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MATHEMATICS TEACHERS' PEDAGOGICAL ICT COMPETENCY NEEDS FOR INCLUSIVE TEACHING AND LEARNING OF MATHEMATICS IN NIGERIAN SECONDARY SCHOOLS

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Abstract
The study investigated the pedagogical ICT competency needs for inclusive teaching and learning of Mathematics in Nigerian secondary schools. The study was guided by two research questions and one null hypothesis. The study adopted a descriptive survey research design. The population of the study was 105 (34 male and 71 female) mathematics teachers in Nsukka local government area. The entire population served as the sample. One instrument tittle: Mathematics Teachers' Pedagogical ICT Competency Needs Questionnaire (MTIPCNQ) was used to collect data. The instrument was faced validated by three experts. Cronbach alpha method was used to establish the reliability coefficient of the MTICNQ and the reliability coefficient obtained was 0.76. Data were analysed using mean, standard deviation and independent sample t-test. The findings of the study showed that teachers need competence in using ICT in teaching and learning of mathematics for enhancing inclusive education. Furthermore, the findings showed that male and female teachers do not differ in their competence needs in using ICT in teaching and learning of mathematics for enhancing inclusive education. It was recommended that: Mathematics teachers should be trained in the use of ICT in teaching and learning of mathematics in school among others.

Keywords: ICT, inclusivity, teaching and learning, competency needs

Introduction

A typical classroom is made of learners from diverse backgrounds who come to class with different learning needs and styles. As such, classes are made of exceptional, fast, slow as well as learners with special needs. Nonetheless, all learners are expected by the end of their schooling period to acquire requisite skills, abilities, capabilities and knowledge needed for their survival and for the development of the society. To be able to assist all learners acquire these traits, teachers most adopt approaches that are students centred and could help each learner develop at their own pace, thereby insuring inclusive teaching and learning process. However, teaching and learning in most secondary schools in Nigeria is dominated by the conventional or lecture method. This method is teachers centred and make students passive recipients of information (Okeke et al., 2022) and encourages rote learning and memorization (Zakariya, et al, 2016). Researchers such as Osakwe et al., (2023) posits that these inappropriate teaching methods adopted by mathematics teachers is one factor responsible for students' poor performance in the subject. By implication, the uses of these methods have not being able to assist learners to sufficiently acquire the requisite knowledge,

skills and abilities. However, it is compulsory that learners most acquire a required amount of these traits before completing their secondary school education in Nigeria in subjects such as Mathematics. This is because the subject is compulsory for all learners in the primary and secondary school education in Nigeria (Federal Republic of Nigeria (FRN), 2014). Consequently, each child in Nigeria despite his/her learning needs and abilities is expected to pass Mathematics at the Basic Education Certificate Examination (BECE) level and also score at least a credit pass in the subject at the senior school certificate examination (SSCE) level. Moreover, most jobs in Nigeria require a credit pass in the subject. Furthermore, the Joint Admission and Matriculation Board (JAMB, 2022) requires that candidates wishing to study engineering, technology, and most science and management courses and even some art courses at the tertiary institution level score at least credit pass in Mathematics. This is an affirmation of the importance of Mathematics to the individual and the nation as a whole.

In line with the foregoing, it is expected that all learners acquire enough mathematical skills required for the technological development of Nigeria. Hence, the teaching and learning of mathematics in Nigeria requires inclusive classroom setting. This is in line with the United Nations (2022) Sustainable Development Goal 4 (SDG 4) which states that: 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'.Derzhavinaet al., (2021) sees inclusive education as access to quality education for students with different educational needs, including children with disabilities. According to Mitchell (2023), inclusive education implies knowing that learners have diverse abilities and interests, and that they come from diverse ethnic and social backgrounds. According to the author, inclusive education means education that fits the child's ability. From these definitions, it could be seen that education must fit the diversity of learners in every classroom and school. In this study, inclusive education means education that carters for the needs of learners with diverse interest and abilities. If inclusive education is handled properly, all learners will gain academically and socially and will lead to self-improvement (Mitchell, 2023). More so, inclusive education is more economically viable to run and will benefit learners with special education needs and also provides positive outcomes for other learners if properly implemented. So, when students learn together in the classroom, they develop friendship, socials skills, self-efficacy and comfort level among others (Das, 2020). Therefore, educational practices especially in the teaching and learning of mathematics should be such that encourage inclusive learning. A possible way to ensuring inclusivity in education is to employ various information and communication related tools in teaching and learning. ICT involves every means for handling data and facilitating communication, including computer and network hardware and required software (Kaur, 2022).Most form of ICTs be it video, print, computer, and the Internet can be easily used for presentation, demonstration and drill and practice (Chau,2019). In teaching mathematics, the use of ICT gives students the chance to explore mathematical ideas in novel and interactive ways, leading to higher levels of cognitive growth. Furthermore, the use of technology tools, such as graphing calculators, can improve students' comprehension of mathematical ideas and encourage active learning (Asare, et al., 2023), and dynamic mathematics software, such as Geo Gebra, can encourage conceptual understanding and enhance student exploration of mathematical ideas leading to efficient acquisition of needed mathematics skills and abilities.

More so, ICT related platforms such as networked computers and the Internet are best used for interaction and collaboration in the classroom. As such, the slow learners and special need students learn from their colleagues within the classroom, and, acquire from peers social skills, manipulative skills, communicative skills and problem solving skills. Technology is essential in teaching and learning mathematics because it improves the way mathematics should be taught and enhances student understanding of basic concepts (Hemant, 2020). Using ICT can provide a clutter-free working environment where programme features are linked to students' ability which enhance the development of activities that are clear, focused, and appealing to students (Kaur, 2022). ICT allows students to practice skills in a different context, repeating several tasks to aid learning, support language development activities and offer multi-sensory ways of learning and also offer a medium for differentiation. Additionally, ICT usage allows students to be responsible for their own learning, and to work on tasks that are more manageable and achievable. Hence, students will be able to complete and perhaps master tasks irrespective of ability levels. Consequently, the Federal Ministry of Education (FME, 2019) in her national policy of ICT in education stipulates that schools, classrooms, programmes and activities should be developed and designed so that all students including learners with special needs learn and participate together. However, no pattern shift in the educational process can be successfully envisaged without considering the teachers competences first. Competence refers to the capacity to apply or employ a set of relevant knowledge, skills, and attitudes in a particular work area to execute a task to required standards (Khoirudin, Hary&Aji, 2016).Wong (2020) sees competencies as interrelated knowledge, skills and attitudes representing the performance in a job measured against well-established standards. Competence is an array of abilities and skills that are needed for optimum performance of tasks by every individual including the teacher. In this study, competence is seen as mathematics teachers' ability to teach effectively. The present study is interested in teachers' ICT competence which is concerned with the teachers' ability to have a critical and confident attitude toward using technology (Ezeugwu et al. 2016).ICT competency of teachers refers to their capabilities to use computer software, hardware, and the Internet for teaching purposes (Joshi et al., 2021).

There are three major types of ICT competence for teachers which include: personal, subject-oriented and pedagogical (Diri, 2013). However, the focus of the present study is on pedagogical competence. Ezeugwu et al. (2016)sees pedagogical competency as teachers' ability to plan, prepare, teach, assess, and evaluate lessons using ICTs as a supporting tool. Hence, pedagogical competence are those skills, abilities and attitudes possessed by the teachers in teaching and learning using ICTs. These competences are key determinant in the integration of ICT in inclusive education because ICT is a promising practice in the mathematics classroom. Cui (2015) states that if teachers lack the basic skills, knowledge and ability to incorporate technology into their teaching and learning, technology will not be fully utilized. In line with the foregoing, the need to integrate ICT into the teaching and learning in schools in Nigeria has been of great concern to educationists, researchers and institutions of learning. However, the use of ICT in enhancing inclusive education requires that the teachers possess the needed competencies in using ICT related resources in their pedagogy. This means that teachers should be prepared to empower students with the advantages that

technology can bring (Ezeugwu, et al., 2016). However, despite efforts made by government and various agencies in providing schools with various ICT facilities, most of these facilities have not been adequately utilized in teaching and learning of school subjects especially mathematics. This may be unconnected with the lack of prerequisite abilities of most teachers in using ICT for teaching. Teachers therefore need to develop pedagogical ICT competencies in the instructional delivery of all subjects so as to ensure that learners are aided to learn effectively. However, previous researchers such as Ezeugwu, et al. (2016) revealed that mathematics teachers needed ICT competencies for instruction. Another study conducted by Hemant (2020) on the proficiencies of mathematics teachers on ICT revealed that there was medium level of competency level of teachers on ICT. A study by Prieto et al. (2020) on gender and digital teaching competence in dual vocational education and training revealed that no significant gender differences between teachers with respect to the application of e-skills by teaching professionals. However, Laxmi and Jabin (2022) investigated competency in ICT among secondary school teachers in relation to gender and locality and found that there is a significant difference in the competency in ICT of male and female secondary school teachers. Furthermore, a similar study by Díaz-García et al. (2023) on the basic model to integrate teachers' ICT competencies with technological tools at the personal and institutional level found that the technological competencies of teachers were higher than their pedagogical competencies and that the ICT competency was significantly affected by the participants' gender.

These results indicate that findings on the influence of gender on teachers' competence are at best contradictory and yet unresolved. The implication is that further studies are needed on gender and teachers' ICT competence. The findings of these studies clearly show that mathematics teachers lack sufficient level of pedagogical ICT competence in teaching the subject. Consequently, a study conducted by Joshi et al. (2021) revealed that ICT enhancement programs are needed for mathematics teachers at secondary schools. On the contrary, a study by Vitanova et al. (2015) on ICT competencies of 220 primary school teachers reported that the majority (58%) of teachers had high proficiency in ICT skills. Numerous research have shown that using ICT in teaching appears to be better that traditional method. Hence, many countries all over the world have tried to integrate ICT for pedagogy. However, despites such efforts in providing ICT facilities, many teachers appear unable to use it in teaching and learning especially in developing countries such as Nigeria which could be because of a seemingly lack of competence in using ICT in pedagogy. Furthermore, providing schools with ICT facilities without determining the ICT competence of teachers will be an exercise in futility. Therefore, research is needed to determine the competence of teachers in using ICT in teaching. Moreover, it is the belief of the present researchers that the use of ICT in teaching and learning could help students with various abilities learn the subject efficiently. But research focusing on the competence needs of mathematics teachers in the use of ICT in ensuring inclusivity is lacking. Based on this premise, the present study sought to investigate teachers' pedagogical ICT competency needs for inclusive teaching and learning of mathematics in Nigerian secondary schools.

Purpose of the study

Specifically, the study sought to determine the:

1. pedagogical ICT competency needs of mathematics teachers for inclusive teaching and learning of mathematics
2. pedagogical ICT competency needs of male and female teachers for inclusive teaching and learning of mathematics

Request questions

Based on the purpose of the study, the following research questions guided the conduct of the study.

1. What are the areas mathematics teachers need competency in using ICT in teaching and learning of mathematics for enhancing inclusive education?
2. What are the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education?

Hypotheses

Based on the purpose of the study, the null hypothesis formulated was tested at 0.05 level of significance. There is no significant difference in the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education.

Methodology

The study adopted a descriptive survey research design. Nworgu (2015) explained that the design is interested in collecting data on, and describing in a systematic manner the characteristics, features or facts about a given population. The present study sought to collect data on teachers' ICT competence needs in teaching mathematics, analyze such data so as to describe the competency needs of teachers in using ICT for mathematics pedagogy. The study is conducted in Nsukka Local Government Area, Enugu State, Nigeria. No known study on teachers' pedagogical ICT competence need for inclusive teaching and learning of mathematics has been done in the area. The area has 32 public secondary schools with students of different interest and different learning needs. The population of the study consist of 105 (34 male and 71 female) teachers for the 2022/2023 academic session. The entire population served as the sample of the study because the population was small and manageable. One instrument tittle: Mathematics Teachers' pedagogical ICT Competency Needs Questionnaire (MTPICNQ) was used to collect data. The instrument has two sections A and B. Section A elicits information on teachers' gender. Section B is a 20-item questionnaire which elicits information on teachers' ICT competency needs. It is a 4-point scale with rating options of Very Highly Needed (VHN) = 4, Highly Needed (HN) =3, Fairly Needed (FN) = 2 and Not Needed (NN) =1. The instrument was faced validated by three experts, two from Mathematics Education Unit and one from Measurement and Evaluation unit, Department of Science Education, University of Nigeria, Nsukka. The MTPICNQ was trial tested on 20 teachers in a secondary school that was not part of the study. Cronbach alpha method was used to establish the reliability coefficient of the MTPICNQ because the items were scaled in multiple order. The reliability coefficient obtained was 0.76.The

researchers used the face-to-face method of delivering to administer the MTPICNQ on the mathematics teachers. Data were analyzed using mean and standard deviation to answer the research questions and independent sample t-test to test the hypothesis at 0.05level of significance. Mean values of 2.50 and above were regarded as needed and a mean below 2.50 was regarded as not needed.

Results

Research Question One: What are the areas mathematics teachers need competency in using ICT in teaching and learning of mathematics for enhancing inclusive education?

Table 1: Mean and standard deviation scores of mathematics teachers' competency needs in using ICT in teaching and learning of mathematics

S/N	Item Statement	Mean	SD	Remark
1	I need competence in assessing students' learning using computer-based tests	3.36	.574	Needed
2	I need competence in using various mathematics software such as Geo Gebra, Logo and dynamic statistics in teaching mathematics	3.14	.611	Needed
3	I require competence in the use of visual graphs in teaching mathematics	3.11	.609	Needed
4	I need competence in preparing lesson plans using computers	3.27	.609	Needed
5	I need competence on how to use various equation editors in solving mathematics problems	3.19	.708	Needed
6	I need competence in the use of spread sheet to form number patterns	3.28	.714	Needed
7	I require competence in the use of graph plotter to investigate the tasks	3.39	.628	Needed
8	I need competence in the using different instructional software packages in mathematics	3.26	.605	Needed
9	I need competence in preparing ICT-based learning materials in mathematics	3.12	.716	Needed
10	I require competence in establishing virtual learning environment in mathematics education	3.24	.687	Needed
11	I need competence in using various audio devices in teaching mathematics	3.20	.626	Needed

12	I require competence in using specific mathematics software to give assignments to students	3.20	.671	Needed
13	I need competence in evaluating mathematics topics using specific mathematics software	3.17	.672	Needed
14	I need competence in using various assistive technologies in teaching mathematics	3.28	.672	Needed
15	I need competence in using power point in presenting the lessons to students	3.35	.665	Needed
16	I need competence in solving basic problems using graphic programmes	3.14	.685	Needed
17	I need competence in using interactive whiteboard in teaching mathematics	3.25	.585	Needed
18	I need competence in producing learning multimedia software such as videos, images and graphs	3.37	.697	Needed
19	I need competence in the use of multimedia overhead projectors in presenting mathematics lessons	3.62	.488	Needed
20	I need competence in using various social media sites to interact with students	3.87	.342	Needed
	Cluster Mean	3.23	.258	Needed

Result in table 1 shows the areas mathematics teachers need competency in using ICT in teaching and learning of mathematics for enhancing inclusive education. The result shows that the mean scores of the teachers for all the items ranged from 3.12 to 3.87 while the overall mean score was 3.23. The result indicates that the teachers need competence in using ICT in teaching and learning of mathematics for enhancing inclusive education. Furthermore, the standard deviation values for all the items ranged from 0.342 to 0.716 while the overall standard deviation was 0.258. The close nature of the standard deviation values shows that the responses of the teachers were similar.

Research Question Two: what are the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education?

Table 2: mean and standard deviation of the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education

	Item statements	Male (n = 34)		Female (n = 71)		Dec.
		Mean	SD	Mean	SD	
1	I need competence in assessing students' learning using computer-based tests	3.41	.557	3.34	.584	Needed
2	I need competence in using various mathematics software such as GeoGebra, Logo and dynamic statistics in teaching mathematics	3.12	.591	3.15	.624	Needed
3	I require competence in the use of visual graphs in teaching mathematics	3.21	.641	3.07	.593	Needed
4	I need competence in preparing lesson plans using computers	3.26	.618	3.27	.608	Needed
5	I need competence on how to use various equation editors in solving mathematics problems	3.06	.814	3.25	.648	Needed
6	I need competence in the use of spread sheet to form number patterns	3.29	.760	3.27	.696	Needed
7	I require competence in the use of graph plotter to investigate the tasks	3.35	.691	3.41	.599	Needed
8	I need competence in the using different instructional software packages in mathematics	3.38	.551	3.20	.624	Needed
9	I need competence in preparing ICT-based learning materials in mathematics	3.09	.668	3.14	.743	Needed
10	I require competence in establishing virtual learning environment in mathematics education	3.21	.729	3.25	.670	Needed
11	I need competence in using various audio devices in teaching mathematics	3.32	.638	3.14	.616	Needed
12	I require competence in using specific mathematics software to give assignments to students	3.38	.551	3.11	.708	Needed

13	I need competence in evaluating mathematics topics using specific mathematics software	3.24	.699	3.14	.661	Needed
14	I need competence in using various assistive technologies in teaching mathematics	3.35	.691	3.24	.665	Needed
15	I need competence in using power point in presenting the lessons to students	3.47	.662	3.30	.663	Needed
26	I need competence in solving basic problems using graphic programmes	3.12	.729	3.15	.669	Needed
17	I need competence in using interactive whiteboard in teaching mathematics	3.38	.604	3.18	.568	Needed
18	I need competence in producing learning multimedia software such as videos, images and graphs	3.35	.691	3.38	.704	Needed
19	I need competence in the use of multimedia overhead projectors in presenting mathematics lessons	3.62	.493	3.62	.489	Needed
20	I need competence in using various social media sites to interact with students	3.85	.359	3.87	.335	Needed
	Overall Mean	3.24	.265	3.23	.256	Needed

The result in table 2 shows the differences in the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education. The result shows that the mean responses for male teachers ranged from 3.06 to 3.85 for all the items and 3.07 to 3.87 for all the items for female teachers. Furthermore, the overall mean responses for male and female teachers were 3.24 and 3.23 with standard deviation values of 0.265 and 0.256 respectively. This result indicates that male and female teachers do not differ in their competence needs in using ICT in teaching and learning of mathematics for enhancing inclusive education.

Hypothesis

There is no significant difference in the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education.

Tables 3: t-test analysis of the significant difference in the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education

	Mean	SD	N	Df	Std. Error	t_{cal}	*P*-value	*Dec.*
Male	67.47	5.406	34	103	1.095	-0.020	.984	NS
Female	67.49	5.185	71					

Key: *Dec = decision, NS = Not Significant, N = Significant*

The result in Table 3 shows that the difference in the competency needs of male and female teachers in using ICT in teaching and learning of mathematics for enhancing inclusive education was not significant, $t(103) = -0.020$, $p > 0.05$. Thus, the hypothesis is not rejected. This is because the probability value of 0.984 is greater than 0.05 set as level of significance. Thus, inference drawn is that male and female teachers do not differ significantly in their competency needs in using ICT in teaching and learning of mathematics for enhancing inclusive education.

Discussion of findings

The findings of the study showed that the teachers need competence in areas such as: assessing students using computer-based test, using mathematical software soft as GeoGebra and Logo to teach and competency in solving basic problems using graphic programmes among others. This means that the teachers are not quite competent in using ICT in teaching mathematics. Therefore, the teachers require some form of training in the use of ICT in teaching and learning of mathematics. The findings validates previous findings by Ezeugwu, et al. (2016) who revealed from their study that mathematics teachers needed ICT competencies for instruction. The study also supports previous findings by Hemant (2020) who investigated the proficiencies of mathematics teachers on ICT and revealed that the teachers had a medium level of competency level of teachers on ICT. The above findings could be true because most of the teachers in Nigeria and some developing countries are not well-trained in the use of ICT in teaching. Most of the teaching on ICT in Nigeria focuses on use of ICT for performing task such as typing, Corel draw and related practices. Hence, these teachers will not be efficient in using ICT in teaching of mathematics in secondary school.

The findings of the study further revealed that male and female teachers do not differ in their competency needs in using ICT in using ICT in teaching and learning of mathematics for enhancing inclusive education. The reason for no difference in the competency needs of male and female teachers could be because they have similar educational qualifications and years of experience. Another reason could be that since most schools in Nigeria have not integrated ICT fully in teaching and learning in schools, the teachers despite of gender differences are not used to using ICT in teaching. This means that the competency needs of male and female teachers are the same. The findings corroborate previous findings by Prieto et al (2020) who investigated gender and digital teaching competence in dual vocational education and training revealed that no significant gender differences between teachers with respect to the application of e-skills by teaching professionals. This is expected especially given the fact that the teachers received similar training in mathematics and may possess the same level of teaching experience. However, the findings is contrary to those of Laxmi and

Jabin (2022) and Díaz-García et al. (2023) who in their separate studies found that there is a significant difference in the Competency in ICT male or female teachers. A possible reason for the differences in the results of these studies could be because of the areas of the study. Whereas the former studies were conducted in Spain and India, the present study was conducted in Nigeria. Some countries still practice gender stereotyping where different training are meant for males and females, as such, this may influence their competency and related activities. Gender stereotyping is not a common phenomenon among Nsukka people. Men and women are given equal educational opportunities and training. This could be justified by the number of female mathematics teachers in the area. Hence, haven gotten the same training, it is expected that the competency needs of male and female teachers in Nsukka LGA should not differ. Hence, the findings of the study are in order.

Conclusion

Based on the findings of the study, it was concluded that teachers need competency in using ICT in teaching and learning of mathematics for enhancing inclusive education. Furthermore, it was concluded that male and female teachers do not differ in their competency needs in using ICT in teaching and learning of mathematics for enhancing inclusive education. Hence, male and female teachers do not differ significantly in their competency needs in using ICT in teaching and learning of mathematics for enhancing inclusive education.

Recommendations

Based on the findings of the study, the researchers made the following recommendations

1. Mathematics teachers should use trained in the use of ICT in teaching and learning of mathematics in school.
2. Government and school administrators should provide the needed ICT resources required for the teaching and learning of mathematics in schools.
3. Government should encourage inclusive education for all learners rather than building separate schools for certain group of learners.

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