

**ASSESSMENT OF TEACHERS' CONTENT KNOWLEDGE OF SENIOR
SECONDARY SCHOOL MATHEMATICS CURRICULUM IN
SELECTED GEOPOLITICAL ZONES IN NORTHERN NIGERIA.**

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Abstract: For effective mathematics teaching, teachers should possess adequate content knowledge of the subject matter they teach. This study assessed the teachers' content knowledge in order to determine their mastery level across the five themes of Senior Secondary School Mathematics Curriculum (SSSMC). The study was guided by one research question and one hypothesis tested at 0.05 level of significance. The study employed the cross-sectional survey design. The population of the study was 3,154 senior secondary school mathematics teachers in two northern geopolitical zones, Nigeria. A sample of 389 teachers was selected using multi-stage and proportionate random sampling. The instrument used to collect data for the study was Teachers' Content Knowledge Mastery Test (TCKMT). The instrument was validated by experts in mathematics education and test and measurement. TCKMT was a multiple choice test with 50 items. The reliability coefficient of TCKMT was 0.751, established by using split – half method. TCKMT was administered on the teachers. Data on teachers' scores per theme of SSSMC was collated and coded. The coded data was tested for normality. Both Kolmogorov – Smirnov and Shapiro-Wilk's statistics were significant at $\alpha \leq 0.05$. Based on this evidence, Friedman and Kendall's W-test was used to test the formulated hypothesis. On the other hand, the generated descriptive statistics of

mean, mean rank and standard deviation were used to answer the research question which was presented in form of a chart. Results showed significant difference in teachers' content knowledge mastery level of the five themes of SSSMC. Teachers had significant highest content knowledge mastery in Number and Numeration (NN) and least content mastery in Geometry and Trigonometry (GT). However, no significant difference was found in teachers' content knowledge mastery between GT and Newly Introduced Content Areas (LT). The study concluded that mastery level of mathematics teachers in terms of their content knowledge across the five themes of SSSMC was low. It was recommended that State Ministries of Education should organize seminars and workshops for teachers of SSSMC with special attention paid to GT and LT to update and improve their content mastery.

KeyWords: *Content Knowledge, Senior Secondary Mathematics, Curriculum*

Introduction

The Nigerian Educational Research and Development Council (NERDC) is a government agency mandated to develop curriculum for each of the subjects offered at all levels of education in the country. It is in line with this mandate that the NERDC designed and developed the Mathematics curriculum. However, the developed curriculum has passed through several reforms.

During the pre-independence era, Arithmetic was one of the subjects introduced in early schools. With the need to produce interpreters with quantitative competence, the curriculum was compartmentalized into arithmetic, algebra and geometry. Further reforms led to three types of examination syllabus (alternatives A, B and C) which later turned into teaching syllabus. In 1970, modern mathematics took off in Lagos and in 1974; it started in all the states in Nigeria. However, modern mathematics was abolished in 1977. This paved way for the emergence of General Mathematics curriculum when the 6-3-3-4 system of education was introduced in the National Policy on Education in 1978. The curriculum for primary school mathematics, JSS Mathematics and SSS Mathematics were published in March, 1979 (Odili, 2006).

Following the launching of the Universal Basic Education (UBE) in 1999, content obsolete of the General Mathematics curriculum and rapid changes in technology, the Nigerian Government initiated a reform agenda in Education. According to Nigerian Educational Research and Development Council (NERDC - 2012), the reform was tailored to achieving the Millenium Development Goals (MDGs), the core elements of National Economic Empowerment and Development Strategies (NEEDS) and the goals of Education For All (EFA). To take care of the resolutions of MDGs, NEEDS and EFA, the NERDC reviewed the subjects' curriculum, leading to the emergence of the new Senior Secondary School Mathematics

Curriculum (SSSMC). The SSSMC was prepared in July 2007 at the writing workshop organized by the NERDC and presented to the public in 2011. The implementation of the new SSSMC took off in September, 2011, with the first batch of the JSS graduates from the 9-year basic education curriculum. The first set of students who were taught using the new SSSMC graduated in 2014 (NERDC, 2012).

The new SSSMC has five (5) themes which are Number and Numeration (NN), Algebraic Processes (AP), Geometry and Trigonometry (GT), Statistics and Probability (SP) and Introductory Calculus/Newly Introduced Content Areas (LT) unlike the old one which had six themes. In the new SSSMC, newly introduced content areas like modular arithmetic, VAT, annuity, bonds, shares, debentures, logical reasoning, coordinate geometry, matrices and determinants, differential and integral calculus that are considered to be relevant to the global world and development of entrepreneurial skills were introduced. Based on this, NERDC (2007) claimed that topics included in the SSSMC were aimed at:

- i. Improving the mathematical competency of Nigerian children.
- ii. Preparing the Nigerian students for further tertiary level education.
- iii. Helping students to acquire and develop entrepreneurial skills.

However, as sound as the objectives of the SSSMC, parents, researchers, mathematics educators and other stakeholders in education sector, have continued to express doubt as to whether the SSSMC is producing the right type of students expected to be produced in order to meet the societal needs. For instance, Amadi and Onyeka (2018) posited that the nation's expectation from school products with regards to mathematics is still unsatisfactory. Also FME (2023) lamented the low quality of school products due to unqualified teachers.

Researchers like Duru et al (2020), Ijeh and Potokri, (2021), Olalesan and Lawal (2022), Patel (2022) Moses et al (2024), Akubue et al (2024) have shown that among the factors that could be responsible for the lack of competency in comprehending mathematics among secondary school products which have not been extensively studied since the take – off of SSSMC in 2011, is teachers' quality in terms of the knowledge required for effective teaching and learning of mathematics.

Scholars have attempted to study and categorize the knowledge required by a teacher for effective teaching. The study of the structure and what constitutes teacher knowledge began with Shulman cited in Aksu and Kul (2016) who proposed that teacher knowledge comprised of three categories, viz: Content Knowledge, Pedagogical Content Knowledge and Curriculum Knowledge. Later on, other scholars such as An, Kulm and Wu, Hill, Ball and Schilling cited in Aksu

and Kul (2016) have refined and extended Shulman model, leading to the development of various models of teacher knowledge. In all these models, subject matter knowledge or content knowledge appeared as one of the categories of teacher knowledge required for effective teaching.

Content Knowledge (CK) was defined by Lee et al (2018) as knowledge and understanding of facts, concepts and principles and the ways in which they are organized, as well as knowledge about the discipline. CK is classified into Common Content Knowledge (CCK), Specialized Content Knowledge (SCK) and Horizon Content Knowledge (HCK) (Ball et al, 2008). CCK is defined as the knowledge about the subject matter of the curriculum a teacher is teaching while SCK is considered as the deeper knowledge of a specific content such as fractions, including knowledge of student misconceptions on the content, analyzing unusual procedures or algorithms and providing explanation for rules. HCK relates to the knowledge of mathematics being taught and how it connects to the learning horizon. Other scholars such as Akinsola (2018) viewed content knowledge as know-what aspect of the subject matter. It is the subject matter knowledge that a skilled and professional mathematics teacher must master to qualify him/her as competent teacher. Of all the three types of CK, this study focused on CCK because it is the foundation of SCK and HCK. Therefore, mathematics teachers' CK in this study refers to teachers' knowledge of the Senior Secondary School Mathematics which they teach, including the knowledge of correct mathematical terms, facts, principles, generalizations and notations.

Content knowledge is very important since it gives a teacher confidence and motivation to face and teach the students well. Its absence or its low level could force the teacher to skip some topics or pass wrong information to the students concerning the curriculum contents. The consequence is that students use the viral information to write examinations and pass out of the school with the wrong knowledge and poor results in mathematics. In support of this assertion, Bold et al cited by Brunetti et al (2023) documented that gap in content knowledge of African teachers account for 30% of the shortfall in student learning relative to the curriculum. Moreover, the findings of Ijeh et al (2025) showed that teachers' content knowledge contributes 42% to students' achievement in mathematics.

Despite the importance of CK in qualitative teaching, Arewa Research and Development Project (ARDP - 2017) lamented that Northern Nigeria appeared to be largely affected by poor quality of teachers as large number of teachers in the North continued to be either unqualified or underqualified. Therefore, this study is designed to assess the quality of senior secondary school mathematics teachers in terms of their content knowledge mastery across the five themes of SSSMC in two geopolitical zones in Northern Nigeria.

Statement of the Problem

Mathematics curriculum in Nigeria has witnessed a lot of innovations in the past, with the aim of improving students' competence in the subject and making the products of the curriculum relevant to the global world. However, since the take – off of the SSSMC in 2011, parents and other stakeholders in Nigerian education sector, especially in some parts of Northern Nigeria, have continued to express concern over the poor academic performance of students in mathematics as a result of teachers' low competence in delivering the curriculum contents. The problem of teachers' low quality in terms of perceived difficulties in comprehending some mathematical concepts, rules and principles and in teaching the concepts effectively to their students could pose serious challenges to students' learning outcomes.

However, stakeholders in mathematics education have continued to blame instructional strategies used by teachers, inadequate teachers, teachers' qualification, inadequate instructional resources and other student factors like poor background. Little or no attention is paid to the fact that lack of periodic assessment of the quality of teachers' in terms of their content knowledge mastery about a newly introduced curriculum which has newly introduced content areas could cause serious damages in the educational system, thereby making it impossible to achieve the set objectives.

Although efforts have been made by researchers to investigate teachers' content knowledge at different levels of education, the problem of public outcry on teachers' quality in terms of content knowledge mastery persists. Also, there are few studies conducted in Northern Nigeria, especially on SSSMC content mastery among teachers. Still, little attention is paid to the newly introduced content areas. Therefore, this study was set to determine teacher's level of content knowledge mastery across the five themes of SSSMC in two selected geopolitical zones in Northern Nigeria.

Research Question

The following research question guided the study:

1. What is the teachers' mean scores in content knowledge mastery across the five themes of SSSMC?

Null Hypothesis

The following hypothesis was formulated and tested at 0.05 level of significance:

1. There is no significant difference in the content knowledge mean scores of teachers among the five themes of the SSSMC.

Methodology

The study adopted the cross-sectional survey design. The choice of this design was based on the recommendation of Sheka (2011) that cross-sectional design could be used to measure some variables at a single time by drawing only one sample of respondents from the target population at a time and studies it.

The target population for the study is made up of all the mathematics teachers in public senior secondary schools in two (2) geopolitical zones of Northern Nigeria. The two geopolitical zones have a total of three thousand, one hundred and fifty-four (3,154) senior secondary school mathematics teachers (Source: State Ministries of Education and States Secondary Schools Management Boards, 2023).

Multi-stage sampling technique was used to select sample for the study. At the first stage, 40% of the states in each of the two geopolitical zones were randomly selected using 'drawing from the hat' method. This was based on the recommendation of Sheka (2011) that a sample of about 15% - 30% of the population is sufficient for social science researches. This gave a total of five (5) states. At the second stage, proportionate random sampling was employed to select 30% of educational zones of each selected state. Finally, 40% of the teachers in each educational zone were randomly selected. This gave an overall total of 389 mathematics teachers as the sample size.

The instrument used for data collection was Teachers' Content Knowledge Mastery Test (TCKMT) which was developed by the researcher from past SSCE question papers. The initial draft of TCKMT contained sixty (60) multiple choice questions. For each of the five themes in the SSSMC, twelve (12) items were included. TCKMT was subjected to validation and item analysis processes. Based on the results of the validation and item analysis, the final draft of TCKMT contained fifty (50) multiple choice questions (ten per theme). In the final draft of TCKMT, questions 1-10 covered NN, questions 11-20 on AP, 21- 30 covered GT theme, 31-40 were on SP and questions 41-50 covered introductory calculus/newly introduced content areas. Each question carried two marks, giving a total of 100 marks (20 marks per theme). Split - half method was used to obtain a value of 0.751 as the reliability index of TCKMT. This index is considered adequate because Strub, Boudreau and Geffin (2004), for a pilot study, reliability index should be equal to or above 0.60.

Data was collected with the help of five (5) research assistants (one from each of the five sampled states) who were trained on the conduct of the study and administration of the TCKMT. Out of the 389 selected teachers, 21 did not participate in the study. So, 368 teachers took TCKMT in order to measure the level of their content knowledge mastery.

The collected data was explored and normality test run. Data exploration showed significant deviation from the normal distribution because both Kolmogorov – Smirnov and Shapiro-Wilk’s statistics were significant at $\alpha \leq 0.05$. This means the data was not normally distributed. Based on this evidence, the researcher used non-parametric test. Specifically, the formulated hypothesis was tested using Friedman and Kendall’s W-test. On the other hand, the generated descriptive statistics of mean, mean rank and standard deviation were used to answer the research question.

Results

The results obtained from the analyzed data were used to answer the research questions and test the formulated hypotheses. The results are presented as follows:

Research Question One: What is the teachers’ mean score in content knowledge mastery across the five themes of SSSMC?

Data on the mean content knowledge scores of teachers across the five themes of SSSM is presented in Figure 1:

Figure 1: Mean, Standard Deviation and Mean Rank of Mathematics Teachers Scores on TCKMT According to the Five Themes of SSSMC

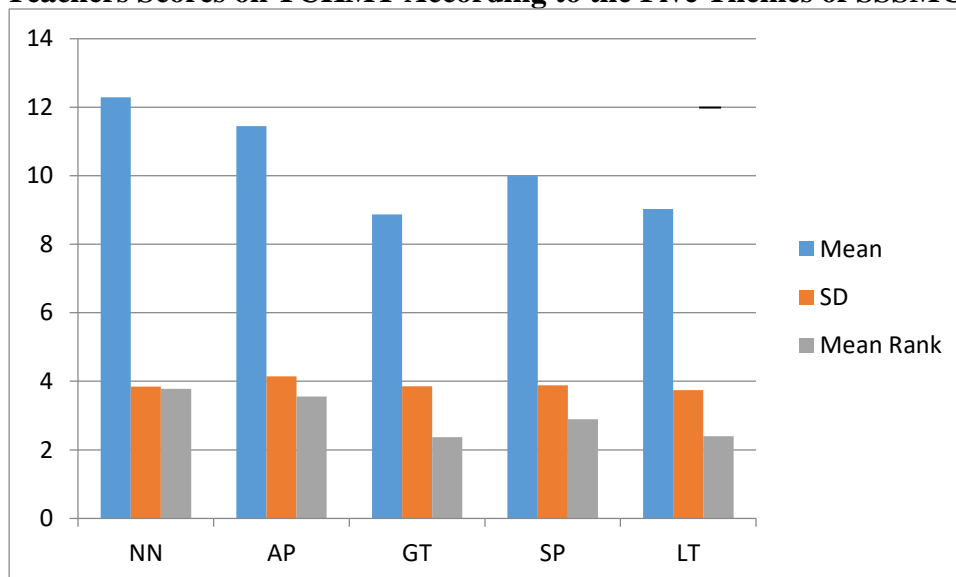


Figure 1 showed the teachers’ mean score in the five themes of SSSMC. The figure revealed that in number and numeration (NN), teachers mean score was 12.29 with mean rank of 3.78 and standard deviation of 3.84. In algebraic processes, teachers mean score was 11.45 with mean rank of 3.56 and standard deviation of 4.14. For Geometry and trigonometry - GT (mean = 8.87, mean rank = 2.37, SD = 3.85), Statistics and Probability (SP) theme (mean = 9.99, mean rank = 2.89, SD = 3.88)

and Newly Introduced Content Areas (LT) theme (mean = 9.03, mean rank = 2.40, SD = 3.74). This showed that teachers performed best in NN, followed by AP, then SP, then LT with GT as the weakest area of SSSMC among the teachers. The teachers had highest level of content knowledge mastery in NN and lowest content knowledge mastery in GT theme.

H₀: There is no significant difference in the content knowledge mean scores of teachers among the five themes of the SSSMC.

Data collected from TCKMT was subjected to Fredman's and Kendall's W tests to investigate the mean difference in content knowledge scores of teachers among the five themes of the SSSMC. Table 1 presented the results of these statistics.

Table 1: Fredman's and Kendall's W tests for the Mean difference in Teachers' Scores among five Themes of SSSMC

	N	Mean	Std. Deviation	Mean Rank	Fredman's Test				Kendall's W Test		
					Chi-Square	df	p-value	Statistic	Chi-Square	Df	p-value
NN	368	12.29	3.843	3.78							
AP	368	11.45	4.142	3.56	275.67	4	0.001	.187	275.67	4	0.001
GT	368	8.87	3.851	2.37							
SP	368	9.99	3.880	2.89							
LT	368	9.03	3.747	2.40							

Table 1 showed that the calculated P – value was 0.001 which is less than the α – value of 0.05. Based on this evidence, the null hypothesis was rejected. This implied that there was significant difference in the mean content knowledge scores of teachers among the five themes of the SSSMC.

In order to detect in which pair of the themes the teachers' mean score significantly differ, the Bonferroni post-hoc test was run. The result of the analysis is presented in Table 2.

Table 2: Post hoc Analysis of Multiple Comparisons in the Mean CK Scores of Teachers among the five Themes of SSSMC

(I) Theme	(J) Theme	Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval
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					Lower Bound	Upper Bound
	AP	.84239*	.28712	.034	.0355	1.6493
NN	GT	3.41848*	.28712	< .001	2.6116	4.2254
	SP	2.29348*	.28712	< .001	1.4866	3.1004
	LT	3.25543*	.28712	< .001	2.4485	4.0624
	NN	-.84239*	.28712	.034	-1.6493	-.0355
AP	GT	2.57609*	.28712	< .001	1.7692	3.3830
	SP	1.45109*	.28712	< .001	.6442	2.2580
	LT	2.41304*	.28712	< .001	1.6061	3.2200
	NN	-3.41848*	.28712	< .001	-4.2254	-2.6116
GT	AP	-2.57609*	.28712	< .001	-3.3830	-1.7692
	SP	-1.12500*	.28712	.001	-1.9319	-.3181
	LT	-.16304	.28712	1.000	-.9700	.6439
	NN	-2.29348*	.28712	< .001	-3.1004	-1.4866
SP	AP	-1.45109*	.28712	< .001	-2.2580	-.6442
	GT	1.12500*	.28712	.001	.3181	1.9319
	LT	.96196*	.28712	.008	.1550	1.7689
	NN	-3.25543*	.28712	< .001	-4.0624	-2.4485
LT	AP	-2.41304*	.28712	< .001	-3.2200	-1.6061
	GT	.16304	.28712	1.000	-.6439	.9700
	SP	-.96196*	.28712	.008	-1.7689	-.1550

Table 2 revealed that the calculated P – value for mean difference between NN and three other themes (GT, SP and LT) was $0.001 < 0.05$ while for AP, the P –value was $0.034 < 0.05$, indicating a significant difference between the mean CK test scores of teachers in NN and the remaining four themes. Teachers' mean CK score was significantly higher in NN when compared with the remaining four themes of SSSMC. Also, Table 2 showed that the calculated P – value for mean difference

between GT and LT was 1.000 which is greater than the α – value of 0.05. This indicated no significant difference between the mean CK test scores of teachers in GT and LT of SSSMC.

Discussions of Findings

The study established the existence of significant difference in the teachers' mean content knowledge score among the five themes of SSSMC. Teachers' score was significantly higher in NN when compared to the other themes of SSSMC. This could mean that NN was the easiest theme for the teachers when compared to other themes. GT was the theme in which teachers had the lowest mean score which indicates that GT was the most difficult theme for the teachers. Although GT was the most difficult area but the study showed that the teachers' content knowledge mastery of GT was statistically similar to LT. This could possibly be linked to the fact that LT were new topics in the curriculum and human being, by his nature, do not readily accept innovation or change which might make the teachers' pay little or no attention to master the LT. The finding of this study is in line with those of Rabiun and Saidun (2015) and Brunetti, Buchel, Jakob, Jann and Steffen (2023) who discovered that mathematics teachers did not have adequate mastery of CCK. The results of this study is also consistent with that of Otun and Olaoye (2019) who found teachers had low content knowledge in Geometry. The finding, however, contradicts Pinamang and Cofie (2017) who found pre-service teachers possessed high level of content knowledge but low level of pedagogical content knowledge in geometrical transformation. The difference could be attributed to difference in location and category teachers involved in the study. The difference could also be attributed to the fact that the work of Pinamang and Cofie (2017) is content – specific while the present study is on general contents of SSSMC.

Conclusion

The mastery level of mathematics teachers' content knowledge across the five themes of SSSM was low. Teachers showed highest content mastery in NN and lowest content mastery in GT, with similar level of mastery in GT and LT.

Recommendations

In order to improve the level of mathematics teachers' content knowledge of SSSMC, the following measures are recommended:

1. State Ministries of Education should organize seminars and workshops for teachers on SSSMC with special attention paid to GT and LT to update and improve their content mastery.

2. Professional bodies in mathematics like Mathematical Association of Nigeria (MAN) should pay special attention to GT and LT in their workshops, conferences and future publications.

References

- Aksu, Z, & Kul, U. (2016). Exploring mathematics teachers' pedagogical content knowledge in the context of knowledge of students. *Journal of Education and Practice*. 7(30), 35 – 42.
- Akubue, A., Agu, N.N. & Ezeugo, N.C. (2024).Evaluation of the implementation of mathematics curriculum in JSS in Enugu state. *UNIZIK Journal of Educational Management and Policy (UJOEMP)*. 6(1), 18-28.
<https://journals.unizik.edu.ng/ujoemp/article/view/3397>
- Amadi, J.C & Onyeka, E.C. (2018). Effect of teachers' use of manipulatives on SS3 students' performance in geometry in Onelga Education Zone in Rivers, Nigeria. *Proceedings of MAN Annual Conference*. 374 – 379.
- Arewa Research and Development Project (2017). *Strategic Agenda for Northern Development*.(STAND). Arewa House.
- Ball, D.L., Thames, M. H. & Phelps, G. (2008). Content knowledge for teaching. What makes it special? *Journal of Teacher Education*. 59 (5), 389 – 407
- Brunetti, A., Buchel, K., Jakob, M., Jann, B., & Steffen, D. (2023).Inadequate teacher content knowledge and what could be done about it: Evidence from El-Salvador. *Journal of DevelopmentEffectiveness*.<https://doi.org/10.1080/19439342.2023.2213681>
- Duru, P.O., Dominic, G.Z., Udoha, C. & Ochuba, P.C.(2020).Effects of teacher subject mastery on the academic performance of secondary school students in Jalingo LGA of Taraba State. *Journal of Contemporary Education Research (JCER)*. 20(8), 344 – 365
- Federal Ministry of Education (2023). Education for renewed hope: Roadmap for the Nigerian education sector (2024 – 2027). FME.

- Ijeh, S.B., Akpomedaye, J.F.O., Njoseh, I.N., Igabari, J.N. & Enakpoya, E.E. (2025). Exploring teachers' mathematical knowledge for teaching and its influence on students' achievement retention and attitude towards mathematics in secondary schools in Nigeria. *International Journal of Social Science and Education Research Studies*. 5(1), 84 – 93 <https://doi.org/10.55677/ijssers/VO5101Y2025-13>
- Ijeh, S.B. & Potokri, O.C. (2021). The impact of teaching practice on female students' preparation for mathematics teacher education programs in Delta State University, Abraka, Nigeria. *International Journal of Learning, Teaching and Educational Research*. 20(12), 35 – 48.
- Lee, Y., Capraro, R.M. & Capraro, M.M. (2018). Mathematics teachers' subject matter knowledge and pedagogical content knowledge in problem posing. *International Electronic Journal of Mathematics Education (IEJME)*, 13 (2), 75 – 90. <https://doi.org/10.12973/iejms/2698>
- Moses, C., Nghipandulwa, L.L. & Abed, K.O. (2024). Exploring curriculum implementation challenges in the teaching of subsidiary mathematics in Oshakati Circuit, Oshana region: A phenomenological study. *Open Journal of Social Sciences*, 12, 604-622. <https://doi.org/10.4236/jss.2024.122033>
- NERDC (2007). Senior secondary education curriculum. Mathematics for SS1 -3. NERDC.
- NERDC (2012). Teachers' guide for the new senior secondary school mathematics curriculum. NERDC
- Odili, G.A. (2006). *Mathematics in Nigerian secondary schools: A Teaching perspective*. Anachuna Educational Books Ltd.
- Olalesan, O.O. & Lawal, C.A. (2022). Impact of teachers' knowledge of subject matter and pedagogical knowledge on secondary school students' attitude and performance in Mathematics in Ibadan zone 1 LGAs, Oyo state. *MAN Annual Conference Proceedings*. 304-309.
- Otun, I.W. & Olaoye, A.A. (2019). Repositioning pre-service mathematics teachers' preparation

and professional development in Nigeria: An analysis of the curriculum of mathematics teacher education in the learning and teaching of JSS mathematics method courses. *Abacus*. 44 (1), 284 – 297

Patel, A.S. (2022). Policy gaps: Addressing subsidiary mathematics curriculum challenges in rural schools. *Educational Policy Review*, 30, 78 – 94.

Pinnamang, I. & Cofie, P.O. (2017). Pre-service teachers' content knowledge and pedagogical content knowledge in teaching geometric transformation. *African Journal of Educational Studies in Mathematics and Sciences*. 13,

Rabiu, A.T. & Saidu, S. (2015). A study on the quality of mathematics teachers in content mastery in primary schools in Kaduna State, *Abubakar Tafawa Balewa University Journal Of Science, Technology and Education*. 3(2).102 - 108

Sheka, G.I.(2011). *Introduction to research methodology in social sciences*. ABU Press Strub, D., Boudreau, M.C. & Geffin, D. (2004). Validation guidelines for IS positivists research. *Communications of the Association for Information Systems*. 13, 380 – 427.