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ENHANCING MATHEMATICS TEACHER-TRAINER'S KNOWLEDGE AND UTILIZATION OF INSTRUCTIONAL MATERIALS FOR EFFECTIVE TEACHING AND LEARNING OF MATHEMATICS IN FEDERAL COLLEGE OF EDUCATION (TECHNICAL), GUSAU- ZAMFARA STATE – NIGERIA

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Abstract

This study aimed to investigate three key issues: (1) whether the instructional materials intended for Mathematics Laboratories and Workshops—such as overhead projectors, multimedia projectors, computers, workshop tools, and consumables—were actually delivered to the Colleges of Education in question; (2) if delivered, whether the mathematics teacher-trainers in the college knew how to effectively use them during instruction; and (3) if not, to identify the reasons behind their lack of knowledge. The study focused on Federal College of Education (Technical), Gusau (located in Gusau Local Government Area), Participants included all eleven mathematics lecturers from the Federal College of Education, Gusau, Each of completed a questionnaire designed to answer the research questions. Findings from the responses indicated the following: 1. Most of the essential instructional tools, including overhead projectors, computers, and multimedia projectors meant for mathematics laboratories, were not supplied. Only a few consumables—being the more affordable items—were supplied. 2. No training workshops had been conducted to equip the mathematics lecturers with skills to use the materials effectively. As a result, they lacked knowledge on how to integrate them into their lessons. 3. Furthermore, the teacher-trainers had not taken any personal steps to learn how to use these teaching aids to enhance their instructional delivery. The paper concludes with several recommendations aimed at addressing these issues. Among them are: 1. Encouraging peer collaboration and support among lecturers within and across the colleges to foster mutual assistance. 2. The National Commission for Colleges of Education (NCCE), which oversees all colleges of education in Nigeria and outlines the required instructional materials in its "Minimum Standard," should organize training workshops—either independently or in partnership with the colleges—to educate mathematics teacher-trainers on how to effectively use these instructional tools for improved teaching and learning outcomes.

Keywords: Instructional materials, knowledge acquisition, utilization, mathematics teacher-trainers, effective teaching and learning.

Background of the Study

Since the 1990s, reforms in Mathematics Education have emphasized improved teaching methods, particularly the use of instructional materials for more effective mathematics instruction. Modern teaching practices encourage a shift from the traditional "chalk and talk" approach to methods involving teacher-created constructions and student-led problem-solving and discovery activities. When teachers use instructional tools effectively, students are more likely to understand mathematical concepts deeply. Researchers assert that a teacher's mastery of mathematical content is essential but insufficient unless paired with the ability to convey that knowledge through physical models and teaching aids. Odero (2010) emphasized that learning outcomes are enhanced by appropriate use of teaching materials. Where such resources are unavailable or poorly used, learning is often hindered. Well-chosen instructional tools can clarify complex concepts, sustain interest, and engage students more fully in lessons—fostering behavioral change and boosting achievement. Instructional materials are resources that support teachers in delivering content effectively and students in grasping concepts meaningfully. Learning involves a relatively permanent change in behavior through practice and experience, as stated by the Federal Ministry of Education (1981). Leyola (2015) also highlights that successful learning requires active engagement from both teachers and students. In this context, instructional materials include devices like overhead and multimedia projectors, computers, and hands-on equipment such as drills and calculators.

Constructivist educators argue that students need hands-on interaction with materials to build understanding and discover mathematical principles. The presence and effective use of such tools are considered vital for quality education and school effectiveness. Okafor and Anaduaka (2013) argued that explaining concepts without using tangible materials impedes learning. According to Obioma (2007), integrating instructional materials into the 9-Year Basic Education curriculum helps achieve national education goals, including the Millennium Development Goals (MDGs) and the National Economic Empowerment and Development Strategies (NEEDS).

Widespread student aversion to mathematics, persistent failure rates, academic dishonesty, and broader challenges like unemployment and financial hardship underline the need for improved mathematics instruction. The National Commission on Science Teaching for the 21st Century (2015) advocated for the use of teaching aids to address these issues. To use such resources effectively, teachers must know how to select, arrange, and apply them to enhance instruction.

This paper seeks to determine whether mathematics educators in Zamfara State's two Colleges of Education are trained in the use of instructional materials assigned to their mathematics laboratories and workshops. Assessing their knowledge is the first step toward ensuring meaningful use of these tools.

A brief history of Zamfara State educational background.

This study focuses on mathematics instruction in Zamfara State because of the region's longstanding educational underdevelopment, especially in science and technology. Located in northwestern Nigeria, Zamfara's educational challenges stem from its historical preference for Islamic education over Western schooling during the pre-independence period. While southern Nigeria embraced Western education, Zamfara remained focused on Arabic studies.
Even more than five decades after independence, the disparity in science and technology education between the North and South persists. To bridge this gap and promote female education, especially in technical fields, the Nigerian government established the Federal College of Education (Technical) in Gusau in 1989—a women-only institution, and the only one of its kind in Nigeria. Mathematics and science instruction at this institution must therefore be strengthened using proper instructional tools. The second institution, the State College of Education in Maru, was created in 2000 to address the need for more qualified teachers. Despite these initiatives, enrollment in the Mathematics Departments of both colleges remains low, as shown in Table 1 below.

Analysis of Enrolment Trends in FCE(T), GUSAU

Table 1: Students' Enrolment Figures in Mathematics Department in comparison with a few other Departments in F.C.E.(T) Gusau from the year 2014/2015-2022/2023 Academic Session.

Department	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
Mathematics	14	18	22	14	14	14	-	6	5

Source: offices of the Heads of Department

Table 1 demonstrates persistently low enrollment in mathematics course from 2014/2015-2022/2023.

Understanding Instructional Materials

According to Okafor and Anaduaka (2013), instructional materials are tools designed to spark and sustain students' interest in learning mathematics, while also aiding their comprehension of mathematical topics. Asogwa, Onu, and Egbo (2013) further define instructional materials as physical objects used by teachers to convey essential information, helping students better grasp lesson objectives and appreciate the content being taught.

Importance of Instructional Materials in Teaching Mathematics

Instructional materials play a critical role in mathematics education. Their benefits include:

- Highlighting the importance of mathematics in science and technology.
- Offering diverse experiences that encourage students to trust their mathematical thinking.
- Allowing students to clarify and solidify ideas through discussion, writing, and reading.
- Enabling learners to form hypotheses, gather evidence, and justify their reasoning.
- Supporting the use of various strategies to solve complex, non-routine problems.
- Setting high expectations for all students regardless of background, ability, or identity.
- Providing flexible yet structured learning progressions.
- Promoting active student involvement in creating, evaluating, and applying mathematical knowledge.
- Reflecting real-world applications and advancements in how math is taught.
- Integrating modern technologies into teaching practices.
- Modeling different assessment methods to measure not just knowledge but also reasoning and problem-solving skills.
- Encouraging collaboration, self-reliance, and connections between mathematics and other subjects or disciplines.
- Challenging students' thinking by asking them to explain and justify their reasoning.
- Supporting teachers in delivering lessons that are engaging, effective, and relevant.
- Helping clarify abstract concepts by making them more concrete.
- Overcoming language or comprehension barriers to make mathematics more accessible and meaningful.
- Reinforcing key points and clearing up confusion.

- Facilitating information sharing between teachers and learners.
- Expanding teaching options and helping overcome physical or contextual constraints.
- Enabling teachers to present questions and provide immediate feedback.
- Allowing students to learn at their own pace and revisit material as needed.
- Enhancing and supplementing instruction, encouraging both teachers and students to engage more deeply with content.
- Aiding in the explanation of new mathematical ideas and improving student understanding.

Given the strong emphasis on using instructional materials in mathematics education, it is essential to ask: How valuable is mathematics in our daily lives and society?

Definition of Mathematics

Odili (2006) defines mathematics as the study of quantity and space, an exact and systematic science shaped by human intellect and focused on ideas, processes, and reasoning. It includes a body of knowledge, techniques, and human-created methods. Kreyszig (2004) describes mathematics as a structured science based on a few core concepts and unified principles, offering a strong link between theory and real-world application. It is a study of patterns and relationships, a language of logic and structure, and a discipline marked by precision and internal consistency.

The Need for Mathematics Education in Nigeria

Given mathematics' role in driving technological and scientific progress essential to national growth, the Nigerian government has made the subject mandatory at both basic and senior secondary school levels. Additionally, mathematics is a required subject for entry into higher education institutions in the country. Anold (2003) echoes Galileo's belief that mathematics is the language of nature, critical to understanding the world. For instance, engineers at Lausanne National Polytechnic used advanced mathematical equations and simulations to optimize the design of a Swiss boat, "Alinghi," which went on to win the 2003 America's Cup.Philosopher Kant also asserted that science is only precise when it incorporates mathematics. Johnson (n.d.) noted the widespread use of mathematics in everyday life—from budgeting to nutrition—and its critical importance across numerous professions. Insurance companies use mathematical models to assess risk and determine premiums. Statisticians design research tools and analyze data essential for business decisions.In architecture, math is used to design buildings, estimate costs, and prepare contracts. Economists use numbers to study market trends and generate reports on job growth, inflation, and currency values.

Mathematics also plays a significant role in medicine. According to Glydon (2008), medical professionals use math daily for prescriptions, dosages, and interpreting diagnostic data. Pediatricians calculate heart rates and body mass indices, all using mathematical formulas. Radiographer Delebra (2015) emphasized the necessity of mathematical knowledge for achieving precision in her field, while Powers (2015) added that strong math skills are vital for success in radiology sciences.

Keener and Sneyd argued that teaching physiology without mathematical context is like

teaching planetary motion without referencing Kepler's laws. Mathematical models have even influenced public health policy in the UK, including responses to disease outbreaks. Colwell (2003) regarded mathematics as "biology's next microscope," emphasizing its foundational role across disciplines. Ale (2006) and the National Teachers' Institute (2007) agreed that mathematics supports nearly every field of study and human endeavor. On an online discussion forum about why people dislike mathematics, users emphasized its practicality and universal application. One participant said math is essential for solving problems across careers, while another highlighted its global respect and cross-cultural relevance. Others described math as a tool for understanding nature and advancing science and technology.

Okafor and Anaduaka (2013) concluded that mathematics is rooted in precision and expertise—qualities essential for progress.

With all these in mind, the next important question is: Do mathematics educators in Zamfara State colleges know how to effectively use the instructional materials available to them?

Table 2. The number and percentage of the participating Mathematics Teacher-Trainers' in Federal Colleges of Education (Technical), Gusau

College	No. of Mathematics Educators	Percentage	No. that participated	Percentage
F.C.E.(T) Gusau	11	100	11	100
Total	11	100	11	100

Source: Mathematics Head of Departments of (F.C.E.T.) Gusau

Table 2 shows that there are nine (11) Mathematics Teacher-Trainers' in Mathematics Department of Federal College of Education (Technical) (F.C.E.T) Gusau and all of them (100%) participated and completed the questionnaire used in getting the information used in writing this paper.

According to National Commission for Colleges of Education (N.C.C.E) (2009) Minimum Standard, a document that spelt out the activities and the requirements of all the colleges of education in Nigeria, the instructional materials, equipment and consumables expected to be made available in the Mathematics Laboratory/Workshop of each of the colleges of Education in Nigeria are as shown in table 3 below.

Instruction Materials for Mathematics Laboratories/Workshops in Colleges of Education in Nigeria

Table 3. Instructional materials meant for the Mathematics Laboratories/Workshops in the two Colleges of Education in Zamfara State [(F.C.E.T) Gusau

S/No.	Item description	Quantity Required
	INSTRUCTIONAL MATERIALS FOR THE LABORATORIES	
1.	Mini/micro computers	One computer to ten students
2.	An Overhead projector	1
3.	Multimedia projectors	
	EQUIPMENT FOR MATHEMATICS WORKSHOPS	
1.	Work benches	4
2.	Vice	4
3.	Drilling machine (manual & electric)	4
4	Drill bit (various sizes)	4 sets
5	Hand saw (various sizes)	6
6	Solid shapes (cube, cuboid, cylinders, prisims etc.	5 each
7	Engraving machine	2
8	Cutting knives	4
9	Hammer (different sizes)	4
10	Screwdrivers	6
11	Mathematical sets (including black board sizes)	20
12	Weighing scales	5 sets
13	Scientific calculators	5
14	Scissors (different sizes)	10
15	Pinchers	4
16	Jack and plane	4
17	Electric Organizers	4
	CONSUMABLES FOR MATHEMATICS WORKSHOPS	4
1	Cardboard papers	1 realm
2	Binding wire	5
3	Plywood (assorted)	10 sheets
4	Glue(wood)	5
5	Gum (liquid)	5
6	Celotapes	5
7	Metal sheets	5
8	Transparencies	5
9	Nails (assorted sizes)	As required
10	Graph sheets	20
11	Beads (assorted sizes and colors)	20

12	Thread etc	2 rolls

Source: N.C.C.E. Minimum Standard for Colleges of Education in Nigeria.

Having seen the list of the instructional materials meant for the Mathematics Laboratories/Workshops in the two colleges, there is need to find out from the mathematics lecturers whether these items are supplied or not. There is also need to find out how much of these items they can comfortably use during their classroom instructions. These questions are addressed as shown below.

Question 1. Are the instructional materials indicated in the list given to you which are meant for your Mathematics Laboratories/Workshops made available? If they are supplied please tick the word" available" otherwise tick the word" not available".

Availability of the Instructional Materials

Table 4. Frequency and % ratings of the responses of Mathematics Teacher –Trainers' on the availability of the instructional materials, in FCE (T), Gusau Mathematics Laboratories,/Workshops.

F.C.E.(T) Gusau

S/No.	Items Description	Available	%	Not available	%	Decision
	INSTRUCTIONAL MATERIALS FOR MATHS					
1	Mini/micro Computers	11	100	0	0	available
2	Overhead Projector	11	100	0	0	available
3	Multimedia Projectors	0	0	11	100	not available
EQUIPMENT FOR MATHS WORKSHOP						
1	Work benches	09	100	0	0	available
2	Vice	0	0	11	100	not available
3	Drilling Machine	11	100	0	0	available
4	Drill bit	11	100	0	0	available
5	Hand saw	11	100	0	0	available
6	Solid shapes	11	100	0	0	available
7	Engraving Machine	11	100	0	0	available
8	Cutting knives	11	100	0	0	available
9	Hammer	11	100	0	0	available
10	Screwdrivers	11	100	0	0	available
11	Mathematical sets(assorted)	11	100	0	0	available
12	Weighing Scales	11	100	0	0	available

13	Scientific calculators	11	100	0	0	available
14	Scissors	11	100	0	0	available
15	Pinchers	11	100	0	0	available
16	Jack/plane	11	100	0	0	available
17	Electric Organizers	11	100	0	0	available
1	Cardboard Sheets	11	100	0	0	available
2	Plywood (assorted)	11	100	0	0	available
3	Binding wire	11	100	0	0	available
4	Glue (wood)	11	100	0	0	available
5	Gum (liquid)	11	100	0	0	available
6	Collotypes	11	100	0	0	available
7	Metal sheets	11	100	0	0	available
8	Transparences	0	0	11	100	not available
9	Graph sheets	11	100	0	0	available
10	Beads (assorted)	0	0	11	100	not available
12	Thread etc.	11	100	0	0	available

Source: N.C.C.E. Minimum Standard for Colleges of Education in Nigeria.

From table 5, the responses of the mathematics educators from the FCE(T), Gusau, show that none of the instructional materials (mini micro computers, Overhead projectors or multimedia projectors) meant for the Mathematics Laboratories in the two colleges were supplied. The Mathematics Laboratories were even conspicuously absent. The Mathematics Workshops of the college were in existence. It is only the less expensive ones (work benches, Handsaw, solid shapes, Cutting knives, Hammer, Screwdrivers, mathematical sets, weighing scales, scientific calculators, pinchers, Jack and plane) that were fully supplied to the College.

Mathematics Educators responses to the questionnaire

Question 2. Do you have the knowledge of how to utilize the instructional materials which are supposed to be made available in your Mathematics Laboratory for your classroom instructions? Please tick either "yes" or "No" against the options you selected.

Table 5. Frequency and % ratings of the Mathematics Educators' responses on whether they have the knowledge of how to utilize the instructional materials (technologies) which are supposed to be supplied to their mathematics Laboratories for effective classroom instructions.

S/No.	College	Freq. Yes	%	Freq. No	%
1	F.C.E.(T) Gusau	0	0	11	100

Source: Lecturers' questionnaire.

Table 5 shows that none of the mathematics lecturers has the knowledge of how to utilize the

instructional materials meant for Mathematics Laboratories for the delivery of their lessons since the frequency of those who said Yes is zero with zero % and frequency of those who said No is Eleven (11) with 100% for F.C.E. (T) Gusau

Question 3. Do you have the knowledge of how to utilize all the equipment and consumables meant for your Mathematics Workshops for adequate preparation of your Pre-service Teachers in the art of making their own instructional materials? Please tick where appropriate "yes (all)", if you can utilize all the equipment and consumables adequately and when appropriate for your classroom mathematics instructions, and "yes some", if you can utilize only some of them and "No", if you do not know how to use any of them for your class room instructions.

Table 6. Frequency and % ratings of the Mathematics Lectures responses on whether they have the knowledge of how to utilize all the equipment and consumables which are supposed to be supplied to their Mathematics Workshops for adequate preparation of their Pre- Service Teachers'.

S/No.	College	Freq. yes (all)	%	Freq. yes (some)	%	Freq. No.	%
1.	F.C.E.(T) Gusau	0	0	11	100	0	0

Source: Teacher-Trainers' questionnaire.

From table 6, it could be seen that none of the Mathematics Lecturers have the knowledge of how to utilize all the available equipment and consumables while delivering their lessons. The entire staff, fifteen (15) of them, claimed they only know how to make use of some of them for their classroom lesson delivery. 0% claimed they cannot deny having knowledge of how to utilize any of the equipment and consumables neither can they claim having the knowledge of how to make use of all of them while delivering their lessons at any point in time.

Question 4. On the list of the equipment and consumables given to you

Question 5. If the response to questions two (2) and three (3) above is yes, did you acquire the knowledge through any workshop(s) organized by any of the bodies? Tick the ones you cannot confidently utilize during the course of the delivery of your mathematics lessons.

The items ticked under equipment by the respondents were: Vice, Drilling machines, Drill bit, Jack and plane, Engraving machines and Electric Organizers while the ones ticked under consumables were: Binding Wire, Metal sheets, Plywood and Transparences. isted below, aimed at teaching the Teacher-Trainers how to make use of these items in grooming their Pre-Service Teachers' in the art of making their own instructional materials?

a) National Commission for Colleges of Education (N.C.CE.).

b) The College Authorities.

c) Any other specified workshop.

d) Self effort.

None of the respondents' ticked any of the above options. This implies that neither N.C.C.E. nor the college authorities organized any workshop to teach the mathematics educators how to make use of these items for effective delivery of their class room instructions. The Mathematics Lecturers' themselves did not make any effort to learn how to use these items

through any other means for effective delivery of their lessons despite the fact that the lecturers' from School of Technical Education, which is one of the schools in F.C.E.(T) Gusau can assist in teaching the mathematics lectures' how to handle some if not all the equipment and consumables in their workshops.

Discussion

Although both colleges have existed for over a decade, there has been no formal assessment of whether the instructional materials were supplied or used effectively. More concerning is that the lecturers themselves have not made efforts to acquire the necessary skills for using these resources in the classroom. Tables referenced earlier indicate that none of the educators were trained to use the instructional materials in their entirety. Many could only operate some basic tools, and they showed no confidence with more advanced instructional aids. Equipment like the "Rabometer" provided since the 1990s by NCCE lies unused due to lack of knowledge on its application. In some cases, these tools are deteriorating in storage, potentially ruined by pests and poor maintenance. This reveals the urgent need for practical training on the use of instructional materials. Such training should start at the teacher preparation stage and be reinforced through regular workshops. It would ensure that pre-service teachers are adequately prepared for real-world teaching scenarios, including improvisation when necessary. Leyola (2015) emphasized that instructional materials should not be used simply to meet classroom expectations, but must be purposefully applied to support student learning. Kedzera (2006) added that teachers' use of high-order instructional tools depends greatly on both availability and training. Without proper support, teachers often underutilize these materials, weakening the impact of curriculum reforms. The study suggests that peer collaboration among departments and between institutions could greatly enhance educators' ability to use teaching tools. For example, teachers in the School of Technical Education at FCE (T), Gusau who regularly use such materials could train colleagues in the Mathematics Department. This cross-departmental approach would bridge the training gap and foster a more effective teaching environment. Diamini (1995) also noted that simply delivering instructional tools to classrooms does not guarantee their use. Without training, teachers may miss opportunities for professional growth, hindering curriculum delivery. Therefore, training must accompany supply, making effective use of teaching materials a core focus in education policy.

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Recommendation

To ensure instructional materials in mathematics departments are used effectively, the following steps are recommended:

1. Monitoring and Evaluation: Regular audits should be conducted to confirm that instructional materials are both delivered and appropriately utilized.
2. Peer Support: Colleges should encourage collaboration among teachers across departments and institutions to enhance training and the sharing of instructional knowledge.
3. Workshops and Professional Development: The NCCE, in collaboration with college authorities, should organize training sessions focused on the application of mathematics instructional tools.
4. Pre-service Teacher Training: Colleges must incorporate hands-on training in the use of instructional materials into the pre-service teacher curriculum. Trainees should also be taught how to improvise with available tools.

Conclusion

The paper concludes that for mathematics education to be effective, all required instructional

materials must be fully supplied and paired with adequate training. In Zamfara State—where education is already underdeveloped—this is especially important. When Mathematics Teacher-Trainers are trained to use these materials effectively, pre-service teachers will be better equipped to teach the subject at lower educational levels. Training should also include the ability to improvise in resource-limited settings. Furthermore, institutions should avoid allowing materials to deteriorate, unused in storage, and promote cross-departmental learning to optimize resource use. The study strongly supports the need for peer collaboration and institutional partnerships to enable the sharing of instructional strategies. Only when teachers are equipped with both tools and the knowledge to use them can they be held accountable for their application in classroom settings.

This paper recommends that when these Teacher Trainers have been trained in the art of efficient use of the instructional materials, equipment and consumables (when fully supplied), the next exercise should be to test the lectures competency level in the utility of these items for effective mathematics classroom delivery.

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