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On Categories of Mathematics Teachers' Classroom Characteristics and Perceived Influence on Effective Mathematics Teaching in Secondary Schools in Plateau State, Nigeria

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Abstract: In this paper, the categories and influence of teachers' classroom characteristics relative to effective mathematics teaching in secondary schools in Plateau state, Nigeria were examined. The aim was to see how students are assisted to learn mathematics from teachers engaging fully their professional practices fully. Exploratory and descriptive survey research methods were used to examine the trajectories. Sample for the study consisted of 60 trained mathematics teachers from secondary schools in Plateau state that participated in a week-long capacity building workshop on teaching new concepts from secondary school mathematics curriculum in Nigeria organized recently by the state chapter of the Mathematics Association of Nigeria. Purposive sampling technique was used to select the sample based on the fact that the study targeted only mathematics teachers that participated in the capacity building workshop. A 52-item TCCQ on teacher effectiveness, interest, rapport with students, etc. was used for data collection. The findings from the study revealed that mathematics teachers' ability to teach effectively is significantly associated with many factors including the use of different strategies ($\chi^2=52.75$), revision ($\chi^2=47.13$), good lesson plans ($\chi^2=53.93$) and being friendly with students ($\chi^2=35.66$). There was no significant variation regarding how the characteristics influence teacher effectiveness based on qualification ($F_2, 58=0.689$). Among other things, therefore, it was recommended that teachers should be committed to teaching mathematics effectively in the classroom by taking cognizance of the variables especially designing of good lesson plans and previous knowledge irrespective of their qualifications.

Keywords: *Mathematics, teaching, characteristics, effective, learning, understanding.*

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Introduction

Convergence of opinions indicate that the performance of students in mathematics is dismal with many of them lacking genuine interest in the subject in Nigeria and many countries in the world (Abdulhamid et al., 2017; Adegoke, 2013; Akinsola, 2001; Bot, 2011; Cai et al., 2009; Eniayeju, 2010; Eshiwani & Shikuku, 2001; Federal Ministry of Education [FME], 2006; Odili, 2006; Oladokun, 2017; Uloko & Imoko, 2007; West African Examinations Council [WAEC], 2013; WAEC, 2014; WAEC, 2015). Some of the reasons adduced include students' poor ability, inadequate and poorly utilized instructional materials, lack of trained and qualified mathematics teachers, lack of mathematics teachers with interest in teaching, poor training and preparation of students for mathematics examinations, difficult nature of mathematics and the use of poor quality teaching methods and strategies (Bot, 2013; Bot & Caleb, 2014; Bot & Dareng, 2013; Bot & Timku, 2014; FME, 2006; Odili, 2006; WAEC, 2013; WAEC, 2014; WAEC, 2015). Other reasons include low motivation, self-esteem and self-efficacy for teachers; emotional problems affecting students and teachers, poor study habits by students, poor interpersonal relationships existing among students and teachers (Aremu & Sokan, 2003), lack of modern equipment, poor teaching and learning environment (Adegoke, 2013) as well as lack of understanding of basic mathematical principles (Bursal & Paznokas, 2006).

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The poor performance syndrome in mathematics among students is very worrisome to a lot of stakeholders including parents, government and guardians who rather than devising concrete measures and steps to tackle the root cause, resort to blaming teachers for wrongful knowledge impartation (Bot & Caleb, 2014; Bot & Dareng, 2013; FME, 2006). Thus except the teachers take drastic measures to assist their students learn to achieve better results in mathematics especially during standard external examinations, the blame-game would continue unabated giving the essential nature of mathematics in the advancement of science and technology in which Nigeria cannot afford to lag behind in the new age and stakeholders are not willing to waste slim resources in training their wards giving that mathematics obtained at credit level, is a compulsory requirement for further education in higher institutions' science-based and other courses. Beside these reasons, measures to be taken are necessary to produce mathematically bright students that will find it easy to gain admission and further their studies in higher institutions of learning at any time within and outside the shores of Nigeria otherwise they will be denied the opportunity, and hence spoil their future ambitions.

A number of ways have been suggested for this purpose especially to address majorly the problems of poor performance and pedagogic inadequacies in mathematics instruction to include the use of past examinations question papers for revision, revision exercises, simple language and practical lessons in mathematics (Binda, 2005; Bot, 2013; National Mathematical Centre, 2009; WAEC, 2013; WAEC, 2014, WAEC, 2015). Also, suggested are the adoption of an integrative method, counselling strategies and indigenous languages (Adegoke, 2013), proper mathematical thinking exercises and learning strategies to promote and support computational thinking (Larson, 2016), critiquing of common mistakes, comparing multiple solution paths (Rittle-Johnson & Jordan, 2016), working on interesting problems that allow for students' generated solutions (Larson, 2016), connecting procedures to underlying concepts (Wathall, 2016), provision of complex, rich problems that allows for multiple entry points and different approaches without imposing procedural steps (Suurtamm et al., 2015) as well as the use of technology such as on-line calculators in teaching and learning mathematics to enhance and sustain students' interest (National Council of Teachers of Mathematics [NCTM], 2015). Much as these measures are apt, the extensive probing of mathematics teachers' classroom characteristics that influence effective teaching and veritable training of students is required. Specifically, there is a need to investigate in depth the teaching and learning traits and attributes that teachers possess which are required to engage students in meaningful learning and understanding of mathematics such as sincerity, patience, respect, good rapport, interest, good questioning habit and commitment to work.

Meaningful learning is a function of forming connections between previous and new related knowledge and skills that enable a huge number of learners to be able to understand what is taught to them in class. Understanding denotes the ability to identify, read, comprehend and apply what is taught and learned with little or no difficulty. In relation to mathematics, it can be described as the ability to look at a problem critically from different perspectives and resolving it using relevant mathematics tools. This involves reading, identifying, expressing and representing a problem; identifying, recognizing the data; solving and interpreting the solution. In buttressing this, Bloom (1956) posited that individuals show understanding if they can recognize, recall, restate, translate and apply information. Understanding is, therefore, an important problem solving skill required by students to learn mathematics successfully. It is no wonder Grant (1978) and NCTM (2000) viewed understanding as the main focus of teaching mathematics; hence posited that students need to learn mathematics with full understanding to be successful problem solvers. However, for a teacher to be effective in teaching mathematics for learners to achieve understanding level, the age, maturity, temperament, home background, intelligence and experience of the learners must be considered in accordance with different learning theories, for instance, the stimulus-response theory (Skinner, 1938), theory of modes of learning or representation (Bruner, 1964) and meaningful verbal learning theory (Ausubel, 1963). Ausubel for instance, in his theory of meaningful verbal learning, stated that learning is meaningful when new knowledge is anchored on existing knowledge in the cognitive structures of learners. If the new knowledge does not relate to the old one, the learner will memorize it mechanically which is often called rote learning except advance organizers are used to facilitate the process. This means that in the absence of previous knowledge serving as sub-summers in their cognitive structures, students will often find it extremely difficult to learn and understand what is taught to them in mathematics very well. Beyond this theoretical underpinning, in their professional practice, teachers at any level of education are supposed to be well equipped in background training, experience, subject matter qualification and professional development to achieve effectiveness in mathematics subject-matter delivery in the classroom. This is because it is obvious that nowadays in the classroom, opportunity to teach and help students learn mathematics effectively is highly dependent upon a wide range of factors that lay in various activities and practices including encouraging independent learning, persistence, self-direction and engaging high level cognitive processes and strategies and so on. Teachers without these skills cannot engage in meaningful teaching of mathematics in the present age of science and technological innovation.

Furthermore, Ausubel's (1963) theory, among other things, recognized the important role of the learner on the need to assist them with relevant ideas, concepts, materials and resources for laying a solid foundation for meaningful conceptual development. Consequently, to help students to learn, understand and apply mathematics very well, teachers need to prepare adequately. Specifically, they need to study students and their problems, establish good rapport, motivate and guide them properly. Also, they need to be friendly or positively disposed with students, competent, confident, prompt in providing feedback, patient, kind, cheerful, loving, supportive, modest, responsible and creative in tandem with Bot (2013), Bot (2014), Lassa (2012) and Odili (2006), who maintain that except mathematics

teachers deploy different methods and support students learning widely, the students will find it difficult to learn and understand mathematics with genuine enthusiasm. To achieve this, Bot (2014) opined that constant teacher-interaction with students and scaffolding mechanism are required to help the students learn mathematics with full interest and attention in the classroom while Dweck (1986), Middleton (1995) and Ajaegbu (1999) suggested the use of incentives such as marks and gifts, and new teaching methods and strategies in the classroom to achieve this purpose.

The use of new methods such as cooperative, competitive and individual learning in mathematics instruction is particularly important since according to Good and Brophy (2003), no single extended method could be sufficient to address the instructional challenges students encounter in the classroom. More so, it has been argued that no guaranteed single effective approach to mathematics instruction exist (Wilén et al., 2008); hence mathematics teachers are required to use different methods in attempting to help their students to learn mathematics. The efficacy of new teaching methods and strategies is not in doubt when employed in mathematics instruction in terms of enhancing interest, commitment, independence, classroom management, performance and retention of subject matter. For instance, Gambari et al. (2013) revealed that the use of cooperative, competitive and individual learning methods and strategies significantly improve and bridge the gaps in mathematics performance of high, medium and low achievers and recommended that teachers should adopt them. Similarly, Zakaria et al. (2010) found the use of cooperative learning better with high achievement gain for students compared with the use of lecture method in teaching mathematics whereas an earlier reported study (Kramarski & Mevarich, 2003), demonstrated that using cooperative learning alone, the use of cooperative learning together with meta-cognition strategy, the use of individualized learning with meta-cognition and the use of individual learning resulted in significant improvement in reasoning ability and achievement of students in mathematics. No doubt, this suggests the import of new teaching strategies in mathematics instruction with the implication that teachers need to use them besides other humane traits and attributes to support students' learning in the classroom.

Statement of the Problem

It has been pointed out that to be effective in teaching mathematics in the classroom, it is absolutely necessary for mathematics teachers to engage certain germane characteristics such as being positively disposed albeit showing genuine interest in teaching, encouraging, motivating and being friendly with students. Unfortunately, most mathematics teachers hardly demonstrate these characteristics in the classroom and this has been one of the major factors responsible for the problem of poor performance and lack of interest of most students in mathematics in the secondary school in Nigeria. The problem of this study thus is to investigate the extent to which teachers' effectiveness can be measured by the characteristics they engage in assisting their students in the classroom during mathematics teaching. This will help identify the dominant teachers' characteristics in the classroom toward determining students' effective learning of mathematics for emphasis against the backdrop of the fact that many students will be motivated and encouraged to learn better that way otherwise they may experience laxity and their performance in mathematics affected negatively.

Purpose of the Study

The purpose of this study was to identify and examine the categories of the characteristics that teachers engage in assisting students in the course of mathematics teaching in the classroom. Specifically, the aim of the study was to find out the characteristics and or behaviors associated with effective mathematics teaching, the frequency, the extent to which they exert influence on mathematics teaching and the degree which teachers vary in their perceived engagement.

Research Questions

The research questions that guided the study are:

- (1) What categories of characteristics teachers exhibit while teaching mathematics in the classroom?
- (2) How important are the characteristics teachers use for effective mathematics teaching in the classroom?
- (3) To what extent do the characteristics teachers use influence mathematics teaching in the classroom?
- (4) How do the characteristics teachers use vary according to their teaching qualifications in mathematics?

Hypothesis

The hypothesis formulated and tested at 0.05 level of significance in the study is: There is no significant variation in perception of teachers on the manner which their specific behaviors influence effective mathematics teaching in the classroom.

Method

This study used exploratory and descriptive survey research methods to examine the influence of manifest teacher characteristics associated with effective mathematics teaching with students in the classroom. Sample for the study

consisted of 60 qualified classroom mathematics teachers drawn from private and public secondary schools in Plateau state who participated in a one-week-long capacity building workshop on teaching of new topics in the junior and senior secondary school mathematics curriculum in Nigeria. The workshop was organized recently by the state chapter of the Mathematical Association of Nigeria. Purposive sampling technique was applied since the study used only mathematics teachers that participated in the capacity building workshop.

Data was collected using Teachers Classroom Characteristics Questionnaire (TCCQ) consisting of 52 items on effectiveness, interest and rapport, motivation and resourcefulness, commitment, cooperation, treatment, counselling and assessment of students in the classroom. The TCCQ was designed using a five-point Likert scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). It was scored as follows: SA=5 points, A=4 points, U=3 points, D=2 points and SD=1 point for positive items while the negative items were scored in reverse order. The TCCQ was face-validated by experts, one from mathematics education and the other from test and measurement unit before it was administered to the participating teachers. The reliability of the TCCQ in measuring the teacher classroom characteristics was determined by Cronbach Alpha coefficient based on the use of Likert scale. The coefficient obtained was 0.81 for all the tested 52 items thus making the TCCQ a reliable instrument for the purpose of the study. The data collected was thereafter analyzed using frequency counts, percentages, chi-square and analysis of variance (ANOVA) based on the measurement scale. In particular, the ANOVA was used to test the significance of the hypothesis on perceived variation in response of the teachers giving that three groups of qualifications (NCE, BSc.ED, Others) were involved. The individual scores generated from the measurement scale were merged as continuous data on the bases of teaching qualification in each group to represent independent observations from the population with NCE minimum teaching qualification. This fits ANOVA whether or not the assumptions of homogeneity of variance as a result of grouping, normal distribution from the target population and independent observations based on qualification of the teachers are met. Norman (2010) argued and averred that it is perfectly appropriate to summarize the ratings from Likert scale using means and standard deviations and parametric techniques like ANOVA to analyze Likert scales or data with small sample sizes, unequal variances and with non-normal distributions, with no fear of coming to wrong conclusion.

Results

Results from the study are presented and discussed as follows:

Table 1. Perceived Categories of Mathematics Teachers' Characteristics for Effective Mathematics Teaching

Category	Freq./Percent	Category	Freq./Percent	Category	Freq./Percent
Strategies	59(98.33%)	Patience	14(23.33%)	Assessment	52(86.66%)
Classroom Management	56(93.33%)	Sympathy	14(23.33)	Feedback	54(90%)
Discussion	20(33.33%)	Kind Hearted	57(95%)	Revision	60(100%)
Application /Transfer	9(15%)	Cheerful	23(38.33%)	Questioning	60(100%)
Conducive Environment	57(95%)	Punctual	54(90%)	Forming Connections	60(100%)
New Methods	12(20%)	Good Lessons	58(96.66%)	Appropriate Representation	22(36.66%)
Clarifying Misconceptions	15(25%)	Compassionate /Respectful	13(21.66%)	Friendly Language	59(98.33%)
Cooperation	59(98.33%)	Friendliness	59(98.33)	Accommodating Support	16(26.66)
Counselling	57(95%)	Nurturing	52(86.66%)		18(30%)
Motivational	20(33.33%)	-	-	-	-

Table 1 reveals that the categories of characteristics mathematics teachers possess to exhibit in the classroom during teaching are multifaceted with varying influence rates to include use of revision exercises (100%), different solution strategies (98.33%), questioning (100%), solving practical problems through connections (100%) and the use of friendly and simple language for communication (98.33%).

Table 2. Mathematics Teachers' Perceived Responses Regarding 'Effectiveness' in Mathematics Teaching

Item	SA	A	U	D	SD	χ^2	Decision
1. Use of different strategies in mathematics	30	23	6	1	0	52.73	Sig.
2. Ensures good classroom management	21	29	6	2	2	43.40	Sig.
3. Does not discuss mathematics solutions	6	7	1	20	20	26.06	Sig.
4. Does not encourage application and transfer of knowledge in mathematics	1	5	3	23	28	44.87	Sig.
5. Creates conducive learning environment for mathematics	19	25	13	2	1	32.33	Sig.
6. Does not use new methods of teaching mathematics	4	0	8	24	24	37.13	Sig.
7. Does not clarify misconceptions in mathematics	0	4	11	20	24	31.20	Sig.
8. Revises work with students in mathematics	25	26	9	0	0	47.13	Sig.
9. Organize and lead effective discussions and questioning in mathematics	23	24	13	0	0	39.93	Sig.
10. Simplifies teaching mathematics through structures and connections	27	20	13	0	0	41.53	Sig.
11. Does not use appropriate representations (pictures, objects, etc.) in mathematics	3	4	15	23	15	21.93	Sig.
12. Uses friendly language so that students have an understanding of mathematics	26	21	12	1	0	39.13	Sig.
13. Does not allow students ask questions in mathematics	1	2	12	15	30	39.93	Sig.

χ^2 Critical Value=9.488 at 0.05 Level of Significance

Table 2 shows that the ability of mathematics teachers to teach the subject effectively is significantly associated with the use of different solution strategies ($\chi^2=52.75$), revision ($\chi^2=47.13$), mathematics applications ($\chi^2=44.87$) and efficient classroom management ($\chi^2=43.40$). However, lack of discussion of solutions ($\chi^2=26.06$) and lack of appropriate representations ($\chi^2=21.93$), though significant, are not so much related to their effectiveness in the classroom.

Table 3. Perceived Responses of Mathematics Teachers Regarding Commitment to Mathematics Teaching

Item	SA	A	U	D	SD	χ^2	Decision
1. Not patient in teaching students mathematics	4	5	5	20	26	31.13	Sig.
2. No sympathy for weak students in mathematics	2	8	4	14	32	41.93	Sig.
3. Very kind hearted in teaching students mathematics	25	25	7	3	0	42.20	Sig.
4. Not being cheerful with students in mathematics	2	12	11	18	17	13.80	Sig.
5. Always punctual and happy to teach mathematics	14	32	8	2	4	41.93	Sig.
6. Design good lessons that allow students to participate actively in mathematics	29	25	4	1	1	53.93	Sig.
7. Very helpful in teaching students mathematics	25	22	10	2	1	35.93	Sig.
8. Searches for and uses new ideas to improve teaching and learning mathematics	20	26	9	3	2	33.00	Sig.
9. Does not consider and attend to individual students in teaching mathematics	5	4	14	22	15	18.06	Sig.
10. Does not consider students' previous knowledge in teaching mathematics	0	0	12	20	28	43.20	Sig.
11. Does not help students to reason properly and develop good skills and strategies in mathematics	0	1	12	23	24	38.33	Sig.
12. Simplifies teaching and helps students understand structures and connections in mathematics	27	20	13	0	0	41.53	Sig.

χ^2 Critical Value=9.488 at 0.05 Level of Significance

Table 3 reveals that the commitment of mathematics teachers to teaching in the classroom is significantly related with ability to design good lessons ($\chi^2=53.93$), consider students' previous knowledge ($\chi^2=43.20$) and being kind-hearted ($\chi^2=42.20$) more than being cheerful ($\chi^2=13.80$) and ability to attend to students individually ($\chi^2=18.06$).

Table 4. Perceived Mathematics Teachers Interest in Teaching, Rapport with Students, and Motivation/Resourcefulness

Item	SA	A	U	D	SD	χ^2	Decision
1. Does not show compassion and mutual respect for students in teaching mathematics	0	8	5	21	26	35.40	Sig.
2. Work with students as a friend to help them learn mathematics better	23	22	14	0	1	35.66	Sig.
3. Helps nurture students' desire to learn mathematics	24	24	4	5	3	35.13	Sig.
4. Has interest in students learning mathematics	10	28	10	7	5	25.53	Sig.
5. Has no interest in accommodating students in learning mathematics	0	10	6	28	16	33.40	Sig.
6. Provide safe and healthy environment for students to learn mathematics	22	31	4	0	3	53.00	Sig.
7. Provide students with enough learning materials and activities in class to learn mathematics well	16	29	11	4	0	37.26	Sig.
8. Uses different strategies or intervention methods/techniques in mathematics	23	29	6	2	0	49.00	Sig.
9. Does not consider students' experiences, interests and real-life situations in mathematics	0	3	18	22	17	28.73	Sig.
10. Does not provide essential support, clues or scaffolds for students to develop confidence in mathematics	1	3	14	19	23	28.06	Sig.
11. Does not use different motivational techniques in teaching mathematics	2	7	11	18	22	20.46	Sig.

χ^2 Critical Value=9.488 at 0.05 Level of Significance

In Table 4, the perception of mathematics teachers regarding interest and rapport with students show significant association in being friendly with students ($\chi^2=35.66$), compassionate and respectful ($\chi^2=35.40$) and nurturing students' desire in learning mathematics in the classroom ($\chi^2=35.13$). Similarly, the use of different motivational techniques, and being resourceful in handling mathematics are significantly related to teachers' ability to use interesting strategies and variety of learning materials ($\chi^2=49.00$), as well as the provision of a safe and healthy environment for learning mathematics ($\chi^2=53.00$).

Table 5. Perceived Mathematics Teachers' Responses on Cooperation, Treatment and Counselling of Students

Item	SA	A	U	D	SD	χ^2	Decision
1. Provide opportunity for students to learn by sharing ideas and problems in mathematics	38	18	3	0	1	73.53	Sig.
2. Discourage students from accepting responsibility for learning by sharing in mathematics	1	4	9	28	18	35.40	Sig.
3. Provide opportunity for students to share materials, do activities together in mathematics	24	24	10	2	0	38.73	Sig.
4. Clarifies and have students share their learning intentions or targets/goals in mathematics	19	28	13	0	0	42.60	Sig.
5. Treat students equally without discrimination in mathematics	29	28	0	2	1	63.66	Sig.
6. Does not give equal time and attention to students to ask and answer questions in mathematics	2	12	4	22	20	24.86	Sig.
7. Treat students' strategies, skills, methods and techniques without complaints in mathematics	15	33	9	1	2	48.33	Sig.
8. Allow students lead discussion and encourages them without discrimination in mathematics	22	19	15	1	3	27.00	Sig.
9. Counselling students always to work hard and achieve good results in mathematics	32	15	10	3	0	45.53	Sig.

χ^2 Critical Value=9.488 at 0.05 Level of Significance

In Table 5, the results reveals the ability of mathematics teachers to engage students in cooperative learning effectively is significantly associated with students' freedom to learn and share mathematics ideas, and problems ($\chi^2=73.53$), and also their learning goals ($\chi^2=42.60$) more than having them accept responsibility for learning together in the classroom ($\chi^2=35.40$). Also, Table 5 reveals that mathematics teachers treatment and counselling of students in class is significantly associated with their ability to treat students equally ($\chi^2 = 63.66$), treat their strategies, skills, methods and

techniques equally without complaining ($\chi^2 = 48.33$) and also counselling them ($\chi^2 = 45.53$) to be successful in mathematics.

Table 6. Perceived Responses of Teachers Regarding Classroom Assessment of Students

Item	SA	A	U	D	SD	χ^2	Decision
1. Give assignments and enough time for students to do and practice mathematics	32	18	2	4	4	46.93	Sig.
2. Periodically assess and obtain data about students achievement in mathematics	9	38	8	3	2	61.80	Sig.
3. Uses students' work, data, observations, assignments to improve teaching practice in mathematics	20	28	8	2	2	38.73	Sig.
4. Does not use assessment scores as guide to improve instruction and achievement in mathematics	2	2	10	20	28	37.13	Sig.
5. Uses different techniques/means of assessing students in mathematics	25	25	10	0	0	45.00	Sig.
6. Does not give standard regular tests and examination to students in mathematics	0	2	12	20	26	36.60	Sig.
7. Provides timely feedback on tests and examinations in mathematics	15	28	11	3	3	31.53	Sig.

χ^2 Critical Value=9.488 at 0.05 Level of Significance

Table 6 reveals the assessment of students in mathematics is significantly related with the ability of mathematics teachers to periodically assess and obtain useful data on students' achievement ($\chi^2=61.80$), giving assignments and enough time for students to do and practice problem solving ($\chi^2=46.93$) and the use of different techniques for assessment ($\chi^2=45.00$).

Table 7. ANOVA Summary on Perceived Effectiveness of Mathematics Teachers' Characteristics in the Classroom Based on Qualifications

Source	Sum of Squares	df	Mean Square	F	Sig	Decision
Between Groups	637.233	2	318.617	0.375	0.689	Accepted
Within Groups	48389.750	57	848.943			
Total	49026.983	59				

F-ratio Critical=8.57, Level of Significance=0.05

Table 7 reveals that the variation in the perceptions of mathematics teachers on the characteristics affecting their teaching effectiveness in the classroom is not statistically significant ($F_{2,58}=0.689$), therefore, the null hypothesis is not rejected. This suggests that mathematics teachers, irrespective of their qualifications viz. Nigeria Certificate of Education (NCE), Bachelor of Science in Education (B.Sc.Ed.) and others have related feelings that their teaching effectiveness is influenced as it is related to many important teaching variables in the classroom.

Discussion

In the classroom, the perceived characteristics of mathematics teachers required to be engaged are quite enormous from the categories (Table 1). These include being effective in assessment, treatment and counselling of students, cooperating and motivating them to learn well and being committed to work hard. The use of these characteristics go to determine to a large extent how well teaching is done and the level of performance of students since effective teaching of any form is associated significantly with learning outcomes. Unfortunately, mathematics teachers hardly explore these characteristics for effective teaching and learning to occur. This gap has led to the expression of the views that mathematics is taught poorly and perfunctorily, and that students are often prepared poorly for written examinations resulting in dismal performance by incompetent teachers (Abdulhamid et al., 2017; Oladokun, 2017; WAEC Chief Examiners' Reports, 2013, 2014, 2015). Thus, except well trained and competent mathematics teachers are employed to teach the subject to students very well for better results, it is highly probable that without the characteristics engaged, teachers will continue to receive blame for students' poor performance in mathematics.

Also, an important finding from this study is that effective mathematics teaching as a function of enormous critical characteristics that teachers are supposed to possess and engage is significantly associated with using different strategies, revision, applications and efficient classroom management (Table 2). But teachers often overlook these thereby making it very difficult for students to learn and make progress in mathematics. This concurs with the reports of the Chief Examiners for WAEC mathematics (WAEC Chief Examiners' Reports, 2013, 2014, 2015) regarding the strengths and weaknesses of candidates that teachers hardly prepare their students well in mathematics for the examination; hence the report suggested that teachers should engage students in revision work using past examination question papers and handle mathematics practically to remedy the problem.

Similarly, this study has shown that commitment of teachers to teaching mathematics in the classroom is significantly related to ability to design good lesson plans, considering students' previous knowledge in teaching and being kind-hearted more than being cheerful and ability to attend to students' individual needs during lessons in mathematics (Table 3). This presupposes that if teachers prepare very well with the right type of lesson plans which considers what students already know, and having good rapport with them, the conceptual development will be meaningful since according to Ausubel (1963), learning is meaningful only when what is taught is related and built on what already exist in the cognitive structure. This also agrees with Piaget (1961) that teachers should ensure students have learned or gotten the pre-requisite knowledge or experiences before a concept are taught to them. This implies that without previous knowledge, students will not be ready to learn and will find it difficult to understand and utilize what is taught except the teacher avail them of the related experience.

Also, among other things, this study has revealed that the assessment of students in mathematics is significantly associated with the ability of mathematics teachers to periodically assess and obtain useful data on students' achievement, giving assignments with sufficient time and the use of many techniques for assessment (Table 6). This means that the more teachers evaluate their students, the better their effectiveness. Unfortunately, many teachers are said to find it difficult assessing students due to poor assessment knowledge and skills (Obioma, 2008; Yarquah, 2010; Esere & Idowu, 2011). This affects the performance of students because some like to know their progress to be motivated to learn while others see learning as a waste of time without feedback to help them monitor and work on their weaknesses. It is for this reason that Obioma (2008) particularly suggested that teachers should undergo proper pre-service and in-service training to acquire the necessary assessment skills to be able to use them and evaluate their students properly otherwise the students may be discouraged from learning what they are supposed to learn which eventually affect their performance in mathematics.

Conclusion

In conclusion, this study has demonstrated that effective and efficient mathematics teaching in the classroom is significantly a function of many important characteristics that the teacher needs to have and exhibit. This can be summed up to a number of portent questions: How can mathematics teachers be effective without assessment? What rapport occurs between teachers and students in the classroom? Do teachers employ many techniques of motivating students in the classroom? How do teachers show genuine interest in teaching mathematics? What behaviors do teachers display that determines commitment to teaching mathematics in the classroom? The answers to these and more related questions imply that many teacher characteristics exist and this can be employed for effective mathematics teaching such that the more they are utilized, the better it will be the benefit for students.

Recommendations

Based on the findings of the study, the following recommendations are made:

Mathematics teachers should avail themselves of the perceived teacher characteristics deemed necessary to prepare adequately for effective teaching.

- Commitment to the teaching of mathematics is not significantly associated to teachers' qualification, rather it is associated with the designing of good lesson plans, the use of previous knowledge and related experience, kind-heartedness and cheerfulness with students. Thus mathematics teachers should be committed to teaching mathematics by preparing adequately for the exercise regardless of their qualifications.
- Given that various teacher characteristics such as being friendly, compassionate and respectful are key to having meaningful and successful learning of mathematics in the classroom, the government should task school inspectors and supervisors to examine the extent how mathematics teachers engage them during teaching. This will help motivate many students to learn mathematics with sustained interest.
- The assessment of students in mathematics is significantly related to the ability of teachers to conduct it periodically to obtain useful information on students' achievement. Therefore, mathematics teachers should assess their students' learning at short interval of time and provide feedback promptly. It is only then that students will be motivated intrinsically to learn to understand and improve their performance in mathematics.

Limitations

This study has few limitations that could be addressed through further research. First, the sample size is small since only the mathematics teachers that participated in the workshop were involved in the study. Second, the literature review was not robust on all the categories of the teachers' classroom characteristic captured in the questionnaire due to insufficient recent literature and only the categories affecting directly classroom effectiveness were sought and captured in the questionnaire for response. Third, the sampling technique adopted was purposive sampling instead of random sampling to obtain a representative sample of the participants to respond to the questionnaire, and fourth, assessment of the practical utility of the teachers' classroom characteristics could not be carried out based on the

categories due to limited time the teachers were involved in the capacity building workshop. These few limitations could have affected the findings of this study.

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