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Trends in research in mathematics teaching and learning in Nigeria

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Abstract

This study investigated trends in research in mathematics teaching and learning from 2010 to 2019 in Nigeria. Trends were identified via the review of three local and international databases comprising: The Journal of the Mathematical Association of Nigeria – ABACUS, African Journal of Educational Studies in Mathematics and Sciences (AJESMS), and the International Electronic Journal of Mathematics Education (IEJME). 751 articles were examined out of which 60 articles relating to mathematics teaching and learning were reviewed. Topical issues as well as methodological trends were investigated. Data were analysed via content analysis using codes according to categories, and themes were generated for some research questions. Findings revealed topical issues mostly investigated in mathematics within the trend period as teaching approach (teaching methods and instructional models), dispositions (attitudes and perceptions), classroom assessment (learning outcomes, achievement and performance), technology use (competency, utilization level), demographics (gender), instructional materials, challenges encountered, interactions (experience), and teachers' competence (awareness and knowledge) respectively. The methodological trend showed preference for quantitative research method. The dominant data collection tools utilised were questionnaire and tests while the most preferred data analysis techniques were quantitative statistical tests comprising of descriptive and inferential tests. Conclusion reached was that there is a preference for quantitative approach towards mathematics teaching and learning research given that it maximizes objectivity, replicability and generalizing of conclusions drawn from the study. It is therefore recommended that the result of such researches should be effectively utilized in order to improve the teaching and learning of mathematics at all levels. This will go a long way in minimizing students' poor performance in mathematics.
Keywords: Learning, Mathematics, Nigeria, Research, Teaching, Trends.

Introduction

Mathematics is an essential and relevant knowledge in every human endeavours (MySchool News, 2019) utilized by everyone in one form or the other in the society. Its understanding is useful to all citizens in all disciplines and field of learning such as engineers, businessman, politicians, educationists etc. in order to become a functional member of the society. It is necessary for all school age child to acquire mathematical understanding that will enable him/her utilize and display such knowledge and skills for effective functioning in the society which can be effectively and systematically provided via mathematics instruction in schools (Rusdawati, 2020; Tali, Mbwas & Abe, 2012). Mathematics is thus an important subject made compulsory for all students at both the basic and secondary school levels in Nigerian schools (MySchool News, 2019; Tali, Mbwas & Abe, 2012).

Mathematics is referred to as the queen of the sciences (Etuk and Bello, 2015). Scientific, technological, economical and even political development is dependent on the nation's manpower, which includes mathematics teachers, engineers, medical doctors, technologists and so on (Tali, Mbwas & Abe, 2012). As no nation can grow and develop beyond its manpower, mathematics knowledge is essential in sharpening the mind and producing qualitative manpower that are self-reliant in the society. Hence, Etuk and Bello (2015) believed that adequate and proper foundation in school mathematics will contribute immensely to the development of the young one's intellectual potentials.

Mathematics has been differently defined and viewed from different perspectives by various experts. There is no consensus as regards the definition of mathematics and no accepted definition of mathematics. Until the 18th century, mathematics was defined as "the science of quantity" by Aristotle (Ugwuoke, 2017, Jaiswal, 2020). Mathematics has also been defined as the field of study utilizing numbers and symbols for measurement, properties, and relationships of quantities and sets (Jaiswal, 2020). Mathematics, from the perspective of Khan (2015) and Abe (2012) is regarded as the body of knowledge comprising techniques and methods used in solving problems. The ability to understand and utilize the knowledge of mathematics to solve problems and relate mathematics learnt to real life beyond the classroom is necessary by every learner for preparation for life and functionality in the society. Thus, Uwaezuoke and Charles-Ogan (2016) hyped the importance of mathematics in experiments, creativity and hands-on activities.

Mathematics is a compulsory subject for students at both the basic and senior secondary school levels in Nigeria because of its importance to everyday living and people's way of life (Tali, Mbwas & Abe, 2012). The 9-year basic mathematics curriculum is developed and structured around five major themes namely: Number and numeration, Basic operations, Algebraic processes, Mensuration and Geometry, and Everyday Statistics. While the senior secondary mathematics curriculum is structured around the following themes: Number and Numeration, Algebraic process, Geometry, Statistics and Introductory Calculus (Oyedeji, 2016). Part of the importance of mathematics as an essential subject entail providing an effective way of building mental discipline, improving mental rigor in order to develop logical, analytical and problem-solving skills, that is, it develops logical thinking and problem-solving skills that enhance the understanding of other subjects such as physics, music etc. (Jaiswal, 2020; Khan, 2015).

Balanced instruction in the past focused on the achievement and success of both the learners and teachers at school. At the present, this focus has shifted to enabling students achieve the knowledge and skills that will prepare them for life beyond school (Coombes, 2013). As mathematics is continuously growing and being applied to variety of fields of study and profession, mathematics instruction is expected to prepare and equip students in constructing their own understanding, applying prior knowledge and skills to novel mathematics content, taking risks consistently via challenging tasks and seeing the purpose of content learnt (Coombes, 2013). Coombes (2013) posited that effective mathematics instruction is that which impacts students learning. By implication, mathematics teaching has significant effect on students' learning nature and outcomes (Anthony & Walshaw, 2009). This unravels the massive responsibility of teachers in ensuring students mathematical well-being. Diverse researches had been done in a bid to finding a way of improving mathematics teaching and learning, and the students' performance in the subject at all educational levels. This calls for the need to study the general direction of research in the teaching and learning of mathematics. In this article, aspects considered include mathematics teaching and learning, and the problems of mathematics teaching and learning in Nigeria. Thereafter, the trend analysis of journal articles on mathematics teaching and learning published between the period of 2010 and 2019 was examined.

Research Questions
The following research questions guided this study:
1) What is the range and frequency of topics being investigated in mathematics teaching and learning over the period of 2010 to 2019?
2) What are the most frequently used data research methods?
3) What are the most frequently used data collection instruments?
4) What data analysis techniques are employed within this trend period?

Literature Review
Mathematics Teaching and Learning

Verschaffel, Van Dooran and Desmedt (2012) opined that mathematics learning entails the acquisition of new knowledge and skills related to quantity, space and structure. How students learn mathematics influences the rate of their understanding of its concepts, principles and practices. Mathematics learning involves developing mathematical concepts, problem-solving strategies and critical thinking abilities (Rusdawati, 2020). According to Decorte (2010), mathematics learning transcends concepts learning, procedures learning and their applications; it entails the development of right disposition toward the subject and having qualitative look of situations. Students' dispositions towards mathematics reveal their confidence, willingness to explore alternatives, interest, perseverance, and reflections on their own thinking when approaching mathematical tasks. Decorte (2010) outlined features of effective learning processes as being constructive, goal-oriented, cumulative, self-regulated, situated, collaborative and individually different. Learning being constructive implies providing room for learners to be active and not passive recipients of information so as to be able to construct their own knowledge and skill. Learning being cumulative implies that it should be built and based on prior knowledge. Learning should also be self-regulated, thus permitting learners to manage, monitor and control their own learning activities. He maintained also that learning is goal-oriented, implying that it should be guided by predefined goals and objectives set by students to become productive. Learning should also be situated implying that it could be derived beyond the cognitive domain but could be located via cultural activities, social interactions and practices. As no man is an island of knowledge, learners should be allowed to cooperate and learn from each other so as to make learning more productive.

Lastly, students' learning processes and rate of learning vary as a result of their individual differences and unique aptitudes. By implication, given the characteristics of learning, the guidelines to ensure a productive mathematics learning environment were designed via the mathematics educational goals and specific objectives in the mathematics curriculum, containing topics, methods, activities, the pedagogical processes, and situations to develop the appropriate learning activities which will enhance the achievement of the intended outcomes as stated in the curriculum.

Decorte (2010) further opined that "learning mathematics entails doing mathematics or mathematizing" (p.42). Hence, to achieve intended outcomes stated in the curriculum, Decorte (2010) suggested the designing of learning environment that will enhance the development of active learning strategies to support the constructive, goal-oriented, cumulative processes in passive learners; learning environment that will permit and promote students' self-regulation of their own learning processes; learning environment that will permit practical linkage and application of knowledge and skill to real-life situations; and learning environment that will permit flexible instructional approach and interventions, and also take care of students' individual differences. The understanding of mathematical concepts, principles and practices by students is a function of their way of learning and the way they were being taught. This points to

the facts that the mathematics tasks, problem solving situations, methods and the learning tools need clear consideration by mathematics teachers for proper representation of mathematical ideas beyond computation alone which many referred to mathematics.

National Research Council (2000) maintained that effective teaching of teachers will require adequate knowledge of the subject matter and its structure, and the right selection of appropriate teaching activities which will enhance students' proper understanding of the subject and their ability to ask probing questions. Teaching is defined as the sequence of interaction existing between the teacher and the learners with the sole aim of transforming the learners cognitively (Tali, Mbwas and Abe, 2012). Thus, mathematics teaching was viewed as the interaction existing between teachers and learners in impacting knowledge, skills, ideas and practices, which will enable them become functional members of the society. The teachers' instructional decisions and actions are determined by their knowledge, beliefs and goals for instructions. In other words, teachers' subject matter knowledge (content knowledge), pedagogical knowledge (general and content specific) and knowledge about the learners all predict and influence what they teach and how to teach it in mathematics classroom (National Research Council, 2000).

It is an established fact that mathematics is a universal subject applicable to many other fields of study. Anthony and Walshaw (2009) stated that "mathematics is the most international of all curriculum subjects, and mathematical understanding influences decision making in all areas of life-private, social and civil" (p.6). In other words, given this importance of the subject, mathematics is useful and significant in improving and increasing the citizenship and after school opportunities of students in the real world. On the contrary, mathematics is a subject many students have challenge with. Most students view it as a very difficult subject to understand, hence they develop a dislike for it which manifest in their negative attitude towards the subject and poor performance in it at every level of education. It is crucial that teachers understand what mathematics teaching effectiveness entails so as to help intervene and improve on their teaching thereby impacting the learning of students at all levels of education.

Effective mathematics teaching pedagogical approaches according to Anthony and Walshaw (2009) encompasses the following; Maintaining caring classroom community, learning arrangement, building on students' thinking, selecting worthwhile mathematical tasks, creating/ making connections, using range of assessment practices, facilitating mathematical communication, modeling appropriate mathematical language, selecting appropriate mathematical tools and representations, and teacher's knowledge which is a sound knowledge of subject matter and how to transmit and teach it. This is crucial in fostering an effective instruction in mathematics.

Problems of Mathematics Teaching and Learning in Nigeria

Mathematics teaching and learning in Nigeria has encountered many challenges which have been a global concern, mostly to the mathematics educators and government. These problems reflect in the negative attitude shown by students and their eventual poor performance in the subject even at the West African Senior Secondary Certificate Examination (WASSCE) in Nigeria despite its importance. Many factors have been identified as mathematics teaching and learning problems in Nigeria (Aguele & Usman, 2007; Anigbo, 2016; Kyari, Obed & Yalwa, 2018; Tali, Mbwas & Abe, 2012). These problems include but not exhausted to the following: Students' lack of interest in learning mathematics based on its abstract nature and belief that mathematics is difficult leading to negative attitude of students to the subject; shortage of qualified competent mathematics teachers with experience to utilize appropriate instructional strategies to arouse students' interest in mathematics; poor attendance to seminars/ workshops by mathematics teachers for training and update of knowledge; inadequate learning facilities and instructional materials such as mathematics laboratories and conducive learning environment; large class size; and poor remuneration of teachers.

Trend Analysis in Perspective

Mathematics teaching and learning have improved over the years to a stage that its development, character and achievement can be considered and discussed (Niss, 2004). Mathematics teaching and learning is dynamic and ever changing, thus, generating problems, challenges, new developments and policy evaluation needs leading to trends that can form a study's unit of analysis (Frank, Alex & Pravina, 2018). Trend is a pattern of gradual change in a condition, output or process used in estimating events in the past or predicting future events (Trend, 2020). Trend study is the study examining the specific characteristic of a population over time (Trend study, 2014). In this study, the specific characteristic considered was the trend of topical issues and methodologies in mathematics teaching and learning in both local and international journals and databases over a period of ten (10) years from 2010 to 2019. According to Frank, Alex and Pravina (2018), trend analysis avails educational researchers the opportunity in utilizing previous researches to develop conceptual and theoretical frameworks, and provide both qualitative (content analysis) and quantitative (meta-analysis) literature reviews.

Research Methodology

The review conducted in this research is based on content analysis of articles that focused on trends in mathematics teaching and learning research for a time period of ten (10) years from 2010 to 2019. Amy (2019), described content analysis as a research method used in identifying patterns from a set of texts which could be written, oral or visual. He explained further that content analysis can be both quantitative (focusing on counting and measuring) and qualitative (focusing on interpreting and understanding) used in categorizing or coding words, themes and concepts within the texts and whose results are afterwards analysed. It also places quantity on the frequency of use of certain words,

phrases, subjects or concepts in contemporary or historical texts. Literature review was conducted on reputable online databases and hardcopy journals with topics relating to the title under review, which include:

- The Journal of the Mathematical Association of Nigeria – ABACUS
- AFRICAN Journal of Educational Studies in Mathematics and Sciences (AJESMS)
- International Electronic Journal of Mathematics Education (IEJME)

The reviewed research articles were obtained using the search terms such as: "teaching of mathematics", "learning of mathematics", "teaching and learning of mathematics", and "mathematics instruction" respectively. The selected journals were based on two criteria: first, the research papers contain topics relating to the teaching and learning of mathematics. Secondly, papers published in the 2010-2019 range. 2020 was excluded because the entries for 2020 were still ongoing as at the time of writing this article.

Categories for trends in topics explored

Open coding technique was used to determine the topical trends. According to Gallicano (2013), open coding is the approach in content analysis where tentative labels (codes) are created for the data collected that summarize what is happening from the emerged data. The synthesis of the results was carried out based on the criteria stated and from the topics reviewed; the data regarding the teaching and learning of mathematics were coded or grouped as codes.

Categories for methodological trends (research methods, data collection tools, data analysis)

A data set was created with the relevant fields on the research methods (quantitative, qualitative and mixed), data collection tools (questionnaires, tests, observation and interviews) as well as data analysis techniques (statistical and interpretive analysis).

Findings and Discussions

For this study, a total of seven hundred and fifty-one (751) articles were examined, out of which sixty (60) articles relating to mathematics teaching and learning were examined, subjected to content analysis via determined criteria.

Research Question 1: What is the range and frequency of topics being investigated in mathematics teaching and learning over the period of 2010 to 2019?

Range and frequency of topics investigated in mathematics teaching and learning research

The open coding of this research question yielded nine (9) primary topics with thirteen (13) subtopics (Table 1). The aim of the research topics which were explicitly stated in the abstracts of the articles sampled formed the basis of the variables generated. Thus, the variables for this research were categorized and coded under the following 9 primary topics: teaching approach, dispositions, classroom assessment, technology use, demographics, instructional materials,

challenges encountered, interactions and teachers' competence respectively.

Table 1. Range and Frequency of Topics in Mathematics Teaching and Learning (2010 – 2019)(n=60)

Primary topic	No	%	Subtopics
Teaching approach	30	50	Teaching methods, instructional/ learning models
Dispositions	7	12	Attitudes, perceptions
Classroom assessment	4	7	Learning outcomes, achievement, performance
Technology use	7	12	Competency, utilization level
Demographics	4	7	Gender
Instructional materials	3	5	
Challenges encountered	2	3	
Interactions	1	1	Experience
Teachers' competence	2	3	Awareness, knowledge
TOTAL	60	100%	

Research Question 2: What are the most frequently used data research methods?

The most frequently employed research methods

Table 2 revealed the research methods tilized by researchers in the study years. Research methods employed in the articles sampled were quantitative, qualitative and mixed methods. As shown in table 2, the researchers mostly conducted quantitative (68%) and qualitative (27%) while mixed method (5%) was least conducted. A reason for the preference for quantitative research method by most researchers over the others could be that it requires mathematical and/ or statistical knowledge to analyse the data in mathematics teaching and learning effectively (Learning Development, 2018). Since quantitative research method maximizes objectivity in the conduct of the study and conclusions drawn, it also maximizes replicability and generalizability of the findings, and for its prediction ability, it's mostly preferred as the most plausible design to adopt (Harwell, 2011). More so, it employs the use of instruments such as tests or surveys in the collection of data and also relies on probability theory in testing statistical hypotheses corresponding to research questions of interests thereby making general inferences about the characteristics of a population. This is followed by the qualitative research design which though focused on discovering and understanding the experiences, perspectives and thoughts of specific cases, people or group, the generalizations are made on small samples or case studies that may not be representative enough coupled with its time-consuming analysis (Harwell, 2011; Learning Development, 2018). Creswell (2003) as cited in Powoh (2016) maintained that the qualitative research method has been in existence only for a few decades, usually utilized by researchers to generate meaning and understand phenomenon of interest in

mathematics teaching and learning process. It is also used in gathering a general idea from the subjects via case studies and action research to explore, interpret and describe experiences and learning approaches in mathematics.

The mixed research method that combines both quantitative and qualitative method in the same study was least utilized by researchers. Mixed methods researches collect multiple data with diverse strategies and methods reflecting complementary strengths and non-overlapping weaknesses in order to generate insights which quantitative or qualitative methods alone cannot provide (Johnson & Turner, 2003 as cited in Harwell, 2011). This approach thus revealed teachers' disposition, motivation and performance in mathematics instructional practices.

Table 2. Frequent Research Methods (2010-2019) (n=60)

Journal	Quantitative	Qualitative	Mixed method
The Journal of the Mathematical Association of Nigeria-ABACUS	28	6	0
African Journal of Educational Studies in Mathematics and Sciences (AJESMS)	4	1	1
International Electronic Journal of Mathematics Education (IEJME)	9	9	2
Total (All Articles)	41	16	3
Percentage	68%	27%	5%

Research Question 3: What are the most frequently used data collection instruments?

Data collection tools most frequently employed

Table 3 showed Questionnaire (43%), test (27%), observation (22%) and interview (8%) as the data collection tools used in mathematics teaching and learning research. A further analysis reveals that in quantitative studies which included descriptive research of the survey type and quasi-experimental studies, researchers most frequently employed the use of questionnaire and tests respectively to gather data, whereas in the qualitative studies such as case studies and action researches, the trend was towards observation (non-participant) and interviews (focus groups, individual and semi-structured interviews) respectively. Another noted trend entails the combination of different data collection methods. This is called triangulation. Triangulation implies a method of using variety of methods in collecting data on the same topic to increase the validity and reliability of research findings and to study different dimensions of the same phenomenon, not

necessarily to cross-validate. Triangulation combines theories, methods or investigators in a research study, to reduce individual biases (Noble & Heale, 2019).

Table 3. Frequent Data Collection Tools (2010-2019) (n=60)

Journal	Observation	Interview	Questionnaire	Test
The Journal of the Mathematical Association of Nigeria-ABACUS	6	0	17	11
African Journal of Educational Studies in Mathematics and Sciences (AJESMS)	1	0	5	0
International Electronic Journal of Mathematics Education (IEJME)	6	5	4	5
Total (all articles)	13	5	26	16
Percentage	22%	8%	43%	27%

Research Question 4: What data analysis techniques are employed within this trend period?

The frequency of data analysis techniques employed

Table 4 showed the data analysis methods utilised. The findings revealed that most mathematics teaching and learning studies employed the statistical tests analysis in quantitative researches (73%). Under this technique, parametric statistical test (43%) represented the majority, followed by descriptive statistical test (27%) and non-parametric statistical test (3%).

Parametric statistical test as widely used, allows making assumptions and generalizations about the distribution of large population from which the sample was taken (IBM, 2020) and also used to test or explain hypotheses. Rather than utilizing the entire population in gathering data, the researchers collected samples and made inferences about the entire population using a representative sample (Alida, 2020). The descriptive statistics described and summarized data in a meaningful way to allow patterns to emerge from the data.

The discourse analysis on the other hand was often used as interpretative analysis in qualitative research compared to thematic, content and narratives analysis because it makes it easier to understand social interactions.

Table 4. Data Analysis Technology (2010-2019) (n=60)

Descriptive (27%)	Quantitative (73%) (Statistical tests)	
	Inferential	
	Parametric (43%)	Non-parametric (3%)
Simple percentages 9	Variance Analysis (ANOVA, ANCOVA) 18	Wilcoxon test 1

	t-test	Chi-square
Variability (Variance, standard deviation, range) 3	8	1
Central Tendency (mean, median, mode) 3		
Graphical 1		
Total 16		
	26	2
Qualitative (27%) (Interpretative analysis)		
Discourse analysis	9	
Content analysis	3	
Thematic analysis	3	
Narrative analysis	1	
Total	16	

Conclusion and Recommendation

The study constitutes a trend analysis of mathematics teaching and learning in selected databases and related journal articles. The study revealed the areas of interest, topical issues and methodological trends in mathematics teaching and learning researches. Overall, the percentage of related articles in mathematics teaching and learning in selected journals for the period under study was 8%, which is neither negative nor insignificant in the current trends in mathematics education. Content analysis of selected databases and related journals (ABACUS, AJESMS and IEJME) relevant to mathematics teaching and learning was done.

A thorough search of papers using the keywords relevant to the topic was carried out and the study was based on the findings generated from the trend analysis within the period of 2010 to 2019. Findings from the study revealed that teaching approach (teaching methods and instructional/ learning models) represented a major topic in mathematics teaching and learning researches, followed by dispositions (attitudes, perceptions), technology use (competency, utilization level), classroom assessment (learning outcomes, achievement, performance), demographics (gender), instructional materials, challenges encountered, teachers' competence (awareness and knowledge) and interactions (experience) respectively. As regards the research methods, quantitative studies dominated the researches within the trend period under review as most of the studies employed descriptive survey and quasi-experimental research designs. The reason being that, mathematics teaching and learning researchers may want to maximize objectivity, replicability and generalizability of conclusions drawn from the study of a representative sample of the larger population.

Mathematics teaching and learning researchers also employed quantitative data collection tools such as questionnaires, rating scales and tests while observation and interviews which are qualitative data collection tools were minimal. Data analysis methods trend revealed the preference for descriptive and inferential statistical test in analyzing data while interpretative analysis with preference for discourse, thematic, content and narrative analysis were minimal.

Teaching approach seems to be mostly researched as a topical issue in mathematics teaching and learning researches, it is therefore recommended that, the result of such researches should be effectively utilized for improvement in mathematics teaching and learning at all levels. This will go a long way in minimizing students' poor performance in the subject.

References

1) Aguele, L. I. & Usman, K. O. (2007). Mathematics Education for dynamic economy in Nigeria in the 21st century. Journal of Social Science, 15(3), 293-296.

2) Ali, R, Hukam, D.,Akhter, A & Khan, A. (2010). Effect of using problem solving method in teaching mathematics on the achievement of mathematics students. Asian Social Science, 6(2), 67-72.

3) Alida, D. (2020). Descriptive and inferential statistics: Definition, differences and examples. Retrieved from https://study.com/academy/lesson/descriptive-and-inferential-statistics.html

4) Alzabut, J. (2017). On using various mathematics instructions versus traditional instruction: An action research. Journal on Mathematics Education, 8(2), 133-144.

5) Amy, L. (2019, July 18). What is content analysis and how can you use it in your research? [Blog post]. Retrieved from https://www.cribbr.com/methodology/content-analysis/

6) Angbo, L.C. (2016). Factors affecting students' interest in mathematics in secondary schools in Enugu state. International Journal of Education and Evaluation, 2(1), 22-28.

7) Anthony, G. & Walshaw, M. (2009). Effective pedagogy in mathematics. Educational practices series-19. France: Connet Imprimeur.

8) Behlol, M.G, Rafaqat, A.A & Hifsa, S.(2018). Effectiveness of problem solving method in teaching mathematics at elementary level. Bulletin of Education and Research, 40(1), 231-244.

9) Behr, A. L. (2006). Exploring the lecture method: An empirical study. Studies in Higher Education, 13(2), 189-200.

10) Biswas, S. (2019). The effect between lecture method and lecture cum demonstration method in teaching mathematics in class ix. Standard of West Bengal Board of Secondary Education, 2(1), 1-6.

11) Chandramoulesh, G. K. (2015, June 6). Lecture demonstration method definitions, steps, advantages, disadvantages [Blog post]. Retrieved from http://sciencetg.blogspot.com/2015/06/lecture-demonstration-method.html?=1

12) Coombes, C. (2013). What is effective teaching of mathematics? Generation Ready. Retrieved from https://www.generationready.com/what-is-effective-teaching-of-mathematics/

13) Daluba, N. E. (2013). Effect of demonstration method of teaching on students' achievement in Agricultural science. World Journal of Education, 3(6), 1-7.

14) DeCorte, E. (2010). Fostering cognitive growth: A perspective from research on mathematics learning and instruction. Educational Psychologist, 30(1), 37-46.

15) Dudovskiy, J. (2021). Qualitative data analysis. Retrieved from https://research-methodology.net/research-methods/data-analysis/qualitative-data-analysis/

16) Etuk, E.D. & Bello, D.O. (2015). Challenges and prospects of mathematics education in Nigeria. Journal of Assertiveness, ISSN: 2276-9684. Retrieved from https://www.semanticscholar.org/paper/CHALLENGES-AND-PROSPECTS-OF-MATHEMATICS-EDUCATION-Etuk-Bello/f1e5f205b235ac164227ebceca-0696b15b82dc79#citing-papers

17) Frank. M., Alex, B. & Pravina, P. (2018). Trends in pre-service teacher education in South Africa: A content analysis of selected education journals from 2010-2017. *Journal of Gender, Information and Development in Africa (JGIDA). Special Issue*, 261-277.

18) Gallicino, T. (2013). An example of how to perform open coding, axial coding and selective coding. Retrieved from https://www.google.com/amp/s/prpost.wordpress.com/2013/07/22/an-example-of-how-to-perform-open-coding-axial-coding-and-selective-coding/amp/

19) Harwell, M. R. (2011). Research design in qualitative/ quantitative/ mixed methods: Pursuing ideas as the keystone of exemplary inquir. In C. Conrad & R. C. Serlin (Eds), The Sage handbook for research in education: Pursuing ideas as the keystone of exemplary inquiry (2nd ed.), Sage.

20) Haidich, A. B. (2010). Meta-analysis in medical research. HIPPOKRATIA, 14(1), 29-37.

21) IBM (2020). Parametric and non parametric statistics-IBM. Retrieved from https://www.ibm.com/support/knowledgecenter/en/SSFMBX/com.ibm.swg.im.dashdb.analytics.doc/doc/r_statistics.html

22) Jaiswal, S. (2020). What is math? Retrieved from https://www.javatpoint.com/math

23) Japalal (2013, November 28), more maths more: Laboratory method [Blog post]. Returned from http://moremathsmore.blogspot.com/2013/11/v-behavioururldefault.vmlo.html?m=1

24) Khan, S. (2014). Analytic-synthetic method of teaching mathematics- slideshare. Retrieved from https://www.slideshare.net/mobile/Sultankhan1/analytico-synthesic-method-of-teaching-mathematics

25) Khan, L. A. (2015). What is mathematics – An overview. International Journal of Mathematics and Computational Science, 1(3), 98-101.

26) Kulbir, S. S. (2018). Analytic and synthetic method: Methods of teaching mathematics. Retrieved from https://rkdskool.com/2018/09/24/analytic-and-synthetic-methods-of-teaching-mathematics/amp/

27) Kumar, S. V. (2015, December 30). Strategies of teaching mathematics [PowerPoint slides]. Retrieved from https://www.slideshare.net/mobile/vsk84/methods-of-teaching-mathematics-56555590

28) Kyari, S.S., Obed, T. A. & Yalwa, M. (2018). Issues in mathematics education in Nigeria. International Journal of Education and Evaluation, 4(9), 11-17.

29) Learning Development (2018). What is the difference between quantitative and qualitative data and mixed methods? Which is better?. Retrieved from https://cpb.eu.w2.wpmucdn.com/mypad.northampton.ac.uk/dist/d/6334/files/2018/01/Quantitative-qualitative-and-Mixed-Methods-Jan-2018-1hvxxl1,pdf

30) Maheshwari, V. K. (2018, November 30). Mathematics laboratory and lab method –Activity oriented pedagogy in mathematics teaching [Blog post]. Retrieved from http://www.vkmaheshwari.com/WP/?P=2651

31) Mohamed El-Sayed, H. E., Elmashad, H. A. M. & Ibrahim A. A. (2017). The effectiveness of utilizing video - assisted and lecture cum demonstration method on the nursing students' knowledge and skills in using partograph. Journal of Nursing and Health Science, 6(5), 61-70.

32) MySchool News (2019, July 2). Problems and prospects of mathematics education in Nigeria [Blog post]. Retrieved from https://medium.com/@myschoolnews2/problems-and-prospects-of-mathematics-education-in-nigeria-dbd209849082

33) National Research Council (2000). How people learn: Brain, mind, experience and school. Washinton, D. C.: The National Academies Press. Available from https://doi.org/10.17226/9853

34) Niss, M. (2004). Key issues and trends in research on mathematical education. In H. Fujita, Y. Hashimoto, B. R. Hodgson, P. Y. Lee, S. Lerman, and T. Sawada (eds), Proceedings of the Ninth International Congress on Mathematical Education. Springer, Dordrecht. Available from https://doi.org/10.1007/978-94-010-9046-9_3

35) Noble, H. & Heale, R. (2019). Triangulation in research with examples. Available from http://dx.doi.org/10.1136/ebnurs-2019-103145

36) Oldridge, M. (2017, November 23). What do we mean when we say, "Teaching through problem-solving" in mathematics classrooms [Blog post]. Retrieved from https://medium.com/@matthewoldridge/what-do-we-mean-when-we-say-teaching-through-problem-solving-in-mathematics-classrooms-ae1893d66be9

37) Oyedeji, S.O. (2016). Comparison of senior secondary mathematics in Nigeria and China. Journal of Educational Policy and Entrepreneurial Research, 3(1), 80-99.

38) Persuad, C. (2019, March 1). Pedagogy: what educators need to know [Blog post]. Retrieved from https://tophat.com/blog/pedagogy/

39) Physicscatalyst (2017, August 20). Lecture method as teaching strategy: B.Ed. Notes. Retrieved from https://physicscatalyst.com/graduation/lecture-method/

40) Physicscatalyst (2017, August 21). Demonstration method as teaching strategy: B.Ed. Notes. Retrieved from https://physicscatalyst.com/graduation/demonstration-method/

41) Powoh, T. V. (2016). DBA674 Quantitative and qualitative methods, Essay 1: Research methods. Retrieved from https://www.research gate.net/publication/305215626_Research_Methods_Quantitative_Quanlitative_and_Mixed_Methods

42) Ramadhan, N. & Surya, E. (2017). The implementation of demonstration method to increase students' ability in operating multiple numbers by using concrete object.

International Journal of Sciences, Basic and Applied Research (IJSBAR), 34(2), 62-68.

43) Rusdawati (2020). The early childhood mathematics learning. *Advances in Social Science, Education and Humanities Research, 449,* 107-109.

44) Seward, K. (2011, May 20). Virtual math lab tutorial: An introduction to problem solving–WTAMU. Retrieved from https://www.wtamu.edu/academic/anns/mps/math/mathlab/int.algebra/int_alg_tut8_probsol.htm

45) Tali, D.J., Mbwas, L.C. & Abe, A.S. (2012). The teaching of mathematics in secondary schools as a tool for self-reliance and rebranding process in Nigeria. Educational Research and Reviews, 7(1), 1-4.

46) Teaching Math: Methods and strategies (2016, January 22). Retrieved from https://study.com/academy/lesson/teaching-math-methods-strategies.html

47) Tes Editorial (2018, December 10). What is pedagogy? [Blog post]. Retrieved from https://www.tes.com/news/what-is-pedagogy-definition?amp

48) Thiyagu, S. (2011, May 20). Module 9: Problem solving method [Blog post]. Retrieved from http://thiyagumath.blogspot.com/2011/05/module9-problem-solving-method.html?m=1

49) Thiyagu, S. (2011, May 20). Methods of teaching mathematics module 8: Laboratory method [Blog post]. Retrieved from http://thiyagumath.blogspot.com/2011/05/module-8-laboratory-method.html?m=1

50) Trend (2020). What is trend? Business Dictionary. Retrieved from htpp://www.businessdictionary.com/definition/trend.html

51) Trend study (2014). In K. Bell (Ed.), Open education sociology dictionary. Retrieved from https://sociologydictionary.org/trend-study/

52) Ugwuoke, J.O. (2017). History of mathematics in Africa and in Nigeria. Educationgist [Blog post]. Retrieved fromhttps://academicpower.blogspot.com/2017/08/history-of-mathematics.html?m=1

53) Uwaezuoke & Charles-Ogan (2016). Teaching mathematics creatively in the junior secondary classes. Global Journal of Educational Research, 15(1).

54) Verschaffel, L., Van Dooren, W., & De Smedt, B. (2012). Mathematical learning. In N. M. Seel (eds), Encyclopedia of the Sciences of learning. Springer, Boston, MA.