



Mathematics Teachers' Perceptions of Difficulties Encountered by Students in Geometric Constructions in Egbeda Local Government Area, Oyo State, Nigeria

Cristianah Olajumoke SAM-KAYODE

Department of Science Education, Lead City University, Ibadan, Oyo State, Nigeria

*Corresponding author: samkayodeolajumoke@gmail.com

Abstract

This study assessed Mathematics teachers' perceptions of the difficulties encountered by students in geometric constructions in Egbeda Local Government Area, Oyo State, Nigeria. A qualitative research design was adopted for the study using a 30-item self-structured questionnaire administered on Thirty-five (35) Mathematics teachers from sixteen (16) secondary schools, selected through simple random sampling techniques. The schools were sampled based on the followings: Presentations of candidates for the West African School Certificate Examinations for at least twenty years (2004-2023); availability of at least two qualified Mathematics teachers who teach at senior secondary school; availability of Mathematics laboratories, moderately populated classrooms; and sufficient periods for Mathematics lessons on the timetable. The following conclusions were arrived at which include; insufficient number of teachers to teach Mathematics in some of the schools, lack of skillful teachers who are versed in the concept of geometric construction, lack of construction instruments (Mathematical set) by some of the students, insufficient time/periods allocated to Mathematics lessons, laxity by students in practicing geometric constructions at home and overcrowded classrooms. This study recommended that: More Mathematics teachers should be employed to teach Mathematics at the secondary schools, Mathematics Teachers should update their knowledge in the rudiments of the concept of geometric constructions, students should be encouraged to get construction instruments(Mathematical set) to aid their learning of geometric constructions, sufficient time/periods should be allocated to Mathematics lessons, students should be encouraged to practice geometric constructions at home, and school administrators should work on reducing overcrowded classrooms to manageable ones.

Keywords: Mathematics teachers' perceptions, Students' difficulties, Geometric constructions

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Introduction

Technological advancement of any country depends on the scientific background of such country, Mathematics is a key player in this regard especially at the secondary school level and in the society at large. It entails the basic practices of acquiring numerical skills of counting, measuring, weighing, describing shapes of objects, forming new numbers through the use of the basic operations of Mathematics and describing the relationships to real life applications. Mathematics is included in the secondary school curriculum as a result of its relevance to school learnings and the society as indicated in the National Policy on Education (Kaur, 2023). Hence, the goals for the teaching and learning of Mathematics in secondary schools are highlighted as to:

1. Generate interest in mathematics
2. Develop computational skills and foster the desire and the ability to be accurate to a degree relevant to the problem at hand
3. Develop ability to recognize problem and to solve the problem with latent mathematics knowledge
4. Develop precise, logical and abstract thinking
5. Stimulates and encourage creativity in the learners
6. Develop necessary mathematical background for further education (Mukuka et al., 2023).

It is however a concern that despite the importance and relevance of Mathematics, students' performance in the subject at both internal and external examinations reports indicated that, students did not do well in the subject. One of the topics in Mathematics where students have not been performing adequately well is geometric construction (Akinpelu et al., 2024). Geometric construction is a hands-on topic in Mathematics which extension is found in Technical Drawings at the secondary schools. It is practical based and needs a prerequisite knowledge in geometry and trigonometry to be able to gain insight into its understanding and applications. Geometrical construction entails drawing lines, line segments, shapes, circles and other figures accurately using a ruler, a compass, or a protractor. It is the act and discipline that involve the use of drawings to explain how some system work (Technical Drawing, n.d). Many technological fields of endeavours, such as engineering, industry, architecture, orthography and other related fields employ the knowledge of geometric constructions to design their activities, and to convey instructions for the assembling of parts of structures in order to arrive at the expected output of a design. There are many types of geometric constructions which are employed in architectural drawing, electrical drawing, patent drawing, and general designs and illustrations (Ahadi et al., 2023).

Despite the relevance of Mathematics, students' performance in the subject is still a concern at both internal and external examinations (Chand et al., 2021). Records have shown that there has been mass failure in Senior School Certificate Examinations (SSCE), which is the concern of the society at large as indicated in the WAEC Chief Examiners' Reports (WAEC, 2018, 2019; 2020; 2021; 2022). An aspect of Mathematics which is being repeated as a challenge to students at the examinations levels is geometrical constructions. Some of the weaknesses highlighted includes; candidates' inability to sufficiently interpret questions on geometric constructions correctly, wrongly drawn diagrams, poor knowledge of the rudiments of constructions as well as other misrepresentations of the concept of geometry. It is observed that comments on geometric constructions questions come up repeatedly but in different ways depicting unsatisfactory attempts and poor performance of candidates. This topic in Mathematics is meant to equip students towards the scientific background needed for technological advancement of the society but have however not been achieved. Several difficulties encountered serve as impediments not only to geometrical constructions but also to the teaching and learning of Mathematics in secondary school. The teaching strategies used in carrying out geometric constructions for developing these skills in the class

includes: the involvement of students in open field or laboratory work; the inclusion of problem-solving activities; and the use of discovery teaching strategies as appropriate (Saputra et al., 2023).

Studies conducted in the past have indicated the need for attention on students' performance in Mathematics with a focus on geometric constructions. Among these studies include (Alqassab et al., 2018), who worked on Training Peer-feedback Skills on Geometric Construction Tasks as a Role of Knowledge Domain and Peer-feedback Levels. The study discovered a dearth in students' performance and the need for an intervention, hence the study was carried out to ameliorate teachers' roles in improving the strategies needed for better result. Similarly, (Jablonski & Ludwig, 2023), researched on Teaching of Geometric Construction in Junior High School, where an intervention was introduced to make the roles played by teachers worthwhile with a focus on the Junior High School. The outcome indicated a proactive measure to the teaching and learning of Geometric Constructions for better performance. In the recent time, (Simarmata et al., 2024) carried out a study on Developing Students' Geometric Constructions ability through Technology using Cinderella Software Application which indicated an innovation to STEM integration for Senior Secondary School of Sokoto State, Nigeria. This study brought into the limelight the technological approach to the teaching and learning of Geometric Constructions at the Senior Secondary School level and recommended that both Cinderella and activity-based approaches should be adopted to encourage students' performance in Geometric Constructions as well as organizing workshops for Mathematics teachers for better discharge of their duties in Mathematics classroom.

It is not an overstatement that geometric construction is a topic in Mathematics relevant to many fields of science and technology. However, due to its relevance to Mathematics, Engineering, Architecture, Building-technology, Computer Science, and other technical fields of structuring and the society, students' performance at final examinations is springing up concerns on yearly bases. This could be as a result of many factors including the way they were being taught by their teachers, inability of teachers to devote more time to teaching the topic as a result of overload and shallow knowledge of the topic by the teacher (García-Hernández et al., 2022). Other factors include students' weakness in having the required kits for the learning of construction, insufficient time/periods allocated to Mathematics lessons, laxity by students to attend to homework, and overcrowded classrooms. It is on this note that this study focused on Mathematics Teachers' Perceptions of Difficulties Encountered by Students in Geometric Constructions in Egbeda Local Government Area, Oyo State, Nigeria. The following research questions were raised to guide the study:

1. What are the perceptions of Mathematics teachers on teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?
2. What are the perceptions of Mathematics teachers on teachers' years of teaching experiences in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?
3. What are the perceptions of Mathematics teachers on teachers' certificate qualifications in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?
4. What are the perceptions of Mathematics teachers on teachers' workloads in teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State?
5. What are the perceptions of Mathematics teachers on students' possession of relevant kit/set for learning geometric constructions in Egbeda Local Government Area, Oyo State?
6. What are the perceptions of Mathematics teachers on students' attitudes to take home assignments in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?

Methodology

This study employed a descriptive design approach using the survey method to elicit responses from the sampled Mathematics teachers on their perceptions of the common difficulties encountered by students in geometrical constructions topics at the Senior Secondary schools in Egbeda Local

Government Area of Oyo State. All Mathematics teachers in Egbeda LGA formed the population for this study. Thirty-five (35) experienced Mathematics teachers from sixteen (16) secondary schools who have been teaching at the senior secondary school level, and have been involved in marking WAEC Mathematics examinations for at least ten (10) years were selected through purposive random sampling technique participated in the study. The criteria used for the selection of schools were: Presentations of candidates for the West African School Certificate Examinations for at least twenty years (2004-2023) consecutively. The instrument used for this study was a self-structured questionnaire which consisted of two parts: Part A was on the demographic information of respondents, and Part B was on Mathematics Teachers' Perceptions of Students' Difficulties in Geometric Construction Questionnaire (MTPSDGCQ). The questionnaire was structured on a 4-point Likert scale: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1 for rating the perceptions of the participating Mathematics teachers. A mean value of 2.79 and above was considered significant and hence not rejected, while those below 2.79 were considered not significant and so rejected. Two (2) lecturers in the Department of Science Education, Lead City University, Ibadan and two (2) experienced Mathematics teachers in Ibadan, Nigeria validated the instrument. The reliability of the instrument was determined by administering it on some Mathematics teachers outside the sample frame who were part of the population but did not partake in the main study. Cronbach Alpha Statistics was used to find the reliability coefficient of the outcome of the exercise with reliability value of 0.81. The data collected were analyzed using descriptive statistics of frequency counts, percentages, arithmetic mean and grand mean in order to answer the research questions raised for the study. The researcher with three (3) research assistants personally administered the questionnaires to the respondents after obtaining permission from the principals of the schools and the cooperations of the teachers. The questionnaires were filled and collected immediately.

Results

The results of the study are hereby presented:

Table 1. Distribution of Respondents by Gender

Gender	Frequency	Percentage (%)
Female	23	65.71
Male	12	34.29
Total	35	100.00

Table 1 displayed the demographic information of the participants of the study, where 23 (65.71%) female teachers and 12 (34.29%) male teachers were involved. The information here shows that there was no gender discrimination in the sample for the study.

Research Question 1: What are the perceptions of Mathematics teachers on teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?

Table 2. Mathematics Teachers' Perceptions on Teachers' Knowledge of the Content of Subject Matter in Teaching and Learning of Geometric Constructions

S/N	Item	SA	A	D	SD	Mean	Decision
1	Geometric construction topics can be taught without revision at any time	11	14	4	6	2.86	Not Reject

2	Teaching geometric constructions is simple but technical	20	10	4	1	3.40	Not Reject
3	Anybody in science can teach geometric construction effectively	6	5	12	12	2.14	Reject
4	Teaching geometric construction is always stressful	8	7	14	6	2.49	Reject
5	My students enjoy my class during geometric construction topics	19	10	4	2	3.31	Not Reject
	Grand Mean					2.84	Not Reject

Key: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1

Table 2 showed the analysis of Mathematics teachers' perceptions on teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions in Egbeda Local Government Area of Oyo State. The mean values of item 1, 2, 3, 4 and 5 were 2.86, 3.40, 2.14, 2.49 and 3.31 respectively. Only three out of the five items in this table had mean values that are greater than 2.79 each and were not rejected, while items 3 and 4 with mean values below 2.79 were rejected. A grand mean of 2.84 calculated for table 2 was also greater than 2.79. This indicated that majority of the participated Mathematics teachers in the study perceived that teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions is necessary for a better output in Egbeda Local Government Area, Oyo State.

Research Question 2: What are the perceptions of Mathematics teachers on teachers' years of teaching experiences in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?

Table 3. Mathematics Teachers' Perceptions on Teachers' Years of Teaching Experiences in Teaching and Learning of Geometric Constructions

S/N	Item	SA	A	D	SD	Mean	Decision
6	Experience counts in teaching geometric constructions	21	9	0	5	3.31	Not Reject
7	No matter the years of teaching, what you don't know, you don't know	20	11	4	0	3.46	Not Reject
8	You can manipulate your teaching of geometric constructions, if you are experienced in teaching	19	9	2	5	3.20	Not Reject
9	There's always a shortcut to teaching geometric constructions irrespective of your years of experience	19	9	2	5	3.20	Not Reject
10	Some teachers are not experienced but they are good in teaching geometric constructions	19	10	3	3	3.29	Not Reject
	Grand Mean					3.29	Not Reject

Key: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1

The analysis of Mathematics teachers' perceptions on teachers' years of teaching experiences in teaching and learning of geometric constructions in Egbeda Local Government Area Oyo State was displayed in Table 3. The mean values of item 6, 7, 8, 9 and 10 were 3.31, 3.46, 3.20, 3.20 and 3.29 respectively. All the five items in this table had mean values that are greater than 2.79 each and a grand mean of 3.29 calculated for table 3 was also greater than 2.79. The decision on each item and the grand mean were not rejected. This indicated that the majority of Mathematics teachers who participated in the study perceived that teachers' years of teaching experiences in teaching and

learning is of importance in teaching and learning of Geometric Constructions in Egbeda Local Government Area, Oyo State.

Research Question 3: What are the perceptions of Mathematics teachers on teachers' certificate qualifications in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?

Table 4. Mathematics Teachers' Perceptions on Teachers' Certificate Qualifications in Teaching and Learning of Geometric Constructions

S/N	Item	SA	A	D	SD	Mean	Decision
11	Qualification matters in teaching geometric constructions	12	8	5	10	2.91	Not Reject
12	Experience is the same as qualification in teaching geometric constructions	0	11	11	13	1.94	Reject
13	Some teachers are not certificate qualified but they are good in teaching geometric constructions	4	8	9	14	2.06	Reject
14	Certificate in teaching is deceptive when it comes to teaching geometric constructions	3	9	11	12	2.09	Reject
15	To be good in teaching geometric construction does not need certificate in education	8	9	9	9	2.69	Reject
Grand Mean						2.34	Reject

Key: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1

The analysis of Mathematics teachers' perceptions on teachers' certificate qualifications in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State is shown in table 4. The mean value of item 11 was 2.91 which was greater than 2.79 was not rejected, while items 12, 13, 14 and 15 having mean values of 1.94, 2.06, 2.09 and 2.69 respectively, which were less than 2.79 each were rejected. The grand mean of 2.34 calculated for table 4 was also less than 2.79 and was rejected. This implied that many of the participated Mathematics teachers perceived that teachers' certificate qualifications might not be the main criteria to bring about effectiveness in the teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State.

Research Question 4: What are the perceptions of Mathematics teachers on teachers' workloads in teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State?

Table 5. Mathematics Teachers' Perceptions on Teachers' Workloads and the Teaching and Learning of Geometric Construction

S/N	Item	SA	A	D	SD	Mean	Decision
16	Teachers' workload has nothing to do with the teaching of geometric construction	6	6	12	11	2.20	Reject
17	Teaching construction needs to be backed up with assignment which must be marked	14	12	6	3	3.06	Not Reject
18	Too many assignments could not be marked due high school work load on teachers	17	8	8	2	3.14	Not Reject
19	I get scared with geometric construction topics because it is stressful to teach and to assess	8	7	14	6	2.49	Reject
20	Geometric construction is a time demanding topic	17	8	8	2	3.14	Not Reject

Grand Mean	2.81	Not Reject
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Key: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1

The analysis of mathematics teachers' perceptions on teachers' workloads and the teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State is displayed in table 5. The mean values of item 16, 17, 18, 19 and 20 were 2.20, 3.06, 3.14, 2.49, and 3.14 respectively. Items 16 and 19 displayed on this table indicated mean values of less than 2.79 each and were rejected, while items 17, 18 and 20 with mean values greater than 2.79 were not rejected. A grand mean of 2.81 calculated for table 5 was also greater than 2.79, hence, this indicated that Mathematics teachers perceived that teachers' workloads and might not influence the teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State.

Research Question 5: What are the perceptions of Mathematics teachers on students' possession of relevant kits for learning geometric constructions in Egbeda Local Government Area, Oyo State?

Table 6. Mathematics Teachers' Perceptions on Students' Possession of Relevant Kit/Set for Learning Geometric Constructions

S/N	Item	SA	A	D	SD	Mean	Decision
21	Students' may not need to have personal kit/set to learn geometric construction	5	7	11	12	2.14	Reject
22	Students can do well in geometric construction without having a personal set/kit	5	7	11	12	2.14	Reject
23	Major criteria needed for learning geometric construction is IQ and speed in drawings	14	10	6	5	2.94	Not Reject
24	Students can collaborate with one another in using kit/set to learn geometric construction	10	10	9	6	2.69	Reject
25	Inability to use construction kit/set effectively affects students learning of geometric construction	15	10	7	3	3.06	Not Reject
Grand Mean						2.60	Reject

Table 6 displayed the analysis of Mathematics teachers' perceptions on students' possession of relevant kit/set for learning geometric constructions in Egbeda Local Government Area, Oyo State. The mean values of item 21, 22, 23, 24, and 25 were 2.14, 2.14, 2.94, 2.69 and 3.06 respectively. Three items 21, 22 and 24 with mean values of less than 2.79 each were rejected, while item 23 and 25 with mean values greater than 2.79 were not rejected. A grand mean of 2.60 calculated for table 6 was also less than 2.79. This indicated that Mathematics teachers' perceptions on students' possession of relevant kit/set for learning geometric constructions is not the main factor for learning geometric constructions in Egbeda Local Government Area, Oyo State. Research Question 6: What are the perceptions of Mathematics teachers on students' attitudes to take home assignments in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State?

Table 7. Mathematics teachers' Perceptions on Students' Attitudes to Take-home Assignments in Teaching and Learning of Geometric Constructions

S/N	Item	SA	A	D	SD	Mean	Decision
26	Doing homework may not make much difference in students' learning of geometric construction	9	7	7	12	2.37	Reject
27	Some students are assisted in doing homework without doing well in geometric construction	16	11	5	3	3.14	Not Reject

28	Students can be motivated to learn geometric construction through homework exercises	14	12	6	3	3.06	Not Reject
29	Some students who could not do classwork properly may fail to attempt homework on geometric constructions	10	10	7	8	2.63	Reject
30	Students who fail to do homework skip attendance of Mathematics class	10	10	7	8	2.63	Reject
Grand Mean						2.77	Reject

Key: Strongly Agree (SA) = 4; Agree (A) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1

Table 7 displayed the analysis of Mathematics teachers' perceptions on students' attitudes to take-home assignments in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State. The mean values of item 26, 27, 28, 29 and 30 were 2.37, 3.14, 3.06, 2.63 and 2.63 respectively. Three items 26, 29 and 30 had mean values of less than 2.79 each were rejected, while item 27 and 28 with mean values greater than 2.79 were not rejected. A grand mean of 2.77 was calculated for table 7, which was less than 2.79. This indicated that there could be other factors that could be responsible for the teaching and learning of geometric constructions aside students' attitudes to take-home assignments in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State.

Discussion

The analysis of Mathematics teachers' perceptions on teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions in Egbeda Local Government Area of Oyo State as displayed in table 2 indicated that majority of the participated Mathematics teachers in the study perceived that teachers' knowledge of the content of subject matter in teaching and learning of geometric constructions is necessary for a better output in Egbeda Local Government Area, Oyo State. This finding is in line with the submission of Osakwe, (Egara & Mosimege, 2024); (Rezat & Rezat, 2017), when a study was carried out on Interaction Patterns: An Approach for Enhancing Students' Retention in Geometric Construction. This submission highlighted the need for teachers to have adequate knowledge of the subject matter in order to help students' knowledge retention (See et al., 2020); (Tursynkulova et al., 2023); (Alkhabra et al., 2023). On teachers' years of teaching experiences in teaching and learning of geometric constructions in Egbeda Local Government Area Oyo State, majority of Mathematics teachers who participated in the study perceived that teachers' years of teaching experiences in teaching and learning of geometric constructions is of importance. This assertion is in agreement with (Abdulhadi et al., 2024); (Baluyos et al., 2019), where study on Mathematics Teachers' Perceptions of Quality Assurance Strategies on Teachers' Productivity in Osun State, Nigeria was carried out on the need for teachers to have ample experience in teaching for productivity in the classroom activities.

The display of Mathematics teachers' perceptions on teachers' certificate qualifications in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State as shown in table 4 indicated that many of the participated Mathematics teachers perceived that teachers' certificate qualifications might not be the main criteria to bring about effectiveness in the teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State. This outcome is at variant with the standard laid down by (Lila Maria Kaban et al., 2024) that the teaching profession should be for those with teaching qualifications, such as NCE, B. Ed., B.Sc. (Ed.), M.Ed., and PGDE. However, the need for teachers' certificate qualifications cannot be ruled out in education in order to curb the inflow of people who are not trained to teach but use teaching as a platform to get their desired jobs outside teaching. Mathematics teachers' perceptions on teachers' workloads and the teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State as displayed in

table 5 brought to the limelight the roles of teachers' workloads, its influence on the teaching and learning of geometric construction in Egbeda Local Government Area, Oyo State. This outcome is in agreement with the views of Kanwal, (Adeseko Sunday Olaifa et al., 2024) where it was submitted that excess workloads could lead to low productivity by teachers and should be managed by school administrators for effective subject delivery.

In table 6 on Mathematics teachers' perceptions on students' possession of relevant kit/set for learning geometric constructions in Egbeda Local Government Area, Oyo State, students' possession of relevant kit/set for learning geometric constructions did not indicate any red light but an added rudiment for learning, since the main factor for learning geometric constructions could be focused on the need for the students to understand the concept first of all and then make use of the tools to practice what needs to be done as pertaining to geometric constructions (Ponte et al., 2023). Mathematics teachers' perceptions on students' attitudes to take-home assignments in teaching and learning of geometric constructions in Egbeda Local Government Area, Oyo State was indicated in table 7. Here, students' attitudes to take-home assignment did not indicate a priority. This indicated that there could be other factors such as class sizes and allocated time and periods to the teaching and learning of geometric constructions which were addendum as suggested by the participating Mathematics teachers that could aid effective teaching and learning of Geometric Constructions in Egbeda Local Government Area, Oyo State.

Conclusion

This study concluded that, teachers' knowledge of the content of subject matter in geometric constructions, teachers' years of teaching experiences and teachers' workloads are viewed as germane while students' attitudes to take home assignments are to be focused on for effective performance of students in geometric constructions in Egbeda Local Government Area, Oyo State. However, teachers' certificate qualifications and students' possession of relevant kit/set for learning geometric constructions are perceived as not very strong views probably due to other factors outside the scope of this study.

Conflicts of Interest

The authors declare no conflict of interest.

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