAR) Theory and Model of Cognition (Newell, Laird and Rosenbloom, 1987)**

SOAR is a symbolic cognitive architecture that implements computationally the Newell's unified theory of cognition which explains what happens in cognition when individuals solve problems. Its focus is problem solving and the architecture is used in simulations in different contexts including engineering and robotics, computer and business simulations, Artificial Intelligence management, etc. This theory sees problem solving as a goal oriented activity in which the problem solver searches for matching operators (solutions) in the problem space in order to achieve the expected result. In the light of this theory, the assessment of students' mathematical proficiency is a result oriented activity that the teacher must carry out routinely and necessarily in order to achieve the goal state of producing mathematically proficient students.

2. **Iterative Development Process Model (Rittle-Johnson, Siegler and Alibali, 2001).**
The theory affirms that procedural knowledge and conceptual knowledge develop in an iterative way and problem representation is one mechanism in the process which mediates the iterative development of the two types of knowledge. In the light of this theory, the relationships that exist between the strands of mathematical proficiency are iterative as all the strands of mathematical proficiency are intertwined (Kilpatrick, Swafford and Findell, 2001).

Methodology
Research Design
The study adopted an exploratory design. According to *Devin* (2015), a research is exploratory when the researcher has an idea or has observed something and seeks to understand more about it by examining a data-set and looking for potential relations between variables.

Area of the Study
The study was conducted in Education Districts I and IV of Lagos State. These two Education Districts are made up of a total of seven Local Government Areas in Lagos State.

Population of the Study
The population of the study consisted of all the senior secondary school students in Lagos State. The target population consisted of 286, 544 SS II students in the State.

Sample size and Sampling Procedure
The sample consisted of a total of 394 SS II students from six intact classes from Education Districts (ED) I and IV of Lagos State. The Education Districts and schools were selected using purposive sampling technique while the intact classes were selected using simple random sampling technique. Intact classes were used because random sampling of students might not produce the perfect condition or sample for the nature of the exploration.

Research Instruments

The following instruments developed by the researcher were used to obtain data for the study

1. Students' Mathematical Conceptual Understanding Checklist (SMCUC)
2. Students' Mathematical Procedural Fluency Checklist (SMPFC)
3. Students' Mathematical Strategic Competence Checklist (SMSCC)
4. Students' Mathematical Adaptive Reasoning Checklist (SMARC)
5. Students' Mathematical Productive Disposition Questionnaire (SMPDQ)
6. Mathematics Achievement and Skills Test (MAST)

The SMCUC, SMPFC, SMSCC, SMARC and SMPDQ were designed to assess and gather data relating to different strands of students' mathematical proficiency while the MAST was designed to gather data on students' achievement and assess skills possession.

Design and Description of Instruments

The SMCUC, SMPFC, SMSCC and SMARCare checklists. A checklist is a list of sequential behaviors and/or skills arranged in a system of categories (Wortham, 2001). The rationale behind the use of checklists is that the study adopts a skills- assessment approach and because according to McAfee and Leong (1997) in Bhargava and Kirova (2002), checklists are particularly effective for documenting mathematical skills and knowledge. There were forty skills in each checklist. The SMPDQ is a questionnaire and the MAST is essay type test. The MAST contained routine and non-routine (the quadratic formula dilemma, the birthday cakes decoration and the girls' measures problems) questions.

Scoring of Instruments

Questions in the MAST were scored according to complexity. The MAST was scored over one hundred (100). There were forty skills altogether in each checklist. For each skill, one mark is awarded if the student possessed the skill or expressed the required skill in the right way and zero mark is awarded if otherwise. The maximum score obtainable for each checklist was forty marks and the minimum was zero marks. The scoring of the SMPDQ was done in the 4-point way. For positive questions, the awarding of scores was as follows: Strongly Agree (SA) ----- 4 points, Agree (A) ---- 3 points, Disagree (D) ---- 2 points and Strongly Disagree (SD) ---- 1 point. For the negative questions, the awarding of scores was done in the reverse order. The maximum score obtainable was forty marks.

Validity and Reliability of Instruments

The research instruments were face and content validated by three professional mathematics teachers' educators. MAST was tested and retested after a period of two weeks. The reliability coefficients of the two administrations were: Cronbach's alpha (0.975) and Pearson Moment correlation (0.966). Kuder-Richardson formula 20 was used in establishing the reliability coefficient of the four checklists and the coefficients obtained were: SMARC (0.8766), SMCUC (0.8831), SMPFC (0.9452) and SMSCC (0.8874). Alternative forms of the SMPDQ were administered parallel and reliability coefficients were: Cronbach's alpha (0.927), Pearson Moment correlation (0.881).

Conceptual framework and Procedure for Data Collection

Results of students' previous unified examination were obtained from their teachers and used as students' achievement scores. The MAST was administered to students as an essay type mathematics test and marked using a comprehensive marking scheme to MAST as guide. Procedures and steps as well as final answers were scored. For each student, using one checklist at a time, a one-to-one correspondence was established between each of the forty skills contained in the checklist and the student's demonstration of that skill in the student's answer sheet. The student's exhibition of the ability specified by the skill implied that the student possessed the skill and attracted one mark otherwise; it was regarded as not possessing the skill with zero mark awarded. This procedure was done for all the skills in the given checklist. The total number of skills rightly exhibited in the checklist by the student was regarded as the student's score in the concerned strand of MP. The same procedure was repeated for all other checklists for that particular student. Each student had a total score for each of the four checklists corresponding to AR, CU, PF and SC scores. For PD, the student's responses to items in the SMPDQ were graded accordingly to get the score for PD. Consequently, a student had five total scores corresponding to the obtained scores in the five strands of MP and a six score for MP as the sum of all its strands. Same procedures were repeated for all the study students.

Data Analysis

Both descriptive and inferential statistics were used in analyzing data, answering research questions and testing research hypotheses. Research questions 1 and 2 were answered quantitatively using frequency counts, sums, means, ratio and percentages while research question 3 was answered using Pearson's moment correlation. Hypothesis 1 was tested using independent samples t-test while hypothesis 2 was tested using correlation analysis. The statistical significance level (α) was set at 0.05.

Results And Discussion

Research question 1: What is the mathematical proficiency level of senior secondary school students from Nigerian public schools?

For each strand of mathematical proficiency, the maximum obtainable mark was 40. This gave a total of two hundred as the maximum obtainable mark for mathematical proficiency. The descriptive statistics of students' mathematical proficiency scores (strands-wise and combined) is presented in the table below:

Table 1: Descriptive statistics of students' scores in MP and all its strands

Strand	N	Sample mean	Mean percent	variance	Sum	Standard Deviation	score obtainable Min	Max
AR	394	10.609	26.52	35.847	4180.0	5.987	0	40
CU	394	9.272	23.18	30.178	3653.0	5.493	0	40
PF	394	9.444	23.61	63.082	3721.0	7.942	0	40
PD	394	29.344	58.69	14.525	11561.5	3.811	10	40
SC	394	16.117	40.29	47.513	6350.0	6.893	0	40
MP	394	74.786	35.61	804.350	29465.5	28.361	10	200

Table 1 shows that students had a mean of 10.609 for AR, a mean of 9.272 for CU, 9.444 for PF, 29.344 for PD, 16.117 for SC and 74.786 for MP. These mean values correspond to proficiency levels of 26.52%, 23.18%, 23.61%, 58.69%, 40.29% and 35.61% respectively. Hence the overall mathematical proficiency level of senior secondary school students from public schools is 35.61%.

Research question 2: How does gender influence Nigerian senior secondary school students' mathematical proficiency?
A summary of the descriptive analysis of students' mathematical proficiency scores (strand-wise and combined) based on gender is given in table 2.

Table 2: Descriptive statistics of students' mathematical proficiency scores (strands-wise and combined) based on gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
AR	female	186	10.075	5.6093	.4113
	male	208	11.087	6.2810	.4355
CU	female	186	8.570	5.0187	.3680
	male	208	9.899	5.8263	.4040
PF	female	186	8.360	7.4074	.5431
	male	208	10.413	8.2902	.5748
PD	female	186	28.844	3.7629	.2759
	male	208	29.791	3.8073	.2640
SC	female	186	15.532	6.3196	.4634
	male	208	16.639	7.3439	.5092
MP	female	186	71.382	26.4772	1.9414
	male	208	77.829	29.6790	2.0579

Table 2 shows that a total of 208 male students and 186 female students took the test. For the male students, the meanvalues for AR, CU, PF, PD, SC and MP were 11.087, 9.899, 10.413, 29.791, 16.639 and 77.829 respectively. The female students' mean values for AR, CU, PF, PD, SC and MP were 10.075, 8.570, 8.360, 28.844, 15.532 and 71.382 respectively. The male students scored marginally higher than their female counterparts in MP and all the strands. The corresponding mean differences were 1.012, 1.329, 2.053, 0.947, 1.107 and 6.447.

Hypothesis 1: There is no significant influence of gender on students' mathematical proficiency (strand-wise and combined).
The statistical significance of each mean difference was tested using the independent samples t-test statistic. The results obtained indicated significant difference between male and female students' mathematical proficiencies in favour of the male category for MP, CU, PF and PD. Table 3 below contains the result.

Table 3: Independent samples t-test of students' MP scores and strands based on gender

		Levene's test for equality of variances		t-test for equality of means					95% confidence interval of the difference	
		F	Sig.	T	Df	Sig. (2 -tailed)	Mean diff.	Std. Error diff.	lower	upper
AR	EVA	3.404	0.066	-1.68	392	0.094	-1.01	0.603	-2.196	0.173
CU	EVA	5.058	0.025	-2.41	392	0.016	-1.33	0.551	-2.412	-0.246
PF	EVA	4.238	0.040	-2.58	392	0.010	-2.05	0.796	-3.618	-0.489
PD	EVA	0.004	0.951	-2.48	392	0.014	-0.95	0.382	-1.698	-0.196
SC	EVA	6.429	0.012	-1.60	392	0.112	-1.11	0.694	-2.472	0.258
MP	EVA	4.160	0.042	-2.27	392	0.024	-6.45	2.847	-12.05	-0.850

EVA - Equal variances assumed

However, as the table further shows, there was no statistically significant gender influence for AR and SC. Consequently, gender had significant influence on students' CU, PF, PD and MP but no statistically significant gender influence on AR and SC. Following the existence of significant influence of gender for MP, CU, PF and PD, the null hypothesis that there is no significant of gender on MP was rejected. However, there was failure to reject the hypothesis with respect to AR and SC.

Research Question 3: To what extent is each strand of mathematical proficiency related to mathematics achievement?
The set of students' achievement scores in previous unified examination obtained from teachers was correlated with the set of scores in each strand of MP. Table 4 below contains the result.

Table 4: Mean, standard deviation and correlation coefficient of the relationship to mathematics achievement for each strand of mathematical proficiency.

strand	Mean	Std.D.	r_{ma}
AR	10.609	5.9872	0.947
CU	9.272	5.4934	0.932
PD	9.444	7.9424	0.940
PF	29.344	3.8111	0.893
SC	16.117	6.8930	0.937
MP	74.786	28.3611	0.864

Results showed that the relationship between any strand of mathematical proficiency and mathematics achievement is high and positive. The Pearson's coefficients of correlation between mathematics achievement and AR, CU, PF, PD, SC and MP are: 0.947, 0.932, 0.940, 0.893, 0.937 and 0.864 respectively.

Hypothesis 2: There is no significant relationship between each strand of mathematical proficiency and achievement in mathematics.

The statistical significance of the correlation was obtained for each of the strands. All the correlation coefficients were significant at p = 0.01 < 0.05 as indicated in the table below.

Table 5: Statistical significance of the Pearson's correlation coefficient for the relationship between each strand of mathematical proficiency and mathematics achievement

	AR	CU	PF	PD	SC
Pearson's correlation coefficient with MA	.947**	.932**	.940**	.893**	.937**
Sig. (2-tailed)	.000	.000	.000	.000	.000
N	394	394	394	394	394

**. Correlation is significant at the 0.01 level (2-tailed)

Following the existence of significant relationship between each strand of MP and MA, the null hypothesis that there is no significant relationship between each strand of mathematical proficiency and mathematics achievement was rejected. There is hence a significant relationship between each strand of mathematical proficiency and mathematics achievement.

Discussion

The mathematics achievement of students has remained abysmal for several years. The finding of this study with respect to students' proficiency level was that students' levels of proficiencies were low for each strand of mathematical proficiency and for mathematical proficiency as a whole. This finding supports the fact that students' performance or achievement in mathematics has been poor (Chief Examiners' report (2012), Binda (2005)). The low proficiency levels found for all strands disagree totally with the high proficiency levels observed by Awofala (2017). Furthermore, male students have often times been regarded as more mathematically able students in comparison to the females. In fact as Ogunleye (1999) affirmed, because of the deemed higher mathematical power of the male gender, many disciplines requiring more of mathematical abilities have been tagged masculine domains. In relation to mathematical proficiency, the finding of the present study showed that males were significantly more proficient than the female counterparts in CU, PF, PD and MP. This finding agrees with the findings of some previous studies which found that male students perform better than female students in mathematics and science (Popoola & Ajani, 2011; Imoko & Anyagh, 2012). However, the finding did not agree with some previous research finding that females achieve better than males (Agwagah, 1993, Anagbogu & Ezeliora, 2007). The findings did not also agree with findings that showed no significant difference in the achievement of boys and girls (Essien & Setati 2007; Ijadunola & Lawal, 2016; Fajemidagba & Suleiman, 2012) except with AR and SC. The finding was in variance with the finding of Awofala (2017) that there was no significant difference between male and female students' proficiency in CU, PF, PD and MP. However, the results agree for the no significant difference observed with respect to AR and SC based on gender.

With respect to the relationship between mathematical proficiency and mathematics achievement (strands-wise and combined), positive and high correlations were found. This is quite logical as one can only perform well in a task when he/she has gained at least a moderate level of skills in the task. As Kilpatrick, Swafford and Findell (2001) affirmed, the strands of mathematical proficiency are related and intertwined. Since mathematics achievement and proficiency are themselves related (Borovik and Gardiner, 2006), the relationship between achievement and the strands of MP is justified. This result agrees totally with Awofala's (2017) result that there was a positive and significant relationship between each strand of MP and mathematics performance. To perform well in mathematics, there must be proper conception of mathematical concepts. Strategic competence is essential in order to sieve between strategies and be able to use an efficient and all-encompassing one. With the level of abstraction involved in mathematics, adaptive reasoning is very essential and to solve problems accurately, procedural fluency is key. Last but not the least, the disposition to any task can predict productivity in that task. When students view themselves as mathematically able, they are geared towards persistence even when the mathematical task might be difficult. It is that persistence through practice that improves both achievement and proficiency in mathematics. However when considered strands-wise, the gender influence was not significant for adaptive reasoning and strategic competence only. The relationship between each strand of mathematical proficiency and mathematics achievement was high and positive.

Conclusion

This study established that students' levels of proficiencies were low for all strands of mathematical proficiency; conceptual understanding, procedural fluency, adaptive reasoning, strategic competence and productive disposition and for mathematical proficiency as a sum of all its strands. Also, significant gender influence was established for mathematical proficiency.

Recommendation

It was recommended based on the findings of the study that teachers of mathematics should pay particular attention to students' mathematical proficiency (strands-wise and combined). This will lead to wholesome improvement in the mathematics achievement of students. Also, periodic and regular assessment of students' mathematical proficiency should be made as this will ensure that students' overall components of mathematics are groomed and nurtured. While gender differences still exist, female students should be encouraged to view mathematics and its problem solving activities as activities that female students are also endowed to excel in. This will produce a better productive disposition and in essence affect every other strand in its own respect.

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