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Examining the Challenges of Integrating GeoGebra Software in the Teaching and Learning of Coordinate Geometry in Colleges of Education in the North West Zone of Nigeria

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Abstract
This study titled 'The Challenges of Integrating GeoGebra software in the Teaching and Learning of Coordinate Geometry" was carried out with the following objectives: to find out the barriers that prevent the use of GeoGebra in teaching and learning of Coordinate Geometry in Nigerian Colleges of Education;; to find the compatibility of the GeoGebra software with the existing text materials in Nigeria Colleges of Education among others. The work was carried out using four research questions; four hypotheses and a sample of fifty-four (54) Mathematics Lecturers from three Federal Colleges of Education. The instrument of the study was adapted from Agyei and Benning (2015) which has a reliability coefficient of 0.89. The findings revealed that lecturers in Colleges of Education face challenges in using GeoGebra such as time constraints, inadequate equipment, and non-availability of functional internet services among others. It was found that GeoGebra software is compatible with the existing text materials. Moreso, gender difference was not found in the attitude towards GeoGebra among lecturers of Colleges of Education. Finally, it was recommended that NCCE redesign the NCE curriculum in order to allocate more time for each course.

Keywords: Challenges, GeoGebra, Coordinate Geometry and Colleges of Education

Introduction

Technology has come to stay in the Nigerian Education system, especially in the evaluation aspect. It is well known that the Unified Tertiary Matriculation Examination (UTME) has been a Computer-Based Test for years. Similarly, the West Africa Examination Council (WAEC) has conducted a pilot test in 2024 of Senior Secondary School Examination in preparation for moving from Paper Pencil to Computer Based Test. More so, many examinations in Nigerian tertiary institutions especially those that involve many students are now computer-based tests. In addition to these Viva- Post Graduate students' final examination is sometimes conducted online where the student is in one town and the examiner is in another. All these and many more have increased efficiency in the evaluation of students and also saved time and energy for both parts of the students and the examiners. Furthermore, the use of technology in the classroom has been supported by all stakeholders in teaching and learning. For example, the National Council of Mathematics Teachers (NCTM,2023) stated that When technology is used strategically, it provides more equitable access for each and every learner to actively engage and participate in the learning of mathematics. The National University Commission (2023) stated that Nigerian University Electronic Teaching and Learning platform has been established in 12 Federal and State Universities as an ICT-enabled interactive teaching and learning tool. In the same vein, Koehler and Mishra (2019) came up with Technological Pedagogical Content Knowledge (TPACK) which is a theory that supports the integration of technology into the classroom. However, the teaching and learning of mathematics have remained the traditional way – teacher and talk method in Nigeria. So also, in many African countries like Kenya (Mwingirwa & Miheso,2016); Ghana (Narh-Kert & Sabtiwu,2022) and South Africa(Mokotjo & Mokhele, 2021).

GeoGebra is a mathematics software that is acceptable and being used in more than one hundred countries in the world. Software is one of the means that technology can easily be incorporated into the teaching and learning of mathematics in Nigerian classrooms. It is free and easy-to-use software. It also has a lot of free tutorial text materials and YouTube videos that any interested person can learn from. According to Regional Institute of Education, Mysuru. (2019), GeoGebra can assist teachers in making a presentation, explanation, illustration, or demonstration of mathematical concepts, ideas and proofs. GeoGebra can also enable students to explore, find

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relationships, and patterns, solve and collaborate with others. The software is useful in teaching so many mathematical concepts and courses such as Geometry, Calculus, Algebra, Statistics and Coordinates Geometry.

Coordinates Geometry a course that brings Algebra and Geometry together. The course becomes easier and more understandable when taught using GeoGebra Software (Saidu,2019). GeoGebra has both algebraic and Geometric features. Whenever the coordinates of a point are typed on the algebraic view the point appears on the geometric view and vice versa. Similarly, when a line or circle is drawn in the geometrical view, the corresponding equations appear in the algebraic view. In a null shell, the researchers have established GeoGebra makes the teaching and learning of Coordinates Geometry easier, more meaningful and more interesting. However, Mathematics teachers and lecturers are still facing some challenges in fully using GeoGebra software in the teaching and learning of mathematics in Nigerian tertiary institutions.

Different scholars around the world have conducted research on GeoGebra software, its effects on performance and teachers' attitudes towards the integration of the software into the teaching and learning of Mathematics. Agyei and Benning (2015) conducted a study in Ghana on Pre-Service Teacher's Perception of GeoGebra as an Instructional Tool in the Teaching of Mathematics. Their findings showed that GeoGebra helps Pre-service teachers to expand their understanding of Mathematical concepts as well as instructional strategies, however, their findings indicated that teachers have low awareness of GeoGebra software. More so, teachers see time constraints as a great barrier to using GeoGebra for classroom instruction. However, they concluded that teachers have a positive attitude towards GeoGebra. The work of Agyei and Benning was in an environment that is similar to where this present study is being conducted. However, they used Pre-Service teachers while this work used lecturers (teacher trainers). Mwingirwa and Miheso (2016) conducted research titled "The Status of Teachers' Technology Uptake and Use of GeoGebra in Teaching Secondary School Mathematics in Kenya". Data were collected from practicing Mathematics teachers who were exposed to GeoGebra through training sessions. The findings revealed Mathematics teachers' willingness to use GeoGebra in their classes to teach mathematics. The teachers pointed to Geometry as the most suitable topic to teach using GeoGebra but they demanded more support in terms of training and facilities in order to effectively use GeoGebra for instruction. This work is also similar to the present study, however did not look at some aspects such as gender, teacher competency and compatibility of GeoGebra with their available study.

Horzum and Unlu (2017) conducted research to find the views of Pre-Service teachers on GeoGebra and its use. The sample of the study was 36 teachers. The researchers used open-ended questionnaires to collect data after 14 weeks of training. The teachers were of the opinion that GeoGebra can contribute to the student's academic achievement and the teachers said that they would like to use GeoGebra for their professional career development but they needed support such as provision of computer laboratories and internet. Adelabu and Makgato (2019) investigated the attitudes of male and female students towards Dynamic Geometric Software for Learning Mathematics. The researcher used a 15-item questionnaire to investigate the attitude of 74 grade nine students towards GeoGebra. The findings showed that both male and female students have positive attitudes to GeoGebra and the software is beneficial to both. The work was based on students while the present study is on teachers.

Similarly, Kaur (2019) looked at the Role of Teachers' Attitudes and Beliefs regarding the use of ICT in Indian classrooms. The result of his findings shows that teachers have a positive attitude towards ICT. More so, no significant difference was found between the attitudes of male and female teachers in the use of ICT. However, he was able to trace the challenges of the use of ICT in some Indian schools which include poor infrastructure, technical problems and inadequate training. These are not different from many developing countries in the world. In a similar development, Musa et al (2021) captioned their study as "Teachers status of GeoGebra use in Teaching Geometric Transformation". The study was conducted using 98 secondary school teachers in a mixed method research while the data analyzing way descriptive approach. Their findings show that 15.3% of the teachers use GeoGebra in their classroom instructions. They reported that even though GeoGebra was recommended by the Malaysian Ministry of Education, teachers were facing problems such as lack of competency, exposure and experience in operating GeoGebra software and also time constraints. The challenges reported by these researchers are similar to the ones reported by researchers in other countries.

In the same vein, Mokotjo and Mokhele (2021) investigated the challenges of integrating GeoGebra in the teaching of Mathematics in South African schools. The study sought the views of teachers across South Africa. Their findings showed that there were not enough facilities in most schools to integrate GeoGebra in the classroom. A bigger challenge is that of security in which the few available facilities such as computers and projectors are stolen by thieves and vandals. Not only these, there were problems of inadequate power supply. The problems of South Africa seem to be similar to the problems of Nigeria in terms of power supply and vandalism. Another study

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from Malaysia conducted by Zulkipli and Musa (2022) titled Teacher's Attitude towards the Use of Technology in the Teaching and Learning of Mathematics. The study sampled 162 mathematics teachers and used a questionnaire to collect data. The data collected was analyzed using a t-test. The results showed that teachers have positive attitudes towards the use of technology, but male teachers have more positive attitudes than their female counterparts. However, no age and years of teaching experience do not show any significant difference.

Literature has shown that research has been conducted on the teacher's views on the integration of GeoGebra in the classroom all over the world. There is evidence of such reports from countries like Ghana, Kenya, Malaysia, and Turkey to mention a few. However, the researchers of this work didn't find a similar study that was conducted in Nigeria. Hence, there is a need to find out the lecturers' views on the challenges of integration of GeoGebra in North West Nigeria. Furthermore, Colleges of Education are at the forefront of the production of teachers in Nigeria. if the lecturers in these institutions are sensitized on the use of GeoGebra software. They will in turn pass the knowledge to their students who are prospective teachers. The students who are willing to become teachers in future may use GeoGebra to teach their students. From all the literature reviewed so far, no research has been conducted using teachers' trainers (teachers of Colleges of Education). Therefore, this study will fill that gap. In addition to these above another gap that this study will fill, is the attitude of male and female lecturers in the integration of GeoGebra software in the teaching and learning of coordinate geometry. Finally, none of the studies reviewed specified coordinate geometry. Therefore, this study will fill that gap.

Statement of the Problem

Many scholars have established through research the benefits of using GeoGebra software in teaching and learning mathematics. It has been established that it increases students' academic performances, also improves their attitude positively towards the learning of mathematics. Furthermore, teachers have the competency of using the software effectively (Saidu, & Rabiu,2024). However, GeoGebra is not being used in the classroom as it is supposed to be used. Teachers are still sticking to their traditional method of teaching using chalk and talk.

As a result, the researchers wish to find out the challenges and other constraints that are affecting the integration of GeoGebra in the teaching and learning of Coordinate Geometry particular and Mathematics in general.

Objective of the study: The objectives of the study are to:

i. identify the barriers that prevent the lecturer from integrating GeoGebra into teaching Coordinate Geometry.
ii. establish the compatibility of GeoGebra with the existing resources in Nigeria.
iii. find out the level of competency of COE lecturers in integrating GeoGebra in Mathematics classrooms.
iv. verify if there is a gender difference in the attitude of COE lecturers towards integrating GeoGebra into the classroom.

Research Questions: The study is guided by the following research questions:

i. What are the challenges/barriers to integrating GeoGebra in the teaching and learning of Coordinate Geometry?
ii. What is the compatibility of GeoGebra with the existing resources (textbooks) in Nigerian Colleges of Education?
iii. What is the competency of Colleges of Education lecturers in using GeoGebra as an instructional tool?
iv. Is there a gender difference between the attitude of male and female lecturers towards GeoGebra software?

Hypotheses

The following hypotheses were formulated in line with the research questions:

H_{01}: There are no barriers to integrating GeoGebra in the teaching and learning of Coordinate Geometry.
H_{02}: Colleges of Education lecturers have no competency in using GeoGebra as an instructional tool.
H_{03}: GeoGebra is not compatible with the existing textbooks and other resources in Colleges of Education.
H_{04}: There is no significant difference between the attitude of male and female lecturers towards GeoGebra software.

Methodology

The study area is the seven states in the North West Zone, Nigeria, with twelve Colleges of Education of which seven are Federal Colleges of Education and 5 state Colleges of Education. The target population consists of all the mathematics lecturers in the seven states. Three Colleges of Education; FCE Katsina, FCE Zaria and FCE Kano were purposely selected due to the fact that they have the least security threat. The researchers visited the colleges and took permission in writing to conduct the research. A total of fifty-four mathematics lecturers, 40 males and 14 females were used in the study. The researchers led the participating teachers in downloading

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GeoGebra software then after that, he demonstrated the teaching of Coordinates Geometry of the circle using the software. Areas covered include;
(i) Equation of a circle with the coordinates of the centre and a point on the circumference given
(ii) Equation of a circle with the coordinates of the end of points of a diameter given
(iii) Equation of a circle with any three points on the circumference given
(iv) Determining the coordinates of the centre and radius of a circle from a given equation'.

After demonstrating and discussing the above concepts on the screen, the lecturers were made to complete the research instrument titled 'Teacher Attitude Towards GeoGebra Questionnaire' which was adapted from Agyei and Benning (2015) The questionnaire has two sections: A and B. Section A contains lecturers' personal information while section B has six sub-headings with five questions each totaling 30 items. The questionnaire was pilot-tested at Kaduna State College of Education Gidan Waya and its reliability coefficient has been found to be 0.89 using the test-re-test method.

Results

Among the personal variables of the teachers selected for analysis along with their opinions on the use of GeoGebra for teaching and learning mathematics in the Colleges were location, highest educational attainment, field of specialization, sex and years of experience on the job. Table 1 shows the descriptive categorization of the teachers by their selected socio-demographic characteristics.

Table 1: Distribution of mathematics teachers by the selected socio-demographic characteristics (n=64)

Variables	Variable options	Frequency	Percent
Location	FCE Zaria	21	38.9
	FCE Katsina	20	37.0
	FCE Kano	13	24.1
Qualification	First degree	16	29.6
	Masters	33	61.1
	Ph D	5	9.3
Specialization	Mathematics Education	17	31.5
	Functional analysis	2	3.7
	Mathematics	21	38.9
	Applied Mathematics	1	1.9
	Space Dynamics	2	3.7
	Science Education	4	7.4
	Pure Mathematics	3	5.6
	Modelling	1	1.9
	Fluid Dynamic	1	1.9
	Statistics	2	3.7
Gender	Male	36	66.7
	Female	18	33.3
Years of experience	1-10years	19	35.2
	11-20years	23	42.6
	Above 20years	12	22.2

(Source: Filed survey, 2024)

A total of 54 mathematics teachers selected from three Federal Colleges of Education were involved in the study. Of the total, 38.9% were based in the Federal College of Education, Zaria, 37.0% were selected from the Federal College of Education Katsina and 24.1% were based in the Federal College of Education Kano. Qualification-wise, 31.5% had a First degree as their highest qualification. Those with Master's degrees were 61.1% and 9.3% were with Doctorate degrees. In terms of specialization, 31.5% of the teachers were in Mathematics Education, 3.7% were specialists in Functional analysis, 38.9% were in general mathematics, and 1.9% were specialists in Applied Mathematics. Others in the categories were 3.7 in Space Dynamics, 7.4% in Science Education, 5.6% in Pure Mathematics, 1.9% each as specialists in Modelling and Fluid Dynamics and 3.7% as specialists in Statistics. The males among the teachers were 66.7% while 33.3% were female among the teachers involved in the study. For years of experience, 35.2% had between 1 and 10 years of experience on the job while 42.6% had between 11 and 20 years of experience on the job. Only 22.2% of the teachers had more than 20 years of experience on the job. These years of experience are expected to provide the teachers with enough information to respond to questions on the use of GeoGebra visualization in the teaching and learning of coordinate geometry in the colleges of Education.

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Challenges to integrating GeoGebra in the teaching and learning of Coordinate Geometry

The opinions of the lecturers on the suggested challenges to integration GeoGebra software in the teaching and learning of Coordinate Geometry among the selected Colleges of Education are scored in Table 2 along with mean and standard deviations.

Table 2: Opinions of Mathematics lecturers on the barrier to using GeoGebra GeoGebra for teaching and learning

Sn	Challenges to use of GeoGebra	SA	A	U	D	SD	Mean	Std. Dev.
1	Time allocated for lecturers will not allow me to use GeoGebra in my lesson	7(13.0)	23(42.6)	10(18.5)	12(22.2)	2(3.7)	3.39	1.089
2	I do not have computer knowledge that I can enable me use GeoGebra in my lesson	4(7.4)	13(24.1)	4(7.4)	27(50.0)	6(11.1)	2.67	1.182
3	Frequent and irregular power supply do not allow me to use GeoGebra in my lesson	14(25.9)	26(48.1)	5(9.3)	6(11.1)	3(5.6)	3.78	1.127
4	The lack of adequate computers and projector stopped me from using GeoGebra	13(24.1)	28(51.9)	5(9.3)	5(9.3)	3(5.6)	3.80	1.088
5	Difficulty in designing GeoGebra activities discourages me from using the software	5(9.3)	14(25.9)	16(29.6)	17(31.5)	2(3.7)	3.06	1.054

(Benchmark = 3.00)

As shown with mean scores and rated opinions in Table 5, one of the major challenges faced in the integration of the software to routine teaching and learning in the Colleges is time allocated for lesson which respondents were generally of the view was too short to accommodate the use of the software. In the Table, 13.0% and 42.6% of the lecturers strongly agreed and agreed that the time allocated for lecturers will not allow them to incorporate the software into their lesson period. However respondents did not agree as indicated with a mean score of 2.67 that not having computer knowledge was one of the challenges that disallow their use of the software for teaching and learning in the Colleges. Couple with the challenge of time allocation were issues of irregular power supply which 25.9% and 48.1% of the lecturers strongly agreed and agreed respectively were major constraints to the use of the software for teaching and learning. Along with these challenges are inadequate ICT equipment like computers and projectors required for effective utilization of the software for teaching and learning. Difficulty in designing GeoGebra activities was not seen as a major challenge that discourages lecturers from using the software as indicated by 29.6% who did not express their view on the factor and 31.5% who disagreed with the suggestion along with 3.7% who strongly disagreed with the opinion. The impression here is that power supply, inadequate ICT equipment like computers and projectors along time allocation were the major challenges faced in the integration of the software into routine teaching and learning of geometry in the selected Colleges of Education.

Compatibility of GeoGebra with existing textbooks in Colleges of Education

The opinions of the lecturers on the compatibility of GeoGebra with the existing teaching and learning resources (textbooks) in the Colleges of Education are scored in Table 3.

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Table 3 Opinions of Mathematics lecturers on the Compatibility of GeoGebra with existing resources for teaching and learning

SN	Compatibility of GeoGebra with existing textbooks	SA	A	U	D	SD	Mean	Std. Dev.
1	I can use GeoGebra to teach coordinate geometry with the existing NCE minimum standard coordinate	10(18.5)	24(44.4)	10(18.5)	9(16.7)	1(1.9)	3.61	1.036
2	I can use GeoGebra to teach the content of students' reference materials	8(14.8)	15(27.8)	17(31.5)	9(16.7)	5(9.3)	3.22	1.176
3	I can use GeoGebra to plan my coordinate geometry lesson	8(14.8)	25(46.3)	12(22.2)	7(13.0)	2(3.7)	3.56	1.022
4	I can use GeoGebra to support chalk and talk method	8(14.8)	12(22.2)	14(25.9)	18(33.3)	2(3.7)	3.11	1.144
5	I have downloaded GeoGebra software	8(14.8)	9(16.7)	6(11.1)	23(42.6)	8(14.8)	2.74	1.320

(Benchmark = 3.00)

Most (18.5% and 44.4%) respondents as indicated with a mean score of 3.61 and a standard deviation of 1.036 agreed that they can use GeoGebra to teach coordinate geometry with the existing NCE minimum standard coordinate. However, 16.7% and 9.3% disagreed and strongly disagreed that they can use the software to teach the content of students' reference materials while 31.5% of the lecturers were not sure. Only 14.8% and 27.8% of the lecturers strongly agreed and agreed respectively that they can use the software to teach the content of students' reference materials. Though most (14.8% and 46.3%) of the lecturers agreed that they can use **GeoGebra** to plan their coordinate geometry lesson only 14.8% and 22.2% strongly agreed and agreed respectively that they use the software to support the chalk and talk method and only 14.8% and 16.7% of the lecturers strongly agreed and agreed respectively that they have downloaded the software. The observation here clearly showed that the level of compatibility of the software among the lecturers in their teaching and learning was relatively low.

Competency of Colleges of Education lecturers in using GeoGebra as an instructional tool

The opinions of the lecturers on competency in the use of the software among the selected Colleges of Education towards integrating GeoGebra in Mathematics classroom teaching and learning are summarized in Table 4

Table 4: Opinions of Mathematics lecturers on Competency in the use of GeoGebra for teaching and learning

SN	Competency in the use of GeoGebra	SA	A	U	D	SD	Mean	Std. Dev.
1	I can use GeoGebra to teach the location of points on a plane	16(29.6)	19(35.2)	11(20.4)	6(11.1)	2(3.7)	3.76	1.115
2	I can use GeoGebra to teach the distance between two points	9(16.7)	29(53.7)	11(20.4)	4(7.4)	1(1.9)	3.76	0.889
3	I can use GeoGebra to teach the midpoint of two points	10(18.5)	23(42.6)	14(25.9)	6(11.1)	1(1.9)	3.65	0.974
4	I can use GeoGebra to teach the equation of a circle	8(14.8)	12(22.2)	14(25.9)	16(29.6)	4(7.4)	3.07	1.195
5	I can use GeoGebra to teach equation of a line	8(14.8)	9(16.7)	16(29.6)	16(29.6)	5(9.3)	2.98	1.205
6	I can use GeoGebra to demonstrate/illustrate to students the concepts of touching circle	8(14.8)	12(22.2)	13(24.1)	19(35.2)	2(3.7)	3.09	1.154
7	I can use GeoGebra to describe to students points inside and outside a circle.	8(14.8)	11(20.4)	11(20.4)	19(35.2)	5(9.3)	2.96	1.243

(Benchmark = 3.00)

The competency level expressed by the lecturers in Table 7 revealed structural differences in the use of the software for teaching and learning in the Colleges. In the table, 29.6% and 35.2% of the lecturers strongly agreed and agreed respectively that they can use GeoGebra to teach the location of points on a plane while 16.7% and 53.7% strongly agreed and agreed that they can use GeoGebra to teach distance between two points and 18.5% along with 42.6% strongly agreed that they can use the software to teach midpoint of two points. But 14.8% and

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22.2% of the lecturers strongly agreed and agreed that they can use GeoGebra to teach the equation of a circle and most of the lecturers disagreed as indicated with a mean score of 2.98 and 29.6% along with 9.3% who disagreed and strongly disagreed with the suggestion and 29.6% who did not express their view on the suggestion in the table. Only 14.8% and 22.2% of the lecturers strongly agreed and agreed with the suggestion that they can use GeoGebra to demonstrate/illustrate to students the concepts of touching circles. The lecturers did not agree that they could use GeoGebra to describe to students points inside and outside a circle. The mean score was 2.96 with a standard deviation of 1.243. The observations from the table showed that the level of competency in the use of the software among the lecturers in the selected Colleges of Education was relatively low.

Gender differences in attitude towards the use of GeoGebra software for teaching and learning

To determine gender differences in the lecturers' attitude towards the use of GeoGebra in the teaching and learning of geometry in the colleges, the mean scores on attitude by male and female lecturers were computed and compared as summarized in Table 5

Table 5: Comparison of attitudes towards the use of GeoGebra for teaching and learning by male and female lecturers

Gender	N	Mean	Std. Dev.	Std. Error	Mean difference
Male	36	3.54	0.970	0.162	0.12
Female	18	3.66	0.716	0.169	

(Benchmark = 3.00)

Table 5 did not reveal much variability in the mean score of the male and female lecturers on the use of GeoGebra for teaching and learning in the selected Colleges of Education. The mean difference was 0.12. The extent of the observed difference is tested in the related hypothesis below.

Test of hypotheses

H_{01}: There are no barriers in integrating GeoGebra in the teaching and learning of Coordinate Geometry.

Table 6: One sample t-test on barriers to integrating GeoGebra in the teaching and learning of Coordinate Geometry by lecturers in the selected Colleges of Education

Variables	N	Mean	Std. Dev.	Std. Error	t-value	Df	p-value
Barriers	54	3.34	0.781	0.106	3.172	53	.003
Test value	54	3.00	0.000	0.000			

(t-critical = 1.96, $p < 0.05$)

The test revealed that barriers to the integration of GeoGebra into the teaching and learning of Coordinate Geometry by lecturers in the selected Colleges of Education were significant. The observed t-value for the test was 3.172 with a p-value of 0.003 ($p < 0.05$) obtained at 53, degrees of freedom (df). By these observations, the null hypothesis that there are no barriers to integrating GeoGebra in the teaching and learning of Coordinate Geometry in the selected Colleges of Education is therefore rejected.

H_{02}: Colleges of Education lecturers have no competency in using GeoGebra as an instructional tool.

The mean scores in Table 6 were compared with the benchmark (3.00) here to determine the extent of competency of the lecturers in the use of GeoGebra as an instructional strategy for teaching and learning of Coordinate Geometry in the selected Colleges of Education. The result of the one-sample t-test used for the hypothesis is summarized in Table 7

Table 7: One sample t-test on lecturers' competency in using GeoGebra as an instructional tool for teaching and learning Coordinate Geometry in the selected Colleges

Variables	N	Mean	Std. Dev.	Std. Error	t-value	Df	p-value
Compatibility	54	3.25	0.857	0.117	2.127	53	.038
Test value	54	3.00	0.000	0.000			

(t-critical = 1.96, $p < 0.05$)

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H_{03}: GeoGebra is not compatible with the existing textbooks and other resources in Colleges of Education.

The mean scores in Table 7 were compared with the benchmark (3.00) using the one sample t-test procedure to determine the extent to which the lecturers considered the software's compatibility with existing textbooks and other resources in Colleges of Education for the teaching and learning of Coordinate Geometry. The result is summarized in Table 14.

Table 8 One sample t-test on compatibility of GeoGebra with existing textbooks and other resources for teaching and learning of Coordinate Geometry.

Variables	N	Mean	Std. Dev.	Std. Error	t-value	Df	p-value
Competency	54	3.33	0.882	0.120	2.712	53	.009
Test value	54	3.00	0.000	0.000			

(t-critical = 1.96, p < 0.05)

The test revealed that lecturers agreed that the software was significantly compatible with existing textbooks and other resources in the selected Colleges of Education for the teaching and learning of Coordinate Geometry. This is indicated by an observed t-value of 2.712 and p-value of 0.009 ($p < 0.05$) obtained at 53, degrees of freedom (df). The result implied that, the null hypothesis that, GeoGebra is not compatible with the existing textbooks and other resources in Colleges of Education is therefore rejected

H_{04}: There is no significant difference between the attitude of male and female lecturers towards GeoGebra software.

The attitudinal mean scores of male and female respondents involved in the study were compared with the two samples t-test to determine the extent of gender variability in attitude towards the use of GeoGebra software as an instructional strategy for teaching and learning of Coordinate Geometry in the selected Colleges of Education. The result of the two samples t-test is summarized in Table 9.

Table 9: Two sample t-tests on attitude lecturers' gender towards the use of GeoGebra software as an instructional strategy for teaching and learning Coordinate Geometry

Variables	Gender	N	Mean	Std. Dev.	Std. Error	t-value	Df	p-value
Attitude	Male	36	3.54	0.970	0.162	-0.452	52	0.653
	Female	18	3.66	0.716	0.169			

(t-critical = 1.96, p < 0.05)

The test revealed that the lecturers did not differ significantly by gender in their attitude towards the use of GeoGebra software as instructional strategy for teaching and learning of Coordinate Geometry in the selected Colleges of Education. This is indicated with an observed t-value of 0.452 and a p-value of 0.653 ($p > 0.05$) obtained at 52, degrees of freedom (df). These observations did not provide enough evidence to reject the null hypothesis. The null hypothesis that there is no significant difference between the attitude of male and female lecturers towards GeoGebra software is therefore retained.

Discussion

The overall objectives of the work are to find out the challenges of integrating GeoGebra in the teaching and learning of Mathematics. An important aspect to note is that the mathematics lecturers used in this study have little or no difficulty in downloading and using GeoGebra. For the few ones that have come into contact with the software for the first time, expressed no anxiety in working with the software but they rather expressed satisfaction and happiness in learning how to use the software. However, the findings of this study indicated that lecturers have challenges in integrating GeoGebra software in the area of time constraints, inadequate computers, projectors and other equipment. Other challenges include lack of adequate professional development and insecurity. These findings are in agreement with the findings of Agyie and Benning (2015); Mwingirwa and Miheso (2016) also that of Kaur(2019); so also that of Musa and Yusmaliza ; Mokotjo and Mokhele (2021). However, Saidu (2019) reported that he was not affected by time constraints when using GeoGebra to support chalk and board teaching. Experience has shown that it is not the use of GeoGebra in the teaching and learning of Mathematics that consumes time but the time allocated to teach mathematics courses, especially Coordinate Geometry is inadequate. The content requires more hours of teaching than the one hour allocated in the NCE minimum standard. Since GeoGebra is not presently used in evaluating the students, the lecturers will give more attention to the traditional chalk and talk method so also the student equally give attention to paper and pencil than the use of GeoGebra. Since the yardstick of measuring students' and lecturers, progress is their examination results, not the new

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knowledge gain that is not examinable at present. Consequently, the lecturers will conclude that there is inadequate time to use GeoGebra in teaching mathematics.

In terms of compatibility with the existing text materials, the findings of the study showed that GeoGebra software can be adequately used with the present teaching materials. The software was originally developed to support the teaching and learning of mathematics also the developer of the software is a mathematics educator. As a result, GeoGebra software makes mathematics teachers teach better and the students understand more easily. However, Musa et al(2021) reported that teachers need more exposure and more training in terms of designing lesson with GeoGebra. Finally, the study revealed that there is no gender difference in the attitude of lectures towards GeoGebra usage. This means both male and female lecturers have positive attitudes towards GeoGebra. This finding is in concordance with the findings of Adelabu and Makgato(2019) and also that of Saidu (2019) who reported both male and female teachers have similar positive attitude towards the use of GeoGebra. However, the findings differ from that of Zulkipili and Musa(2022) who reported that male teachers have more positive attitudes towards GeoGebra than their female counterparts.Which indicates the need for further research in that aspect.

Conclusion

The work was conducted to find out the challenges of cooperating with GeoGebra in the teaching and learning of Coordinates Geometry in Colleges of Education, in North West , Nigeria. The findings established that lecturers face challenges such as time constrain, and inadequate facilities such as computer and projectors among others. The lecturers also stated that they need further training before they can effectively use computers in teaching. However, the software is found to be compatible with the existing teaching materials.

Recommendations: The following recommendation were made based on the findings:

1. The National Commission of Colleges of Education (NCCE) should redesign the NCE Minimum Standard in such a way that enough time will be allocated to every course to enable lecturers to use technology in teaching.
2. The Tertiary Education Trust Fund (TETFUND) should provide adequate computers, projectors and internet services to colleges of Education in Nigeria.
3. Federal and state Ministries of Education should provide more professional training on the use of GeoGebra and other software that are useful in the teaching and learning of Mathematics.

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