NIGERIA MODULE

REPORT COMPENDIUM

Ibrahim Badamasi Babangida University
Nigeria

Table of Contents

Subject : Biology

Cell Structure & Organization

Authored by:
Prof. Naomi Dadi-Mamud

1. Introduction

A. Timeline of implementation in the country

The module was implemented for 6 weeks from 22nd October, 2022 to 21st November, 2022.

B. Learning objectives

i. Describe various types of cells from plants, animals and other living organisms
ii. Differentiate between unicellular and multicellular organisms
iii. Understanding a cell's structure and the tools and methods used to study them.
iv. To be able to demonstrate an understanding of eukaryotic cell structure and function.
v. Understand the concept and importance of cell differentiation.

C. Number of units

There are four units in Cell structure and Organization module as follows:

i. Unit 1: The Cell
ii. Unit 2: Types and Characteristics of Cells
iii. Unit 3: Eukaryotic Cells in Detail
iv. Unit 4: Cell Differentiation

D. Concepts covered

Some of the concepts found in the module include; Unicellular and Multicellular organisms. modern cell theory, Prokaryotes, Eukaryotes, Cell Differentiation

E. Resources - activities, readings

So many resources are used such as tables, videos, and pictures (organisms and tools used to conduct experiments).

Activities such as observing and identifying different types of multicellular organisms around the school compound and at home, investigating types of unicellular organisms that are present in water from a pond and river.

F. Nature and purpose of assessments

Assessments are based on stated learning objectives, with the purpose of determining learners' outcomes and achievement of lesson objectives. They range from multiple choice questions, self-evaluation questions and a series of activities in the various units.

2. Course completion rate

A. Overall completion

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%	-	-	-
21 - 40%	-	-	-
41 - 60%	-	-	-
61 - 80%	-	-	-
81 - 100%	5	15	20
Total	5	15	20

Table 1 reflects that all of the 5 NQTS completed the entire course. Also, this indicates that all of fifteen (15) intervention group teachers have successfully completed the module. This means that all the teachers from both groups have completed the pre-test, post-test, lesson plans, and reflection with a completion rate between 81% and 100%.

B. Assessment completion rate

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5 (100%)	15 (100%)	20 (100%)
Session plans	5 (100%)	15 (100%)	20 (100%)
Reflection	5 (100%)	15 (100%)	20 (100%)
Post tests	5 (100%)	15 (100%)	20 (100%)

Table 2 shows a 100% completion rate, indicating that all the 20 teachers (NQTs and Intervention group) completed the session plans, reflections and pre-tests and post-tests.

3. Time spent on the course platform

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	3 (60%)	10 (66.7%)	13 (65%)
10 to 20	2 (40%)	4 (26.7%)	06 (30%)
21 to 30	-	1 (6.7%)	1 (5%)
More than 30	-	-	-
Total	5 (100%)	15 (100%)	20 (100%)

Table 3 shows that more than half (65%) of the teachers spent less than 10 hours on Moodle platform. There are about 13 out of 20 teachers (3 NQTs and 10 intervention teachers). 6 out of 20 teachers (2 NQTs and 4 intervention teachers) spent between 21 to 30 hrs. And only a teacher (Intervention teacher) spent within the range of 21 and 30 hrs on Moodle platform. An average time of 10 hrs was spent by the teachers. Thus, the overall time spent indicates that the platform is user-friendly.

4. Change from pre- and post-test

Average total score in the pre-test (Total pre-test scores of all teachers (120) divide by twenty (20) teachers = 6.00

Average total score in post-test (Total post-test scores of all teachers (137) divide by twenty (20) teachers = 6.85

The pretest and post-test scores show that teacher development has taken place and the CL4STEM program has an overall positive impact on the teachers' professional development.

Table 4: Change from Pretest to Post test

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice	1	2		
	26-50% Emerging	1	7	4	
	51-75% Proficient		1	4	
	76-100% Accomplished				

Table 4 shows the trend of how the teachers' progressed using their pre-test and post-test scores as indicators of advancement or otherwise as follows:

i. The pretest score categorized three (3) teachers as novices, out of which one (1) teacher remained static, with no advancement even after engagement with the program as indicated by their post-test scores. However, both of the remaining two (2) teachers progressively advanced to emerging category. Thus, the program had a significant impact on three (3) teachers.

ii. The pre-test emerging category also shows a setback in the performance of one of the teachers, who was previously categorized as emerging However, after taking the post-test, the teachers' performance regressed from emerging to novice category. This indicates that the teacher performed less than the pretest after proceeding through the program. However, four (4) out of the teachers previously in the emerging category of the pretest, successfully advanced to proficiency while seven (7) remain in the emerging category even after completing the post-test.

iii. The proficient category had five (5) teachers based on their pretest scores out of which 4 remained uninfluenced by the program, as their post-test scores did not change their category and 1 teacher experienced drawbacks due to a step down into the emerging category.

iv. In general, the teacher development program had a slight but positive impact on 6 out of 20 teachers, as they progressed to higher categories of teacher development expertise. Also, two (2) teachers experienced drawbacks due to a step down to a lower category from their post-test score. This is partly attributed to a number of factors such as health constraints, commitments from a place of work and financial constraints (internet connection is not readily available and expensive). The success is attributed to follow-up calls on CoP and school visits, prompt technical support, increased interest, acceptance and observed added value, and cooperation from stakeholders particularly principals and students among others. Thus, the experiences of the program have become more meaningful in the teachers' professional development.

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	3	3	12	2	20
2. Nature of Science/ Mathematics	2	9	9	0	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	0	7	11	2	20
4. Students' misconceptions & Learning Difficulties	1	7	12	0	20
5. Representation of the Content	2	10	8	0	20
6. Context for Learning	2	9	9	0	20
7. Curriculum knowledge	2	8	10	0	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	1	8	11	0	20
9. Classroom Management	3	9	8	0	20
10. Assessment	0	10	10	0	20
Total	16	80	100	4	200

A. Subject Matter Knowledge

Most teachers fall under the Proficient category with regard to subject matter Knowledge. The teachers demonstrate good knowledge and understanding of the concepts relevant to the topic they teach. And they are able to incorporate these concepts into their lesson activities with students to better enhance their understanding and retention of the concepts.

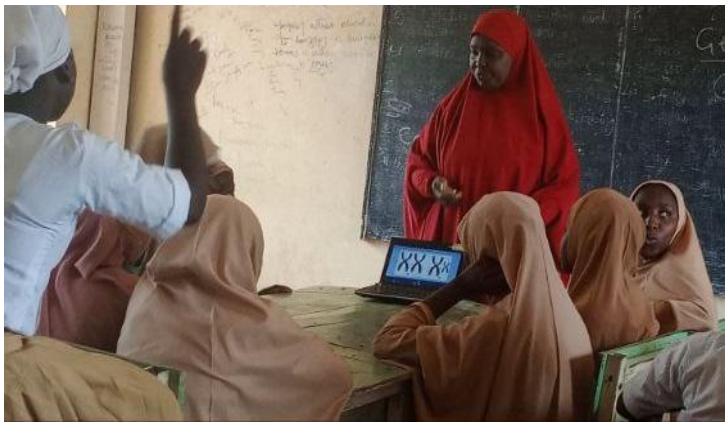


Figure 1: Students engaged in interactive session

B. Pedagogical Content Knowledge

In terms of Pedagogical Content, the majority of teachers are categorized as Proficient. Teachers use the appropriate features of resources, known as TPACK, to reach desired learning outcomes. They utilize resources that are accessible to every student in their class.

Teachers promote an environment focused on inquiry by encouraging learners to ask questions. They also utilize various methods to involve all learners in the learning process. Plan and implement strategies to overcome any misconceptions or learning difficulties that may arise.

Figure 2: Students observing the different types of cells of organisms using a microscope

C. General Pedagogical Knowledge

Teachers have demonstrated proficiency in the category of General Pedagogical Knowledge, as evidenced by examples from their session plans, indicating their level of competence. Teachers promote engagement and expression among students by engaging them in activities both in and outside the classroom such as problem-solving, hands-on activities, and grouping practices.

Figure 3: Students investigating the different types of multicellular organisms around the school compound.

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	132
Teachers	354
Teacher Educators	111
Research fellow	08
Total	**605**

Table 6 implies that posts were mostly made frequently by NQT and Other Teachers as represented in order of Teachers > NQTs > Teacher Educators > Research fellow

B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	182
UDL	52
Technical	309
Communication/ Administrative	62
Total	**605**

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	378
Images	148
External Links to other resources	62
Others	86
Total	**674**

Table 7.1 shows that postings on Technical issues outnumbered other categories of posts. This implies that technical issues are one of the major challenges experienced in this project.

Note: a post made on the CoP platform may contain one or more links, images or videos. In Table 7.2, each of the post types was considered a post and they were counted individually.

C. Qualitative dialogues/ discussion thread

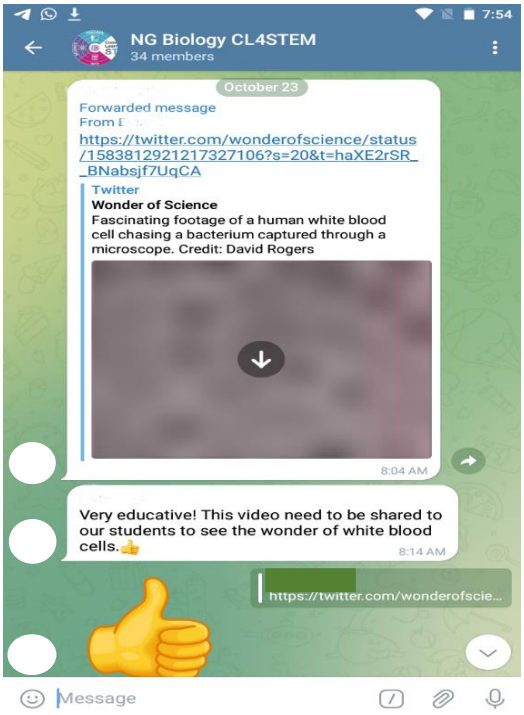


Figure 1: A post from a research fellow providing external resource

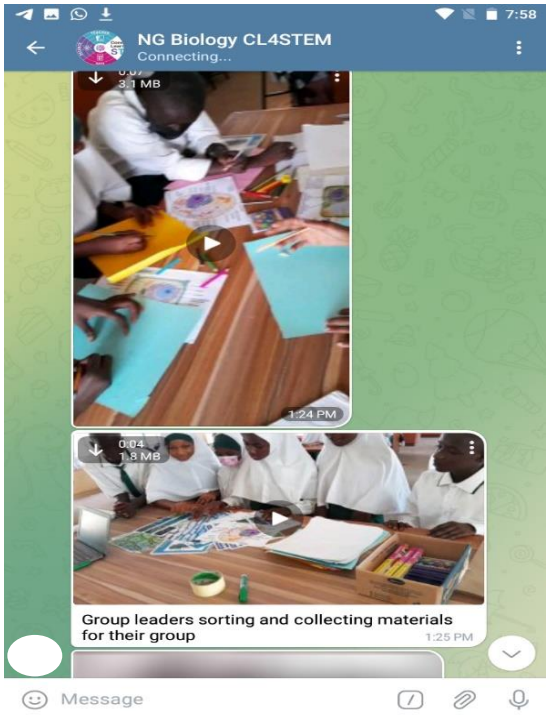


Figure 2: Post of classroom group activities among students ensuring equity and inclusion

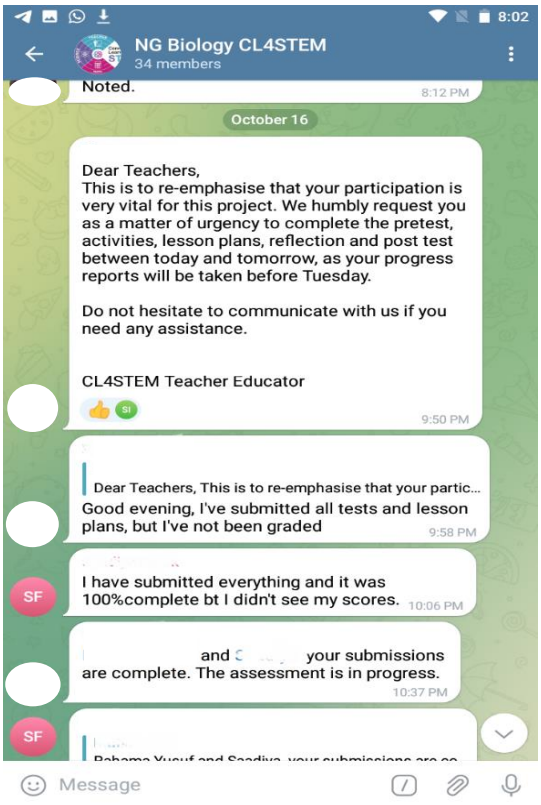


Figure 3: Teacher educator providing support to teachers on CoP

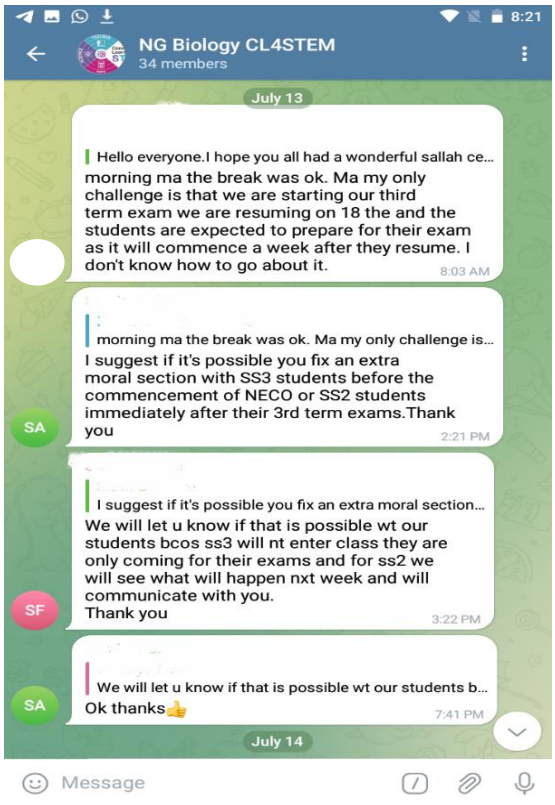


Figure 4: Teacher educator providing suggestion on the module implementation in the classroom

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers:

Teacher participation in the Community of Practice (CoP) and utilization of the Moodle platform were effective in enhancing engagement with the student using the Cell Structure and Organization module. Strategies such as structured discussions and collaborative activities facilitated active participation.

B. Challenges:

Teachers faced challenges due to limited access to resources and technological constraints. Some teachers encountered difficulties in accessing the necessary tools and materials required for conducting experiments.

C. Surprises:

Some teachers expressed difficulties with the user-friendliness of the CoP platform, which led to reduced engagement. These challenges might have included navigating the platform, accessing specific features or resources, or understanding the interface.

D. Any changes required in the module design:

To better facilitate engagement on the platform, various activities should be implemented of which participation attracts rewards. This can serve as a means to motivate teachers to become active on the platform.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Biology

Ecology

Authored by:
Dr. Mufida Bello Hussaini

1. Introduction

A. Timeline of implementation in the country

The timeline for the implementation of this module is four (4) weeks.

B. Learning objectives

The learning objectives are many and designed based on the number of units in the module.

C. Number of units

There are three units in Ecology and Society module as follows:

Unit 1- Understanding Ecology and its Principles (Three lessons)
Unit 2- Ecological Organisation and its Relation to the Environment (Sixteen lessons)
Unit 3- Ecology, Environment and Society (Seven lessons)

D. Concepts covered

There are 14- concepts covered: Concepts of Ecological interactions, Ecology, Environment, Habitat, Ecological niche, Ecosystem, Autotroph, Heterotroph, Trophic level, Food Chain, Food Web, Organizational Levels, Pollution and Socio-scientific issues.

E. Resources - activities, readings

There are so many resources used such as pictures, videos (, charts, apps, instruments e.t.c. Some of these could be found in the following links (https://youtu.be/yyWxv0i5Oz0), (https://youtu.be/XJ6VtduDSyY) and (https://youtu.be/ZXfGe2Cc8Ac) among others.

F. Nature and purpose of assessments

Assessments are based on stated learning objectives, with the purpose of determining learners' outcome and achievement of lesson objectives. They range from multiple choice questions, self-evaluation questions and series of activities in the various units.

2. Course completion rate

A. Overall completion

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%	1	-	1
21 - 40%	-	1	1
41 - 60%	-	-	-
61 - 80%	-	2	2
81 - 100%	4	12	16
Total	5	15	20

Table 1 reflects that 4 out of 5 NQTS completed the entire course and 1 NQT completed the pretest alone. Twelve (12) out of fifteen (15) intervention group teachers recorded between 81% and 100% completion rate. While two (2) recorded completion rates between 61% and 80%. Consequently, one (1) of the teachers' had a lower percentage between 21% and 40%.

B. Assessment completion rate

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre-test	5 (100%)	15 (100%)	20 (100%)
Session plans	4 (80%)	14 (80%)	18 (80%)
Reflection	4 (80%)	14 (80%)	18 (80%)
Post tests	4 (80%)	14 (80%)	18 (80%)

Table 2 shows 100% completion rate in pretest indicating that all the 20 teachers (NQTs and Intervention group) completed the pretest. However, only four (4) NQTs out of five (5), and fourteen (14) out of fifteen (15) intervention group teachers completed the session plans, reflections and post tests.

3. Time spent on the course platform

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	3 (60%)	7 (46.5 %)	10 (50%)
10 to 20	2 (40%)	7 (46.5 %)	9 (45%)
21 to 30	-	1 (7%)	1 (5%)
More than 30	-	-	-
Total	5 (100%)	15 (100%)	20 (100%)

Table 3 shows that half of the teachers spent less time on Moodle platform with ten 10 out of 20 teachers (3 NQTs and 7 intervention teachers) spending less than 10 hours. More time between 21 and 30 hrs was spent by only 2 teachers (1 NQT and 1 Intervention teacher). Average time between 10 to hrs was spent by 9 teachers (2 NQTs and 7 others). Thus , the overall time spent indicates that the platform is user friendly.

4. Change from pre- and post- test

Average total score in pre-test (Total pre-test scores of all teachers (130) divide by twenty (20) teachers = 6.5

Average total score in post-test (Total post- test scores of all teachers (140) divide by eighteen (18) teachers = 7.9

The significant variation between the pretest and post test scores shows that teacher development has taken place and the CL4STEM program has an overall positive impact on the teachers professional development.

Note: Twenty (20) teachers did the pretest, but only 18 did the post test

Table 4: Change from Pretest to Post test

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice	2	1	1	1
	26-50% Emerging	3		5	1
	51-75% Proficient		2	3	
	76-100% Accomplished				1

12 participants showed positive change, 5 participants showed negative change and 3 participants showed no change.

Table 4 shows the trend of how the teachers' progressed using their pre-test and post- tests scores as indicators of advancement or otherwise as follows:

i. The pretest score categorised five (5) teachers as novices, out of which two (2) teachers remained static, with no advancement even after engagement with the program as indicated by their post test scores. However, each of the remaining three (3) teachers progressively advanced to emerging, proficient and accomplished categories respectively. Thus, the program had a significant impact on three (3) teachers.

ii. The pretest scores of 3 teachers categorised them as emerging and their post test scores categorised them as novices implying setbacks as they proceeded through the program. This is partly attributed to a number of factors such as health constraints, commitments from place of work and financial constraints (internet connection is not readily available and expensive). However, five teachers and a single teacher successfully progressed in the program from emerging category to proficient and accomplished respectively.

iii. The proficient category had five (5) teachers based on their pretest scores out of which 3 remained uninfluenced by the program, as their post test scores did not change their category and 2 teachers experienced drawbacks due to a step down into the emerging category.

iv. In general the teacher development program had a significant positive impact on 12 out of 20 teachers, as they progressed to higher categories of teacher development expertise. The success is attributed to follow up calls on CoP and school visits, prompt technical support, increased interest, acceptance and observed added value, cooperation from stakeholders particularly principals and students among others. Thus, the experiences of the program have become more meaningful in the teachers' professional development.

5. Practice

Table 5

Criteria	Number of teachers				*Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	1	8	9	0	18
2. Nature of Science/ Mathematics	1	8	9	0	18
B. Pedagogical Content Knowledge					
3. Instructional Strategies	1	8	9	0	18
4. Students' misconceptions & Learning Difficulties	1	9	8	0	18
5. Representation of the Content	1	7	10	0	18
6. Context for Learning	1	8	9	0	18
7. Curriculum knowledge	1	8	9	0	18
C. General Pedagogical Knowledge					
8. Equity and Inclusion	1	7	10	0	18
9. Classroom Management	1	8	9	0	18
10. Assessment	1	7	10	0	18
Total	10	78	92	0	180

* *18 out of 20 teachers submitted their session plans*

A. Subject Matter Knowledge

The main category with regards to subject matter Knowledge is ''Proficient''.

Teachers tried to contextualise the content by relating various aspects to the learners immediate environment. This is evident from the following extractions in the teachers' reflection:

''During the field trip students made observations and came to conclusions that pollution definitely brings a lot of negative effect to the environment, the dirtiness of the place, the unpleasant smell from the area which was observed by them agree that pollution isn't a good thing, rather all individuals and government should fight against it.''

Figure 1: Card sorting activity of Biotic and abiotic components from Ecology module

Engaging students in activities that will enhance understanding and retention of concepts (Figure 1)

B. Pedagogical Content Knowledge

The main category teachers' fall with regards to Pedagogical Content Knowledge is ''Proficient'' as evident in the following extractions from teacher's session plans:

i. Contextualising learning and linking it with daily activities (Figure 2).
ii. Supporting Higher order thinking skills, equity and inclusion. This is evident in a teacher's statement as follows:
''The teacher made sure that the learners who were less participatory were specifically called so they can answer questions and give their opinions no matter what they are. The learners who were anxious or stressed were ensured that the class was a safe space where they can freely express themselves'' (Extract from teacher's reflection).

Figure 2: Students observing different organisms in their natural habitat

C. General Pedagogical Knowledge

The main category with regards to General Pedagogical Knowledge is ''Proficient''. Teachers have proved to be in this category as indicated in the following examples from their session plans:

i. ''Yes, I gave them activities to do and most of them were able to do it correctly. And I attached those that are unable to do it with those that are able to,this is because students sometimes learn faster with their fellow students (Extracted from teacher's Reflection)'' .
ii. '' The Teacher ask the students the following questions. 1. To list various types of food they are eating at home .2. To mention two animals seen in their house and the food given to them.'' (Extracted from teachers's session plan)

6. Social learning in CoPs

A. Frequency of posts

Table 4: Frequency of posts by participants

Role	Number of posts
NQTs	22
Teachers	24
Teacher Educators	38
Research fellow	20
Total	104

Table 4 implies that posts were made frequently by all participants in order of TE'S> Teachers> NQTs> Research fellow.

B. Frequency of posts

Table 5.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	12
UDL	15
Technical	47
Communication/ Administrative	30
Total	104

Table 5.1 shows that postings on Technical issues outnumbered other categories of posts. This implies that technical issues are one of the major challenges experienced in this project.

Table 5.2 : Frequency of posts by type

Type of post	Number of posts
Text only	36
Images	33
External Links to other resources	4
Others	30 videos and 1 audio
Total	104

Table 5.2 shows that external links to other resources were the least frequent posts. This shows weakness of sharing resources in the Cop and one of the suggestions for improvement and encouragement in the project.

.

A. Qualitative dialogues/ discussion threads

Figure 3: Ensuring Equity and Inclusion in classroom interaction

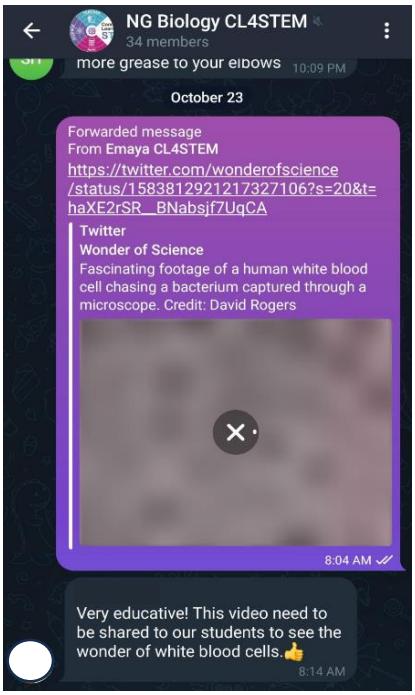


Figure 4: NQT's Response to a post on external resource from a research fellow

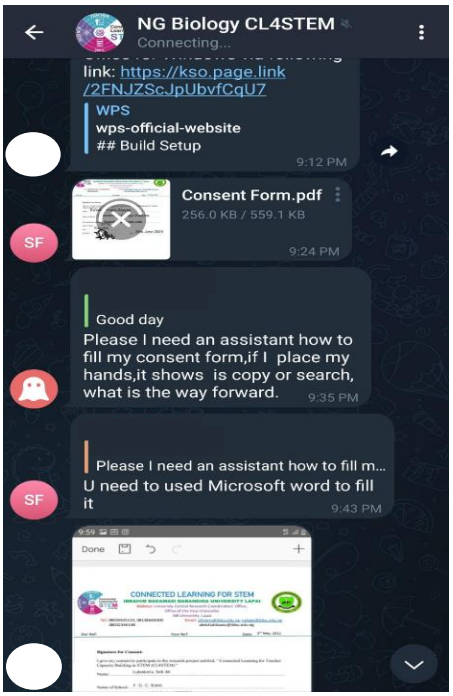


Figure 5: Interaction and teacher supporting teacher on CoP

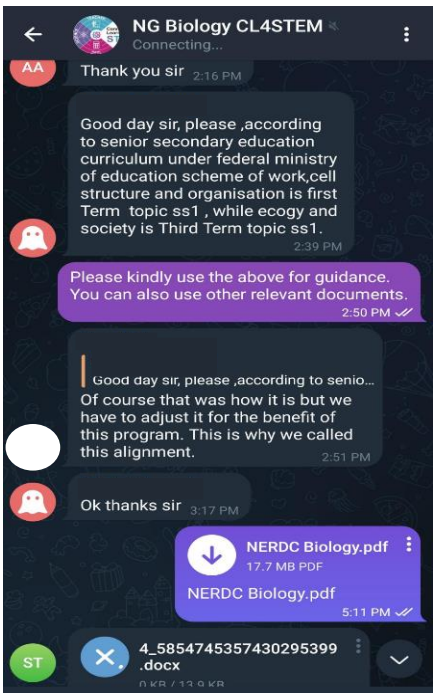


Figure 6: Teachers' interaction providing suggestions on module design on CoP

Figures 3 to 6 show screenshots which serve as examples of interactions and responses between teachers on CoP. These are good examples as they show the following: students' work shared; ensuring equity and inclusion in grouping students (Figure 3), support given to teachers in terms of resources (Figure 4), teachers supporting one another (Figure 5) and teachers pointing out their challenges with implementation (Figure 6).

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

i. **Thoughtful responses by teachers:** Teachers have employed various UDL principles in teaching as evident in the organisation of their session plans as follows:

   a. Clearing students' misconception; ''To clear misconception let us understand that Cells that do not have a membrane-bound nucleus are called prokaryotes, for example, Bacteria''.

   b. Good session narrative using audio visual aid

''The lesson will start by the teacher asking the students to observe their surroundings and say what they see and then from there the teacher will go on to describe ecology."

''After all discussions, the teacher and students will watch the video on Nature of Science through the history of Raymond Lindeman."

ii. **Strategies that need to be addressed:** The implementation of ''Ecology and society module'' was handicapped by the nonavailability of ''Foldscope'' which is one of the resources / tools included for use in the module. It's availability will go a long way in making science available and affordable in developing countries like Nigeria.

B. Challenges

i. Many NQTs experienced difficulties with logging on to the Moodle, particularly due to forgetting password and reset, as such majority of the queries on CoP were related to that (Table 5.1).
ii. While assessing the session plans, many of the teachers did not use the template provided for them, rather they developed their session plan without giving due consideration to the UDL principles and HOT skills.
iii. Implementation in schools was a bit challenging as they couldn't incorporate the module in their routine classroom schedule, either the content is not meant for the class they were teaching or not within their termly schedule.
iv. ICT facilities to implement the project in many schools were not available and adequate.
v. Large classroom size was a huge challenge in the implementation, as many NQTs and other teachers had to sample few students for the project.

C. Surprises

i. Surprisingly peer interaction had a positive impact on the NQTs. A great number of the teachers were able to complete their Moodle exercises based on their interaction with NQTs in other schools.
ii. The teachers (both NQTs and TEs) happily mention that the CoP created for this project is the only one of its kind that has given them an opportunity to connect to teachers from various places and share ideas.
iii. Both TEs and NQTs were surprised and amazed that stories could be well incorporated into lesson preparation and classroom implementation.

D. Any changes required in the module design

Many of the Biology NQTs complained that the outline of the module is not in line with the curriculum. Particularly, Unit 2 is too lengthy as a single unit.

"I would have made pollution a different module of its own" (Extracted from teacher's reflection)

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Biology

Introduction to Genetics & Heredity

Authored by:
Dr. Samirah Dahiru Hunkuyi

1. Introduction

Genetics is a branch of biology that have to do with the scientific study of heredity(inheritance) and variation in living organisms. It is the process of transmission of character/traits from parents to offspring in living organisms. Genetics is very useful in many areas of human lives such as in agriculture to improve the quality of crops, increase yield and in animal husbandry. Medically to determine the paternity of a child, for blood transfusion, marriage counselling, development of test tube babies, choosing the sex of a baby and knowing the sex of a baby. Despite the importance of genetics, there are several problems encountered in the teaching and learning of genetics. With the incorporation of technology mediated activities in this module, the module will allow newly qualified teachers (NQTs) to identify, understand and apply the various aspect of genetics during classroom implementation as well as address the various misconceptions students have regarding genetics.

A. Timeline of implementation in the country:

The module starts 14th July 2022 and ends 25th of September 2022

B. Learning objectives

By the end of the module participants will be able to learn and apply the following concepts in their teaching:

i. The importance of genetics in biology
ii. The laws of inheritance
iii. Elaborate and connect terms like chromatin, chromosome, chromatid and gene
iv. Describe the structure and chemical composition of DNA
v. Explain relationship (similarities & differences) between gene, Chromosome and DNA
vi. Differentiate between chromatin, chromosome and chromatid
vii. Explain the causes of variation and inheritance
viii. Explain cloning, selective breeding, and genetic engineering
ix. Describe applications of genetic in farming
x. Learn to integrate technology in teaching, learning and assessment
xi. Experience multiple means of content presentation, activity, assessment and apply in their lessons

C. Number of units:

There are 3 units in the module.

D. Concepts covered:

Concepts covered in the module include;

i. Unit I: Basics of Genetics (introduction to genetics, Chromosome structure, Types of Chromosomes, Chromosome, Gene and DNA structure and chemical composition);
ii. Unit II: Variation and Inheritance (Introduction to concepts of genetic inheritance & variation, Causes of variations,
iii. Unit III: Introduction to concepts of cloning, selective breeding and genetic engineering

E. Resources - activities, readings:

Techniques such as independent reading, hands-on activities, online discussion forum, story-based learning, supplementary videos on certain topics, animated videos, simulation, interactive videos, illustrations, and virtual lab were contextually embedded through the delivery of this module. Students were given topic to study and make presentations independently, hands-on activities like students observing their family photographs and listing prominent traits seen in their parents and themselves. Students were given questions like "is the genetic materials that we have today exactly the same as that of our ancestors? To discuss in the discussion forum. Also students watched different educative videos on development of a child from a cell to an offspring, matching chromosome diagrams with characters, played educational games on structures and parts of a chromosome etc.

F. Nature and purpose of assessments:

The nature of assessment in the module consists of diagnostic, formative, summative and multiple modes of assessment were also developed in the module so as to support higher order thinking and development of metacognitive skills in students.

2. Course completion rate

A. Overall completion

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%			
21 - 40%			
41 - 60%			
61 - 80%			
81 - 100%	5(100%)	15(100%)	20
Total	5	15	20

B. Assessment completion rate

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5(100%)	15(100%)	20
Session plans	5(100%)	15(100%)	20
Reflection	5(100%	15(100%)	20
Post tests	5(100%)	15(100%)	20

3. Time spent on the course platform

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	4(80%)	5(33%)	9
10 to 20	1(20%)	7(47%)	8
21 to 30		3(20%)	3
More than 30			
Total	5	15	20

4. Change from pre- and post- test

Average total score in pre-test____7.07
Average total score in post-test____8.26

The change in teachers performance from pretest to post test is stated as follows:

i. One teacher was novice in pretest and became proficient in post test
ii. Five teachers were emerging in pretest and became proficient in post test
iii. One teacher was emerging in pretest and became accomplished in post test
iv. Ten teachers were proficient in pretest and became accomplished in post test
v. Three teachers were accomplished in pretest and also in post test

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice			1	
	26-50% Emerging			5	1
	51-75% Proficient				10
	76-100% Accomplished				3

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter			12(60%)	8(40%)	20
2. Nature of Science/ Mathematics			13(65%)	7(35%)	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies			12(60%)	8(40%)	20
4. Students' misconceptions & Learning Difficulties			13(65%)	7(35%)	20
5. Representation of the Content			13(65%)	7(35%)	20
6. Context for Learning			12(60%)	8(40%)	20
7. Curriculum knowledge			12(60%)	8(40%)	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion			12(60%)	8(40%)	20
9. Classroom Management			12(60%)	8(40%)	20
10. Assessment			12(60%)	8(40%)	20
Total			123	77	200

A. Subject Matter Knowledge

The mastery of subject matter content by a teacher greatly determines the quality of teaching and learning. The data generated from the lessons plan in this module shows that most of the teachers understood the subject matter deeply and flexibly in such a way that they helped the students to create useful cognitive map, relate one idea to another and address misconceptions. For instant in one of the lessonsplan, the teacher asked the students to come along with a family group picture with atleast 2 or 3 members of the family so as to enable students explore their own genetic inheritance and establish the most common variation in their families. The family pictures were used for observation and realisation of observable traits. The pictures were shared and students were asked to identify the common traits between the parents and their children and among the siblings. And write them down as they observe. Questions below were asked:

i. What are the most common traits between each family members?
ii. Are they any observable similarities or features between members of the same family?
iii. Are they any observable traits between members of different family? what are the reasons for this similarities and differences?

B. Pedagogical Content Knowledge

The pedagogical content knowledge involves teacher competences in delivery of the conceptual approach, relational understanding and adaptive reasoning of the subject matter. Effective pedagogical skills improve the learning environment by improving teaching and learning styles.

In this module, the instructional strategies like watching short videos related to the topic, discussion, collaboration and inquiry methods used by most of the teacher helped students to become independent and strategic learners. It was observed that students participate differently because some are slow learners, the teachers have to use different methods for easy understanding which makes the learners not to be stressed up and instead they were excited about the module and eager to learn. This was observed during the classroom activities, assignments and their general participation. Certain misconceptions were cleared, most l earners thought only humans could be cloned, in such cases videos of cloned animals and pictures was shown to the students by their teachers.

C. General Pedagogical Knowledge

Classrooms were managed properly as most of the lessons were conducted in a well-ventilated and well seated arranged classrooms. Student with special needs were carried along and given more priority. Learners who were below average in the classroom were engaged with their fellow students (with help of the teachers) to help coach them so as they can have a better understanding of the concept and most of the learning outcomes were 80% met.

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	60
Teachers	200
Teacher Educators	85
Research fellow	20
Total	365

B. Frequency of posts

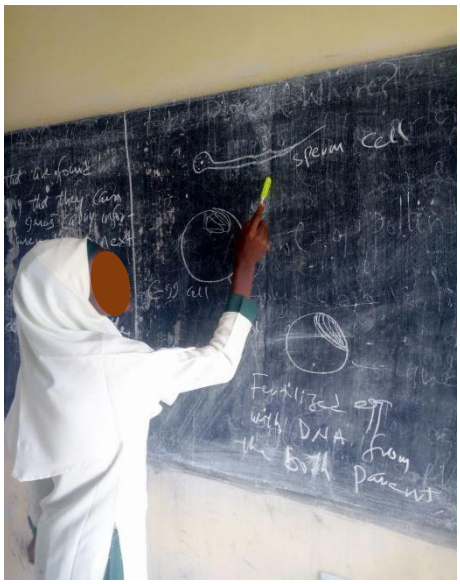
Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	200
UDL	120
Technical	20
Communication/ Administrative	25
Total	365

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	230
Images	130
External Links to other resources	5
Others	
Total	365

C. Qualitative dialogues/ discussion threads



The above examples portrayed the level of teachers and student engagement in the CL4STEM activities right from the NQTs ability to create lesson plans and implementation as well as interaction with students in and out of classroom activities. Teachers from the CoPs biology group list activities that they and the student finds more interesting e.g Students were given opportunity to observe the animal cell and locate chromosomes in the nucleus of the cell.

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

The session went well as it exposes the teachers to technical knowledge of information technology devices. Practical activities in the module and classroom implementation improve greatly the teacher professional competence in the subject.

Learners enjoyed the session. Going forward using videos, pictures, illustrations i.e. technology mediated activities should be an integral part of teaching as it generates attention of learners and they feel in control of the class. There is need to have similar activity and training for teachers in order to improve their competency.

Most of teachers were able to meet the needs of all types of learners. some learners with difficulties in understanding certain terminologies were grouped together with higher IQ learners so that they can help them during group activities and discussions. During activities, every student is carried along as teachers engaged the whole class, gave group work, individual work and also presentations were made.

They were no Socio-economic differences. most learner needs were met, they understood the concept, for those lacking behind, the teachers tried explaining some concepts using the local language.

B. Challenges

From a particular school, the learners enjoyed the first and the last unit, that is introduction to genetics and the genetic engineering part because that is where most of the videos were shown. The second unit was enjoyed the least,which is genetic inheritance unit. For tho se students, the teacher has to use more online interactive videos to make the lesson more interesting to the students.

From another school, the three laws of inheritance is the most challenging part because the students had difficulties assimilating that part but with great effort from the teachers involved using more innovative, the students did their best and participated fully during the whole lessons.

The time allocated for the module should have been increased, because most teachers had to rush a particular session to meet up the timing.

Also the problem of network services in some schools militate the smooth running of the CL4STEM activities.

C. Surprises

The Cop group was very interactive and educative. Yes because everybody was very active and co-orperated well which is very good..

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Chemistry

Atomic Structure

Authored by:
Samira Muhammad Abdullahi, Mutawakkilu Muhammad

1. Introduction

This module aims to increase the pedagogical content knowledge (PCK) of newly qualified chemistry teachers by using open educational resources (OERs) on atomic structure. This module's content will aid teachers' understanding of the atomic structure and associated concepts, as well as their pedagogical knowledge of teaching atomic structure. Aside from the PCK, this module has been designed by incorporating the principles of Universal Design for Learning (UDL) to make chemistry teaching and learning inclusive in order to accommodate the learning needs and abilities of all learners. Similarly, this module emphasizes the use of technology in teaching-learning and assessments.

The course content for this module was created using Bhutan's Science Curriculum Framework for Key Stages III and IV. The module progresses from the historical conception of the ideas of atoms, molecules, elements, and compounds to the formulation of various atomic models, structural components of the atom, atomic number, mass number, isotopes, electronic configurations, and arrangements of elements in the periodic table. Some research-based strategies for addressing common misconceptions among students about the above-mentioned concepts have also been presented. Finally, the module introduces teachers to lesson planning, various interactive modes of assessment, and reflection writing about the lessons taught.

A. Timeline of implementation in the country:

The timeline for the implementation of this module was between 12/09/2022 - 10/10/2022

B. Learning objectives

i. Use open educational resources (OERs) on atomic structure to increase the pedagogical content knowledge of newly qualified chemistry teachers.
ii. Understand the atomic structure and associated concepts, as well as their pedagogical knowledge of teaching atomic structure.

C. Number of units

There are four units in atomic structure module as follows:

i. Unit 1- Introduction to Atom (Four lessons)
ii. Unit 2- Evolution of Atomic models (Eight lessons)
iii. Unit 3- Subatomic particles and Isotopes/Nuclides (Two lessons)
iv. Unit 4- Periodic Table (One lesson)

D. Concepts covered

The concepts covered in this module are concept of atoms, molecules, elements, and compounds to the formulation of various atomic models, structural components of the atom, atomic number, mass number, isotopes, electronic configurations, and arrangements of elements in the periodic table.

E. Resources - activities, readings

Activities: some activities included in this module are –

i. Activity to show gases are made of particles
ii. Give examples of mixtures, elements and compounds
iii. Thermal Decomposition of mercuric oxide, which decomposes into mercury and oxygen.
iv. Preparing a compound ferrous sulphide from its constituent elements iron and sulphur.
v. Think-Draw-Share imaginary atom diagram.
vi. Gathering information on the particulate nature of matter (atomic theory) from sociocultural perspectives.
vii. Create a storyboard about the history of atomic models using Storyboarder, a free mobile app
viii. Apply Pauli's Exclusion Principle in 2s and 2Py orbitals of Oxygen atom.

Readings: some readings included in this module are –

i. Silberberg, Martin, S.. Amateis & Patricia. (2018). Chemistry: The molecular nature of matter. 8th edn. Mcgraw-hill education.
ii. Hill, J. W., McCreary, T. W., Duerst, M. D. & Reuter, R. A.(2020). Hill's chemistry for changing times. 15th edn. Pearson
iii. Lewis, M. and Waller, G. (2012). Thinking Chemistry, Oxford University Press, Oxford, UK.
iv. Chang, R. (2018). Chemistry, International Edition, Mc Graw-Hill Publishing Company, New York.
v. Lewis, M., & waller, G. (1986). Thinking Chemistry. Oxford University Press

F. Nature and purpose of assessments

The nature of assessment was multiple choice question (MCQ) for pretest and posttest exercises. Other forms of activity were also used to assess understanding of concepts covered at the end of the unit and purposely meant to measure the learner's achievement based on the topics discussed like formative and diagnostic assessment.

2. Course completion rate

A. Overall completion

The overall completion rate for the module is given in Table 1, the NQT recorded 4 teachers within the range 81-100 % completion rate while intervention (others) recorded 13 teachers within the range 81-100 % completion. One teacher (1) from intervention (others) recorded completion rate within the range of 21- 40 %. Another teacher (1) from NQT recorded completion rate within the range 41 - 60%. One teacher (1) from intervention (others) recorded completion rate within the range of 1 - 20%.

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%		1	1
21 - 40%		1	1
41 - 60%	1		1
61 - 80%			
81 - 100%	4	13	17
Total	5	15	20

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and Others. All 20 participants (i.e 5 NQTs and 15 others) completed pretest, session plans, posttest tasks and reflection.

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5	15	20
Session plans	5	15	20
Reflection	5	15	20
Post tests	5	15	20

3. Time spent on the course platform

Table 3 shows time spent on moodle platform by participants, two(2) NQTs and nine(9) Others spent less than ten (10) hours. One(1) NQTs participant and three(3) Others spent within the range of 10 - 20 hrs. One(1) NQTs spent within the range 21 - 30 hrs. One(1) NQTs and three(3) others spent above 30 hrs. About 75% participants spend less than 20 hrs on the course while about 25% spend more.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	2	9	11
10 to 20	1	3	4
21 to 30	1	-	1
More than 30	1	3	4
Total	5	15	20

4. Change from pre- and post- test

Average total score in pre-test_7.80
Average total score in post-test_8.35

Pretest data obtained: Nine(9) participants were categorized as Emerging and eleven 11 participants were categorized as Proficient.

For the Post test: Eight (8) participants were categorized as emerging, eleven (11) were Proficient and one (1) became Accomplished.

Regarding the observed changes, nine teachers were classified as Emerging. Among these, four teachers who were categorized as Emerging in both the Pretest and Posttest did not show improvement in their subject matter. On the other hand, five teachers progressed from Emerging to Proficient. Initially, eleven teachers were categorized as Proficient in the Pretest. However, four of them regressed to the Emerging category, and six teachers showed no improvement in their subject matter, remaining Proficient in both the Pretest and Posttest. Additionally, one teacher progressed from Proficient to Accomplished.

None of the participants in the Pretest scored above 75%. Nevertheless, there was an increase in the average scores between the Pretest (7.80) and Posttest (8.35).

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice				
	26-50% Emerging		4	5	
	51-75% Proficient		4	6	1
	76-100% Accomplished				

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	-	4	4	12	20
2. Nature of Science/ Mathematics	-	4	3	13	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	-	1	9	10	20
4. Students' misconceptions & Learning Difficulties	2	4	7	7	20
5. Representation of the Content	4	-	7	9	20
6. Context for Learning	-	5	4	11	20
7. Curriculum knowledge	1	1	10	8	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	-	3	4	13	20
9. Classroom Management	2	1	8	9	20
10. Assessment	-	5	8	7	20
Total	9	28	64	99	200

A. Subject Matter Knowledge

When educators possess a profound grasp of the subject, they can distill the content into essential elements that students can readily understand. Consequently, teachers can choose suitable teaching resources, facilitating a smooth progression in the educational experience.

PREVIOUS KNOWLEDGE: Student have already learnt some basic concept about atoms and their sub atomic particles

INTRODUCTION: Teacher allow the students to recall Bohr's model of atom and that each shell can accommodate only fixed number of electrons

PRESENTATION: The lesson was presented as follows
STEP I: Electron configuration is the arrangements of electrons around the atom of an element. Atoms have shell were electrons reside. each of these shell have sub shell the no. Of sub shell depend on the distance of the shell from the nucleus.
A subshell is a division of electron Shell separated by electron obital in an electron configuration. Subshell are lebelled s,p,d, and f electron.

STEP II: Teacher further explain that subshells into which electrons are distributed are determined by the azimuthal quantum number(l) the azimuthal quantum number is determine by the value of the principal quantum number(n) where n equal to four different subshell (s p d and f) are possible with corresponding to l= 0, l=1, L=2 and l=3
As a result the s,p,d and f subshell can hold the maximum of 2 ,6,10, and 14 electrons respectively.

STEP III: Teacher further explain that the electronic configuration is used to
1. Determine the valency of an element
2. Predict a group of elements properties
3. Interpreting atomic Spectra
Activity: Teacher give the students some few minutes to mention more of the uses of electronic configuration.

From the preceding table, about twelve (12) teachers showed accomplished knowledge of subject matter as indicated in the preceding Table in 5, four (4) of them showed Proficient and four(4) showed Emerging. 13 participants showed accomplished for the nature of science. A teacher highlighted the learning objectives indicating essential concepts to be taught, skills to be developed, "the students are expected to: Describe the subatomic particles of an atom, Describe the atoms of different elements based on their atomic number and mass number, construct atomic isotopes structures and predict the number of protons, neutrons and electrons in a given isotopes or ions, Represent an atom with its electronic configuration.

B. Pedagogical Content Knowledge

Pedagogical content knowledge pertains to a unique form of knowledge that is specific to teachers. It encompasses the skill of educators to integrate their comprehension of instructional techniques (pedagogical knowledge) with their proficiency in the subject they instruct.

***7. The main body of the lesson**	
Time	20 minutes
*Associated LO	The learners should be able to calculate the atomic mass of isotope of chlorine
*Description of the activity/task	Why do we have atom of the same element with the same atomic number but different mass number?
*Main teaching points/ Questions	Two isotopes of chlorine exist in different percentage calculate the relative atomic mass of chlorine

PRESENTATION: the teacher presents the lesson step by step

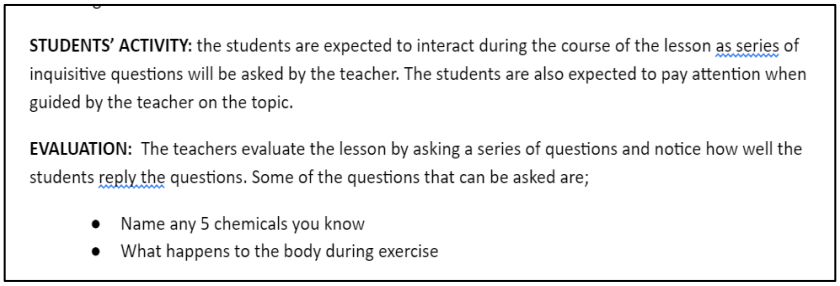
Step 1: the teacher introduces the topic by asking a question like 'what do you understand by chemistry when you look around your environment?', thus creating a brainstorming as well as an interactive session within the learners

Step 2: the teacher then sites examples of some chemical reactions that takes place around us like wood burning creating heat and some chemicals that are in the food we eat, production of shelter etc.....

The following trend was observed for instructional strategies from the preceding table: ten(10) participants showed Accomplished, nine(9) showed Proficient and one(1) showed Emerging. Most teachers were able to identify the main teaching point and clarify terms that are likely to lead to misconception. For example, a teacher asked "What do you understand by the word Atom?" This strategy was intended to stimulate learning by mistake, which is an easy way of identifying misconceptions. Also, 80% of the teachers were at least proficient in representing using multiple modes of text, charts, infographics and among others. 15 participants showed at least Proficient in Context for learning and 18 of the participants showed at least Proficient in Curriculum Knowledge.

C. General Pedagogical Knowledge

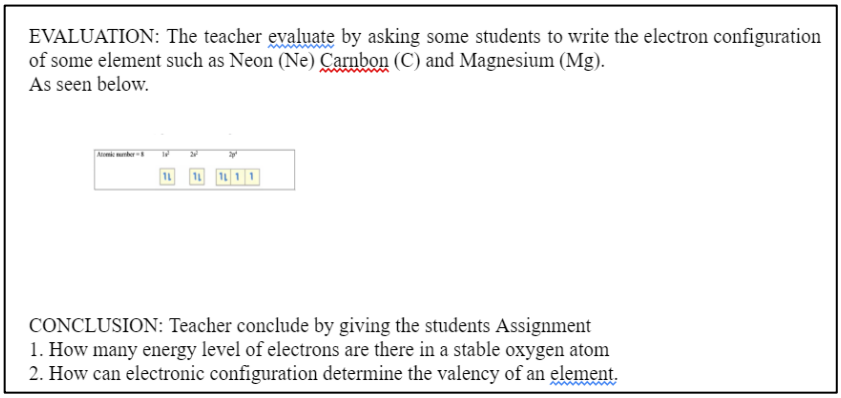
The pattern observed that 13 of the participants showed Accomplished in equity and inclusion, 4 of the participants were Proficient and 3 of them showed Emerging.



STUDENTS' ACTIVITY: the students are expected to interact during the course of the lesson as series of inquisitive questions will be asked by the teacher. The students are also expected to pay attention when guided by the teacher on the topic.

EVALUATION: The teachers evaluate the lesson by asking a series of questions and notice how well the students reply the questions. Some of the questions that can be asked are;

- Name any 5 chemicals you know
- What happens to the body during exercise



EVALUATION: The teacher evaluate by asking some students to write the electron configuration of some element such as Neon (Ne) Carnbon (C) and Magnesium (Mg).
As seen below.

CONCLUSION: Teacher conclude by giving the students Assignment
1. How many energy level of electrons are there in a stable oxygen atom
2. How can electronic configuration determine the valency of an element.

Some schools did not put the issue of equity in gender participation into consideration because the schools were either all girls or all boys schools. For classroom management, some of the participants adopted grouping and disciplinary actions to manage students behaviour and the observation showed that 9 of the participants showed Accomplished, 8 showed were Proficient, 1 showed Emerging and 2 showed Novice. For Assessment, some adopted formative assessment and diagnostic assessment for evaluating students' understanding of the concepts and the observation showed that Seven(7) of the participants showed Accomplished, 8 of them showed Proficient and 5 showed Emerging.

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	64
Teachers	41
Teacher Educators	16
Research fellow	7
Total	118

B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	92
UDL	3
Technical	4
Communication/ Administrative	19
Total	118

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	47
Images	35
External Links to other resources	7
Others	29
Total	118

C. Qualitative dialogues/ discussion threads

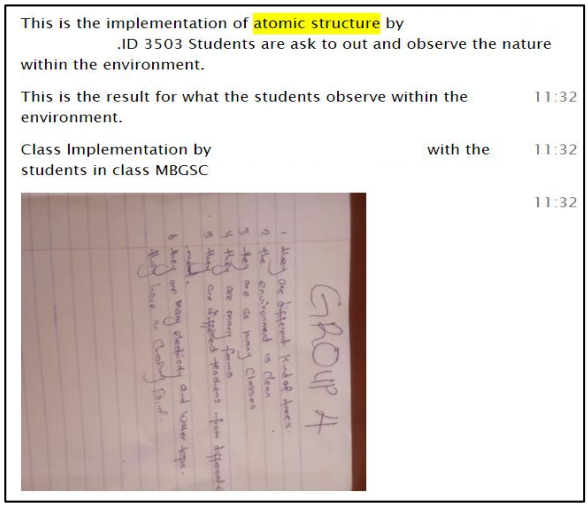


Figure 1: One of the participants posted the implementation method used in the class.

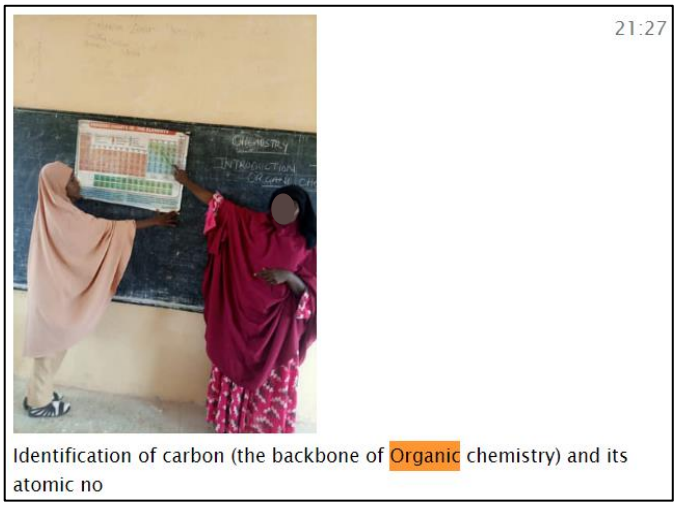


Figure 2: Participants posted images of them using locally available resources like cardboard paper.

Figure 3 and 4: Equity of gender during learning to students.

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

Physical and virtual telegram support aid sharing of ideas and experience between NQT. Images of activities shared by teacher participants on telegram stimulated idea in introducing and teaching the module. Some of these testimonies were captured in reflection on the module written by some of the teachers. For example a teacher wrote "It was interesting and the students got to know the connection between science and nature e.g in the activity where the students use materials around them to construct an atom using different materials to distinguish the subatomic particles."

A. Participation of teachers

Strategies such as asking about nature, group discussions, activities during the learning process really helped because it gives the students a forum to think even though the answer might be wrong but that will help them to recall the concept of the discussed topic.

B. Challenges

The majority of NQT did not use interactive activities like simulations, despite the fact that doing so would have helped them achieve the equity and inclusion principle because it would have helped them teach to a variety of students. Lack of access to necessary IT facilities limits NQT's usage.

C. Any changes required in the module design

It is possible to modify the CoP platform to permit teachers to use a shared platform like WhatsApp. Higher order thinking can be enhanced by a brief offline simulation or video recording of different types of chemical bonding. Since participants couldn't access the current simulations, the simulations can also be made simpler to run on smart devices like smartphones.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Chemistry

Chemical Bonding

Authored by:
Mr. Aliyu Ibrahim

1. Introduction

A. Timeline of implementation in the country

The time for implementation of the chemical bonding module was 4 weeks (14/11/2022 to 12/12/2022)

B. Learning objectives

i. Understand the concept of chemical bonding in terms of "electron transfer" or "electron sharing" , identify various classification of chemical bonding and why atoms bond
ii. Explain the concept of Ionic bonding, understand the formation of ionic bonds/compounds, highlight the properties of ionic bonds/compounds.
iii. Explain the concept of covalent bonding, understand formation of covalent bonds/compounds,
iv. List various forms of covalent bond, give the properties of covalent bonds/compounds
v. Understand concepts of metallic bonding, hydrogen bonding and Van der Waal forces

C. Number of units

The module is made up of four (4) units

i. Chemical bonding
ii. Ionic bonding
iii. Covalent bonding
iv. Other types of bonding

D. Concepts covered :

The concepts covered in this module are chemical bond, Ionic bonding, Covalent bonding and Other types of bonding Bond polarity, chemical bond, coordinate bond, covalent bonding, covalent compound, dipole-dipole forces, double bond, electron affinity, electronegativity, hydrogen bond, interatomic forces, intermolecular forces, Ion-dipole forces, Ionic bonding, Ionic compound, Ionization energy, Lewis's electron dot diagram, London dispersion forces, metallic bonding, nonpolar covalent bond, ordinary covalent bond, oxidation state, polar covalent bonding, single bond, Triple bond, valence electron and Van der Waals forces.

E. Resources

Some of the activities included in this module are

i. Demonstration of an interatomic bond using polystyrene and toothpick
ii. Predict type of intermolecular bond in the compounds given.
iii. Using Venn diagram to explain the role oxidation state in the formation of ionic compounds
iv. Demonstration using attraction between south and north poles of a magnetic bar will be used to explain the attraction between ions in ionic bond

Readings

i. Intermolecular Forces :https://courses.lumenlearning.com/boundless-chemistry/chapter/intermolecular-forces
ii. Lewis, G.N. "The Atom and the Molecule." *Journal of the American Chemical Society* 38 (1916): 762–785
iii. Kohler, R.E., Jr. "The Origin of G.N. Lewis's Theory of the Shared Pair Bond." *Historical Studies in the Physical Sciences* 3 (1971): 342–376
iv. "Chemistry: Chemical Bonds ." Scientific Thought: In Context. . Retrieved January 25, 2022 from Encyclopedia.com:
v. Chemistry: Chemical Bonds | Encyclopedia.comhttps://www.encyclopedia.com/science/science-magazines/chemistry-chemical-bonds
vi. Libretext https://chem.libretexts.org/Courses/Modesto_Junior_College/Chemistry_143_-_Bunag/Chemistry_143__Introductory_Chemistry_(Bunag)/09%3A_Covalent_Bonding/9.16%3A_Van_der_Waals_Forces

F. Nature and purpose of assessments

The nature of assessment was multiple choice question (MCQ) for pretest and posttest exercises. Other forms of activity were also used to assess understanding of concepts covered at the end of the unit.

2. Course completion rate

A. Overall completion

The overall completion rate for the module is given in Table 1, it All the NQT (5) recorded 81-100 % completion rate while intervention (others) 14 participants achieved 81-100 % completion. One teacher from intervention (others) recorded completion rate within the range of 21- 40 %

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%			
21 - 40%		1	1
41 - 60%			
61 - 80%			
81 - 100%	5	14	19
Total	5	15	20

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and others. All 20 participants (i.e 5 NQTs and 15 others) completed pretest, session plans, reflection and post-test task.

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	05 (100 %)	15 (100 %)	20
Session plans	05 (100 %)	13 (86. 7 %)	20
Reflection	05 (100 %)	15 (100 %)	20
Post tests	05 (100 %)	15 (100 %)	20

3. Time spent on the course platform

Table 3 shows time spent on moodle platform by participants, four (4) NQTs and eleven (11) spent less than ten (10) hours. Two (2) participants comprising one each NQTs and other spent within the range of 10 - 20 hrs. Two and one others spent within the ranges of 21-30 hrs and 30 hrs above respectively.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	04 (80 %)	11 (73.3 %)	15
10 to 20	01 (20 %)	01 (6.6 %)	2
21 to 30		02 (13.3 %)	2
More than 30		01 (6.6 %)	1
Total	5	15	20

4. Change from pre- and post- test

Average total score in pre-test: 7.95
Average total score in post-test: 7.70

Pretest data obtained are seven (7) participants scoring 26-50 % (emerging), twelve (12) 51-75 % and one (1) 76-100 % accomplished. For the posttest one (1) participant is a novice, eight (8) are emerging, ten (10) proficient and one (1) accomplished. Movement of participants were observed with one participant each moving from novice to emerging, emerging to novice and emerging to proficient. Two participants dropped from proficient to emerging while fifteen (15) other participants were observed not to have changed. A slight drop was observed between averages of pretest (7.95) and posttest (7.70). The dip in average in posttest is likely due to inability for the participants to spend more time on moodle platform. Over 85 % participants spend less than 20 hrs on the course while less than 15 % spend more. Factors such as inadequate access to computer facilities denied use of other kinematics and simulations embedded in the course content. Most participants failed to critically analyze questions and options for answers for best response as indicated in test scores not varying for pretest and posttest for most of the participants.

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		01 (5 %)		
	26-50% Emerging	01 (5 %)	05 (25 %)	01 (5 %)	
	51-75% Proficient		02 (10 %)	09 (45 %)	
	76-100% Accomplished				01 (5 %)

5. Practice (Session plan and reflection together)

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	0	0	0	20 (100 %)	20
2. Nature of Science/ Mathematics	0	0	06 (30 %)	14 (70 %)	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	0	01 (5 %)	15 (75 %)	04 (20 %)	20
4. Students' misconceptions & Learning Difficulties	0	01 (5 %)	13 (65 %)	06 (30 %)	20
5. Representation of the Content	0	0	16 (80 %)	04 (20 %)	20
6. Context for Learning	05 (25 %)	03 (15 %)	08 (40 %)	04 (20 %)	20
7. Curriculum knowledge	0	0	07 (35 %)	13 (65 %)	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	05 (25 %)	06 (30 %)	05 (25 %)	04 (20 %)	20
9. Classroom Management	06 (30 %)	0	09 (45 %)	05 (25 %)	20
10. Assessment	0	03 (15 %)	12 (60 %)	05 (25 %)	20
Total	16	14	91	79	200

A. Subject Matter Knowledge

All the participants showed accomplished content knowledge as indicated in the preceding Table in 5. A participant highlighted the learning objectives indicating essential concepts to be taught, skills to be developed, "the students are expected to: Understand the concept of chemical bonding. Identify various classification of chemical bonding and why atoms bond. Explain the concept of ionic bonding. Understand the formation of ionic bonds/ compounds. Highlights the properties of ionic bonds/ compounds. Explain the concept of covalent bonding. Understand the formation of covalent bonds/ compounds. List various forms of covalent bond".

B. Pedagogical Content Knowledge

The following trend was observed: 5 % for emerging, 75 % for proficient and 20 % for accomplished for instructional strategies adopted for teaching concepts across the class sessions. Most teachers (above 80 %) were able to identify the main teaching point and clarify terms that are likely to lead to misconception. For example, a teacher wrote "Chemical bonding refers to the process whereby atoms, ions, or molecules attract each other by a force that can hold them together in a substance. The word "bond", as simple as it is, means "anything that holds two or more things together" as the main idea for this module. The teacher defined chemical bonding as "any force of attraction existing between two particles (atoms, ions, or molecules)". This was done to prevent misconception of bond and chemical bond. Another teacher introduced the course by asking students "What do you understand by the word Chemical Bonding?" This strategy was intended to stimulate learning by mistake which an easy way of identifying misconceptions is. Also, about 80 % of the teachers were atleast proficient in representing using multiple modes of text, charts and infographics. But, a few teachers (20 %) used locally available resources for modeling to enhance understanding of difference in main types of bonding. Less than 30 % of participants used life examples to enhance learning of concepts.

C. General Pedagogical Knowledge

The pattern observed was 25 % of the participants were novice and 30 % were emerging. 45 % of the participants were at least proficient in providing equal opportunities to students in learning process. Some school did not put issue of equity in gender participation into consideration because the school were either all girls or all boys' schools. Over 50 % were proficient to accomplished in class management were they adopted such as grouping and disciplinary actions to management students behavior. About 60 % of participants were proficient and adopted formative assessment for evaluating students understanding of the concepts.

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	41
Teachers	81
Teacher Educators	8
Research fellow	5
Total	135

B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	59
UDL	87
Technical	6
Communication/ Administrative	8
Total	160

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	41
Images	107
External Links to other resources	5
Others	7
Total	160

C. Qualitative dialogues/ discussion threads

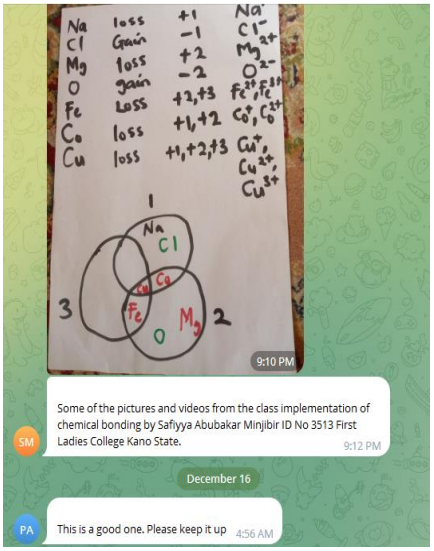


Figure 1: Screenshot of improvised chart from available local resources by participant shared on Telegram CoP

Figure 2: Screenshot of group of learning as evidence of good class management and ensuring equity and inclusion in learning by participant shared on Telegram CoP

Figure 3: Screenshot of group of students in active learning (UDL) ensuring equity and inclusion in learning by participant shared on Telegram CoP followed by encouragement teacher educator

Figure 4: Screenshot of a teacher in active knowledge transfer to group of students

Figure 5: Screenshot of group of students implementing knowledge acquired from teacher by participant shared on Telegram CoP

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

Physical and virtual telegram support aid sharing of ideas and experience between NQT. Images of activities shared by teacher participants on telegram stimulated idea in introducing and teaching the module. Some of these testimonies were captured in reflection on the module written by some of the teachers. For example a teacher wrote that students enjoyed concepts such as "Lewi's electron dot Structure and factors influencing formation of chemical bonds".

Activities such as demonstration of an interatomic bond using polystyrene and toothpick, venn diagram to explain the role oxidation state in the formation of ionic compounds and demonstration using magnetic bar were effective.

B. Challenges:

Activities using interactive medium such as simulations were not used by most NQT while its usage will have been effective in achieving equity and inclusion principle as it will aid teaching in a diverse audience. NQT inability to access required IT facilities limit it uses.

C. Surprises

Participants relied on informal contacts such as voice calls and private messages to core educators and to other participants to discuss on treads and share idea. Also, most participants claimed not to find Telegram user friendly were not use. This reduced the engagement of participant CoP platform.

D. Any changes required in the module design

CoP platform can be amended to allow teachers use common platform such as WhatsApp. Light offline or video recording of simulation of various forms of chemical bonding can improve higher thinking order thinking. Also, the simulations can be simplified to work on smart devices such as mobile phones since participants were unable to get view current simulations.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pretest and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and posttest surveys
6. Telegram CoP group data download for the during of the module

Subject : Chemistry

Organic Chemistry

Authored by:
Dr. Sarah Victor Usman

1. Introduction

The history of organic chemistry can be traced back to ancient times when physicians extracted chemicals from plants and animals to treat members of their tribes. They didn't label their work as "organic chemistry", but they simply kept records of the useful properties and different things they used, such as moringa tree which is sometimes called a 'miracle tree' because all its parts are used for nutritional and pharmacological properties. It was known by then that minerals, plants and animals are the three major sources of useful substances.

Students are expected to have prior knowledge of names of various common items they come across in daily life, for instance 'organic fertilizer', 'organic tea', 'organic coffee', 'organic manure' and the like. Students often think that the word "organic" means natural. The word "organic" is often associated with being natural, which stems from the notion of organic produce grown naturally without the use of pesticides.

Clarification: In chemistry, the term "organic" means carbon-based. Thus, organic chemistry is the study of carbon-based compounds, which includes both natural and synthetic compounds.

A. Timeline Of Implementation:

04th July,2022 To 15th August, 2022(

B. Learning Objectives:

UNIT 1: Introduction to Organic Chemistry

After covering this unit, the learners are expected to:

i. Explain the meaning of the word 'organic' as it is used in chemistry context as opposed to the use of the same word in other contexts.
ii. Explain correctly the meaning of organic chemistry.
iii. Describe correctly the origin of organic compounds.
iv. Differentiate organic compounds which are natural in origin from those which are synthetic in origin.
v. Explain and give examples of organic compounds with dual sources; that is, those which can be obtained naturally and at the same time be synthesized in the laboratory.
vi. Distinguish between organic compounds and inorganic compounds.
vii. Explain the importance of organic chemistry in life.

UNIT2: HYDROCARBONS

After covering this unit, the learners should be able to do the following:

i. Describe the meaning of hydrocarbons
ii. Distinguish hydrocarbons from other types of organic compounds
iii. Explain the uses of hydrocarbons in everyday life
iv. Explain problems associated with the use of hydrocarbons
v. Identify the two major classes of hydrocarbons
vi. Explain the concept of saturated and unsaturated hydrocarbons
vii. Distinguish between the saturated and unsaturated hydrocarbons
viii. Write general formulas of alkanes, alkenes and alkynes
ix. Explain the meaning of homologous series

x. Explain the meaning of functional group
xi. Describe the characteristics of a homologous series
xii. Understand the general IUPAC vocabulary and rules for naming organic compounds.
xiii. Use the IUPAC system to name the alkanes and cycloalkanes.
xiv. Use the IUPAC system to name the alkenes and alkynes.
xv. Apply a general formula to identify the families of hydrocarbons
xvi. Explain the concept isomerism
xvii. Write structural formula of isomers of hydrocarbons up to five carbon atoms

UNIT 3: PROPERTIES OF HYDROCARBONS

After covering this unit, the learners should be able to do the following:

i. Describe the physical properties of lower hydrocarbons.
ii. Compare the physical properties of alkanes, alkenes and alkynes.
iii. Explain the reasons for variation in physical properties of the hydrocarbons.
iv. Compare the chemical properties of saturated and unsaturated hydrocarbons.
v. List the chemical reactions undergone by saturated hydrocarbons and those undergone by unsaturated hydrocarbons
vi. Describe various chemical properties of alkanes, alkenes and alkynes.
vii. Describe the process of preparing lower hydrocarbons (alkane, alkenes and alkynes)
viii. Demonstrate the preparation of lower alkanes, alkenes and alkynes.
ix. Outline the process of purification of organic compounds
x. Describe the application of purification of organic compounds in day to day life.
xi. Describe the fractional distillation of crude oil

UNIT 4: COURSE EVALUATION

i. Pre- Test
ii. Lesson Plans
iii. Reflection Assessment
iv. Post Test

C. Number Of Units: 4

D. Concepts Covered:

i. Unit 1: Introduction to Organic Chemistry – Meaning of Organic Chemistry, Origin of Organic Compounds, Distinction between Organic and Inorganic Compounds, Importance of Organic Chemistry in Life.
ii. UNIT 2: HYDROCARBONS –Understanding the Hydrocarbons, Classification of Hydrocarbons, Homologous Series, Nomenclature and Isomerism.
iii. UNIT 3: PROPERTIES OF HYDROCARBONS – Physical Properties of Hydrocarbons, Chemical Properties of Hydrocarbons, Preparation of the Hydrocarbons and Purification of Hydrocarbons.

E. Resources – Activities and Readings:

https://www.google.com/search?q=organic%20cartoon&tbm=isch&hl=en&chips=q:organic%20cartoons%2Cg_1:organic%20food:txvaZi6mqsM%3D&tbs=il:cl&sa=X&ved=0CAAQ1vwEahcKEwiAoYzyyPD1AhUAAAAAHQAAAAAQDg&biw=1583&bih=757#imgrc=PsVNwBVmUm41DM

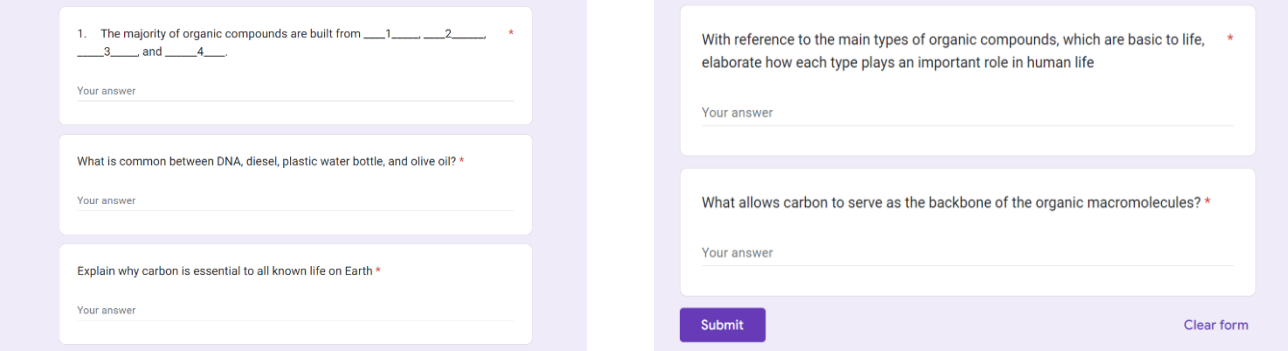


Figure 1.1: Self-assessment from the module

Resources links:

https://chem.libretexts.org/Courses/University_of_South_Carolina_Upstate/USC_Upstate%3A_CHEM_U109_-_Chemistry_of_Living_Things_(Mueller)/11%3A_Organic_Chemistry/11.01_Organic_Chemistry

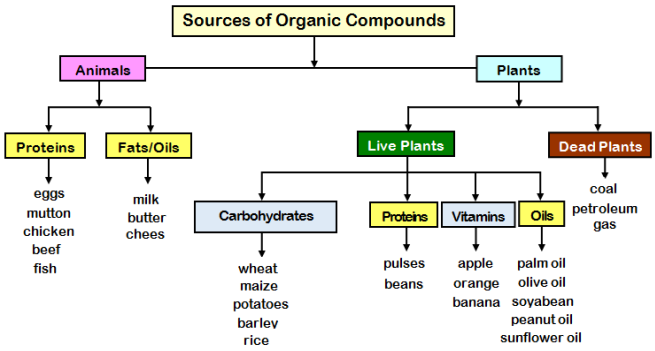


Figure 1.2: Sources of Organic Compounds

F. Nature And Purpose Of Assessments:

Nature: Activity Based

Purpose:

i. To develop Higher Order Thinking with Inclusion and Equity(HOTIE)

ii. To establish a Universal Design of Learning, amongst others.

2. Course completion rate

A. Overall completion

The overall completion rate is given in Table 1 (below). More than 85%(13 out of 15) of teachers from the intervention groups recorded completion rate within the range 81 - 100 % from the module and 60%(3 out of 5) of teachers from NQTs recorded completion rate within the rate 81 - 100% from the module.

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%			
21 - 40%	1		1
41 - 60%		1	1
61 - 80%	1	1	2
81 - 100%	3	13	16
Total	5	15	20

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and Others. All 20 participants (i.e 5 NQTs and 15 others) completed pretest, session plans, reflection and posttest tasks.

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5(100%)	15(100%)	20
Session plans	5(100%)	15(100%)	20
Reflection	5(100%)	15(100%)	20
Post tests	5(100%)	15(100%)	20

3. Time spent on the course platform

Most teachers spent less than 10 hours, in particular about one (1) of the teachers from NQTs and eight(8) from the intervention groups. Two(2) teachers from NQTs and four(4) from intervention groups Others spent between 10 - 20 hours, One (1) NQTs and two(2) teachers from intervention groups Others spent between 21 - 30 hours and One(1) teacher each from both categories spent more than 30 hours. This demonstrates that most teachers, about 75%, spent less than 20 hours.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	1	8	9
10 to 20	2	4	6
21 to 30	2	1	3
More than 30		2	2
Total	5	15	20

4. Change from pre- and post- test

Average total score in pre-test__6.90
Average total score in post-test_7.60

In terms of change observed, one(1) of the teachers who was categorized as Novice based on their pretest score have progressed to the emerging category due to their post test assessment. Six(6) of the teachers who were categorized as Emerging for Pre test have not improved as they are still categorized as Emerging after Post test. Furthermore, two(2) teachers who were categorized as Emerging for Pre test progressed to Proficient for the Post test and one(1) progressed to Accomplished from Proficient after post test. However, five(5) other teachers have regressed from Proficient to Emerging. Also, the pre and post-data indicated that five (5) teachers have not improved in their subject matter knowledge as they were categorized as Proficient in both tests.

None of the teachers from the Pretest score above 75%. However, there is an increase between averages of pretest (6.90) and posttest (7.60).

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		1		
	26-50% Emerging		6	2	1
	51-75% Proficient		5	5	
	76-100% Accomplished				

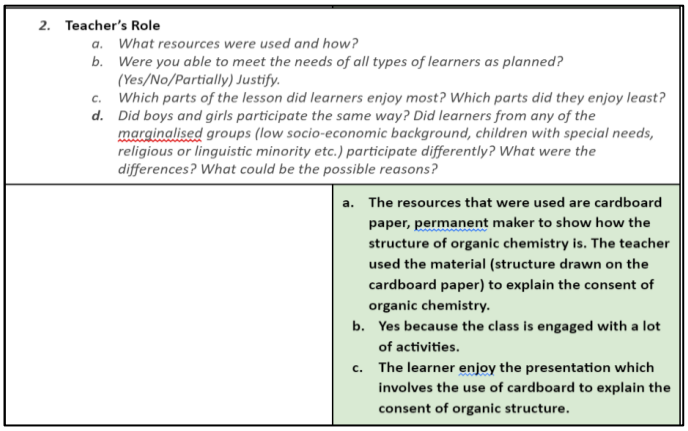
5. Practice (Session plan and reflection together)

Table 5

	Number of teachers				Total
Criteria	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter		5	5	10	20
2. Nature of Science/ Mathematics		5	8	7	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	2	1	12	5	20
4. Students' misconceptions & Learning Difficulties	4	7	3	6	20
5. Representation of the Content	8	4	5	3	20
6. Context for Learning	1	12	4	3	20
7. Curriculum knowledge	1	1	14	4	
C. General Pedagogical Knowledge					
8. Equity and Inclusion	3	2	7	8	20
9. Classroom Management		3	10	7	20
10. Assessment		10	5	5	20
Total	19	50	73	58	200

A. Subject Matter Knowledge

The Subject Matter Knowledge is key here because it is the knowledge in the discipline taught by a teacher. It often includes an understanding about how the discipline progresses along with what is known within the discipline. These areas intertwined as inquiries are made, there is an advancement of knowledge. This is very important as it helps the teacher to teach based on current standards which require the understanding of subject matter deeply and flexibly as well as help students create useful cognitive images, relate one idea to another and also address misconceptions. For example a teacher wrote: The Aliphatic compounds are straight chains or branched chains of carbon atoms. These are also divided into two; Acyclic and Cyclic. For example, propane and cyclopropane".



2. **Teacher's Role**
   a. *What resources were used and how?*
   b. *Were you able to meet the needs of all types of learners as planned? (Yes/No/Partially) Justify.*
   c. *Which parts of the lesson did learners enjoy most? Which parts did they enjoy least?*
   d. *Did boys and girls participate the same way? Did learners from any of the marginalised groups (low socio-economic background, children with special needs, religious or linguistic minority etc.) participate differently? What were the differences? What could be the possible reasons?*

a. **The resources that were used are cardboard paper, permanent maker to show how the structure of organic chemistry is. The teacher used the material (structure drawn on the cardboard paper) to explain the consent of organic chemistry.**
b. **Yes because the class is engaged with a lot of activities.**
c. **The learner enjoy the presentation which involves the use of cardboard to explain the consent of organic structure.**

Figure 1

For the knowledge of subject matter and Nature of science, about 15 teacher indicated from the preceding table showed Proficient and accomplished for each categories.

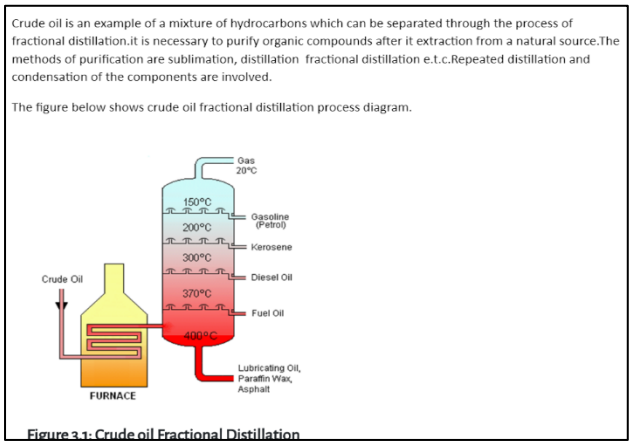


Figure 2: Lesson plan by one of the teachers

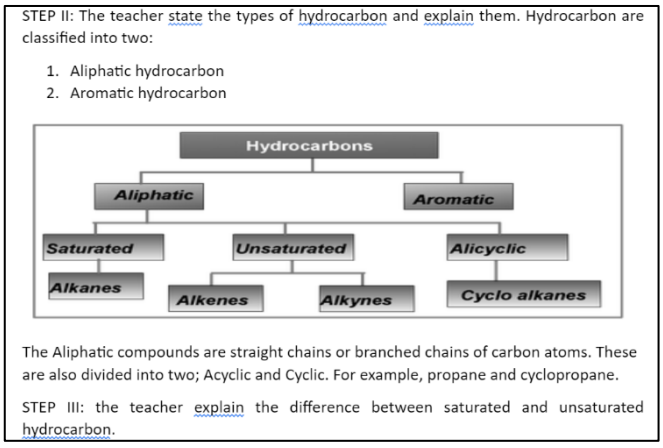


Figure 3: Lesson plan by a teacher

B. Pedagogical Content Knowledge

The pedagogical Content Knowledge framework describes the kinds of knowledge required by teachers for the successful integration of technology in teaching. It suggests that teachers need to know the interconnection between technology, pedagogy and content. Content refers to areas of learning and the knowledge within those areas. The Pedagogical content knowledge has to do with the organization and use of knowledge in regards to instructional strategies employed by teachers which should help check learners understanding to facilitate higher order thinking by using multiple ways of engaging learners with the resources.

From the preceding table, 17 teachers showed proficient and accomplished in instructional strategies criteria. At least 9 teachers showed proficient and accomplished in Students' misconceptions & Learning Difficulties criteria, 8 showed proficient and accomplished in Representation of the Content, 7 showed proficient and accomplished in Context for Learning criteria and 18 showed proficient and accomplished in Curriculum knowledge.

a) *The key concept was to correctly define organic and inorganic as used in chemistry as oppose to the use of the same word in other context. Their misconceptions was clarify.*
b) *I assessed the class by asking them my learning objective questions and also giving them assignment to see their feedback. 80%*
c) *I had challenge with the absentees. Those that were not frequently in school. I had some particular students that were absent from school when we treated the topic 'carbon and its compound'. I have plan to organize an extra class with them to revisit the topic 'carbon and its compound' if and only if they will attend and willing to learn.*
d) *One of my learner have the misconception that organic is 'God made' while inorganic is 'man made'*

Figure 5: Reflection from a teacher

INTRODUCTION: Physical properties are those properties of matter which can be observed to measured without changing the composition of matter. They are used to observe and describe matter.

1. Does the mass and structure of a molecule influence its physical properties? If yes how? Yes, because the shape of a molecule has a lot to do with the polarity of the compound.
2. List any two physical properties of matter you know base on the previous learning on matter?

In this lesson we are going to discuss or learn the physical properties of the lower saturated and unsaturated hydrocarbon and we are going to consider the boiling point, melting point, density and the physical. Other physical properties of hydrocarbons include polarity, color and odors but typically hydrocarbons are colorless gases that have very weak odors.

PRESENTATION:

STEP I: The discuss with the learners that Alkanes have relatively predictable physical properties and undergo relatively few chemical reactions other than combustion, they serve as a basis of comparison for the properties of many other organic compound families.

Melting point and boiling point are characteristics physical properties, that depend on the length of the carbon chain. Note that the first four members of the alkane series are gases at ordinary temperatures, whereas those with five to ten carbon atoms are liquids.

Figure 6: Reflection from a teacher

C. General Pedagogical Knowledge

General Pedagogical Knowledge is a crucial prerequisite for effective teaching. It refers to the specialised knowledge of teachers for creating effective teaching and learning environments for all students. This could be knowledge about the educational aims and contexts, students, learning, evaluation as well as knowledge about principles and strategies of classroom management and organization. It also includes how a teacher can design engaging classroom environments that permit maximum student activity and self regulation. The data generated on this theme indicate that equity and inclusion was taken into consideration based on the abilities of the teachers to use multiple means of engagement, representation, action and expression for creating learning experiences that met the needs of diverse learners. They were able to manage time and space effectively. The teachers also use multiple modes of assessments to support higher order thinking and foster the development of metacognitive skills.

From the preceding table, at least 15 teachers showed proficient and accomplished in Equity and Inclusion, 17 teachers also showed proficient and accomplished in Classroom Management and at least 10 teachers showed proficient and accomplished in Assessment.

1. **Learning Space / Classroom** a. *Where was the class taking place?* b. *How was the class furniture organised?*	
	A. The learning space was big enough to contain the students. The class took place in SS3 classroom. B. The class furniture was facing the board for when the teacher is explaining using charts , but later the learners did the lesson in groups ,where for each group ,a picture or video was shown.

Figure 7: One of the teacher's reflections

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	41
Teachers	180
Teacher Educators	81
Research fellow	23
Total	325

B. Frequency of posts

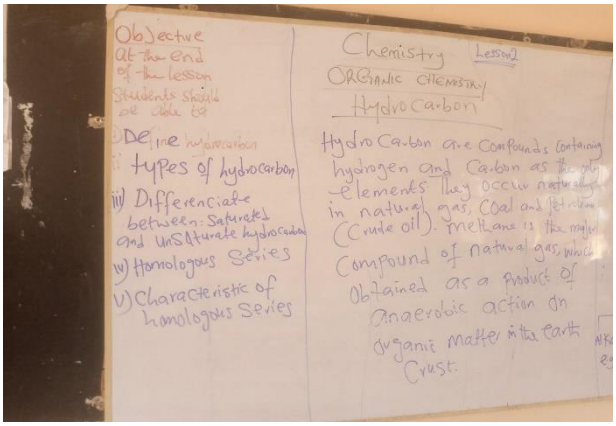
Table 5.1:Frequency of posts by content

Type of Posts	Number of posts
PCK	104
UDL	54
Technical	12
Communication/ Administrative	155
Total	325

Table 5.2 :Frequency of posts by type

Type of post	Number of posts
Text only	155
Images	114
External Links to other resources	12
Others	44
Total	325

Example of PCK



C. Qualitative dialogues/ discussion threads

teaching second lesson with the students, the topic hydrocarbon,typs of hydrocarbon.difference between saturated and unsaturated hydrocarbon and homologous series.

Sample photos during the implementation of Introduction to organic chemistry at GSS Makera, Kakuri. Kaduna by

Class session on introduction to organic Chemistry with SS2 students of Federal Government College kano

Separation Techniques (Below)

i. Filtration took place to separate undissolved substance (chalk dust) from water in the school.

ii. Separating funnel methods also took place where two immiscible liquids (kerosene and water) were mixed and finally separated using separating funnel.

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

The teachers actively participated on all the activities scheduled from the pilot study of the project, module launched / workshop, which exposed the teachers to the technical aspect of the module.

The module implementation improved their professional competence in the subject module.

B. Challenges

Some of the major challenges encountered include, but are not limited to: Network – connectivity problems and poor gadgets, Power (Electricity) supply – not regular, Technical difficulties, High data consumption, Smart phones required and Expensive gadgets – Broad band / high speed internet access.

C. Surprises

The most surprising and impressive fact witnessed during the course of this project is the speed and willingness of the teachers to grasp and adapt to the technical aspect of the project including the use of social media platforms they were not previously accustomed to, all within the stipulated time frame.

D. Any changes required in the module design:

No.

Data Sources Used

1. Moodle completion rate raw data (in CSV or Excel format)
2. Moodle time spent raw data (in CSV or Excel format)
3. Teacher pre test and post test data (in CSV or Excel format)
4. All teachers' lesson plans and reflections (3 lesson plan per module per teacher, and 1 reflection per module per teacher)
5. Teachers' responses for the pre and post test surveys (in CSV/Excel format)
6. Telegram CoP group data download for the during of the module (in CSV or Excel format from subject specific Telegram group

Subject : Physics

Force and Motion

Authored by:
Mr. Yusuf Abdullahi

1. Introduction

This module introduces teachers to the concept of force and motion. Concepts covered include motion, graphical representation, forces and their types and Newtons law of motion.

A. Timeline of implementation:

6 weeks (10/09/2022 – 14/11/2022)

B. Learning objectives:

Learners should be able to:

i. explain concept of motion and it relation to distance and time
ii. discuss motion
iii. sketch and describe position/time and distance/time graphs and interpret them
iv. explain; meaning of force, effects of force & different types of force
v. state Newton's first, second & third laws of motion: demonstrate simple experiments to discuss Newton's laws of motion
vi. apply formulae to solve problems based on Newton's laws of motion

C. Number of units:

(4) four

D. Concepts covered:

i. Motion
ii. Graphical Representation of Motion
iii. Forces and their Types
iv. Newton's Laws of Motion

E. Resources - activities, readings :

Open Educational Resources: CL4STEM Module & Laboratory Experiments and Classroom Demonstrations

F. Nature and purpose of assessments :

Formative and summative assessment to assess the impact of the module on teaching and learning of the concepts.

2. Course completion rate

A. Overall completion

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%			
21 - 40%		01(5%)	01 (5%)
41 - 60%		02 (10%)	02 (10%)
61 - 80%		01 (5%)	01 (5%)
81 - 100%	05(10%)	11 (5%)	16 (80%)
Total	05 (25%)	15 (75%)	20 (100%)

B. Assessment completion rate

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	05 (25%)	15 (75%)	20 (100%)
Session plans	05 (25%)	15 (75%)	20 (100%)
Reflection	05 (25%)	15 (75%)	20 (100%)
Post tests	05 (25%)	15 (75%)	20 (100%)

3. Time spent on the course platform

Table 3 displays the duration of time that participants dedicated to the Moodle platform. The focus group consisted of five (5) teachers referred to as NQTs, while the remaining 15 teachers were part of the intervention group. Among the NQTs, three (3) teachers spent less than 10 hours, one (1) teacher spent between 21 and 30 hours, and one (1) teacher spent more than 30 hours on the platform. Regarding the intervention group, ten (10) teachers spent less than 10 hours, two (2) teachers spent between 10 and 20 hours, and three (3) teachers spent between 21 and 30 hours on the platform.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	03 (15%)	10 (50%)	13 (65%)
10 to 20		02 (10%)	02 (10%)
21 to 30	01 (5%)	03 (15%)	04 (20%)
More than 30	01 (5%)		01 (5%)
Total	05 (25%)	15 (75%)	20 (100%)

4. Pre and Post Tests Average Scores

Average total score in pre-test__6.95
Average total score in post-test__6.95

Pre-Test:

i. Among the teachers who took the pre-test, 3 teachers were evaluated to be Novices indicating they demonstrated 0-25% proficiency.
ii. Seven (7) teachers were categorized as Emerging.
iii. Nine (9) were categorized as Proficient and lastly, one was categorized as Accomplished.

Post-test:

i. After the post-test, 3 Novices progressed, with 2 Novices progressing to becoming Emerging and 1 Novice progressed to become Proficient respectively.
ii. Four (4) of the Emerging did not change turning out to be Emerging after post-test.
iii. Seven (7) previously Proficient teachers regressed to Emerging.
iv. Two (2) and one (1) Emerging teacher progressed to becoming Proficient and Accomplished respectively.
v. One (1) Proficient remained the same and One (1) became Accomplished.
vi. And lastly, one (1) Accomplished teacher dropped to Emerging at post-test.

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		2 (10%)	1 (5%)	
	26-50% Emerging		4 (20%)	2 (10%)	1 (5%)
	51-75% Proficient		7 (35%)	1 (5%)	1 (5%)
	76-100% Accomplished		1 (5%)		

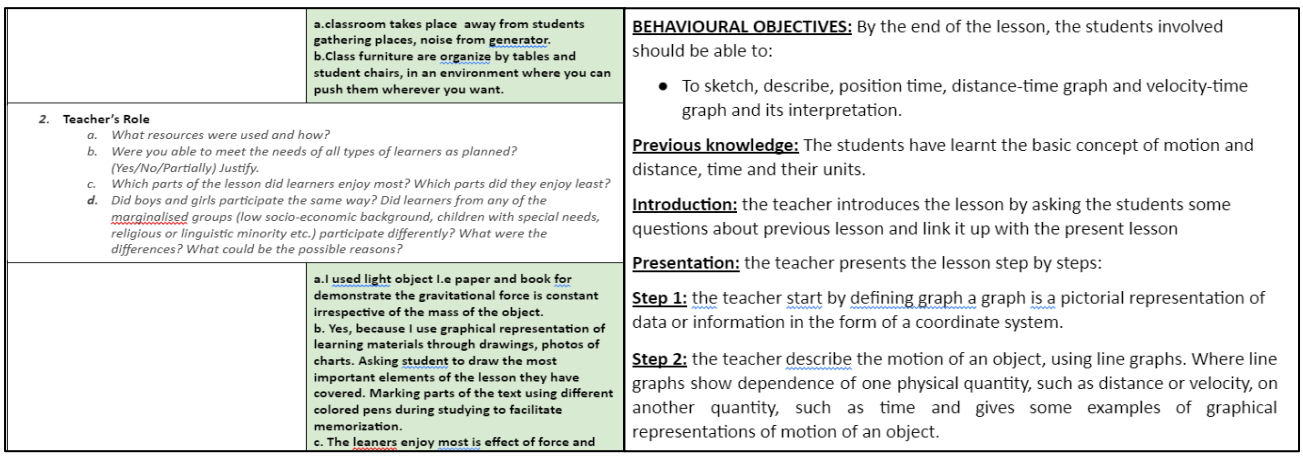
5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter		5	10	5	20
2. Nature of Science/ Mathematics		7	10	3	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies		8	10	2	20
4. Students' misconceptions & Learning Difficulties	1	6	12	1	20
5. Representation of the Content	2	3	11	4	20
6. Context for Learning		2	13	5	20
7. Curriculum knowledge		1	16	3	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	1		19		20
9. Classroom Management			17	3	20
10. Assessment	1	1	15	3	20
Total	5	33	133	29	200

A. Subject Matter Knowledge:

When teachers have a deep understanding of the subject matter, they have the ability to condense the topic into key points that are easily comprehensible for the students. As a result, teachers can select appropriate instructional materials, ensuring a seamless flow in the teaching and learning process. For example, let's consider a teacher who is attempting to explain the connection between force and motion to their students.



a.classroom takes place away from students gathering places, noise from generator.
b.Class furniture are organize by tables and student chairs, in an environment where you can push them wherever you want.

2. **Teacher's Role**
   a. *What resources were used and how?*
   b. *Were you able to meet the needs of all types of learners as planned? (Yes/No/Partially) Justify.*
   c. *Which parts of the lesson did learners enjoy most? Which parts did they enjoy least?*
   d. *Did boys and girls participate the same way? Did learners from any of the marginalised groups (low socio-economic background, children with special needs, religious or linguistic minority etc.) participate differently? What were the differences? What could be the possible reasons?*

a.I used light object I.e paper and book for demonstrate the gravitational force is constant irrespective of the mass of the object.
b. Yes, because I use graphical representation of learning materials through drawings, photos of charts. Asking student to draw the most important elements of the lesson they have covered. Marking parts of the text using different colored pens during studying to facilitate memorization.
c. The leaners enjoy most is effect of force and

BEHAVIOURAL OBJECTIVES: By the end of the lesson, the students involved should be able to:

- To sketch, describe, position time, distance-time graph and velocity-time graph and its interpretation.

Previous knowledge: The students have learnt the basic concept of motion and distance, time and their units.

Introduction: the teacher introduces the lesson by asking the students some questions about previous lesson and link it up with the present lesson

Presentation: the teacher presents the lesson step by steps:

Step 1: the teacher start by defining graph a graph is a pictorial representation of data or information in the form of a coordinate system.

Step 2: the teacher describe the motion of an object, using line graphs. Where line graphs show dependence of one physical quantity, such as distance or velocity, on another quantity, such as time and gives some examples of graphical representations of motion of an object.

B. Pedagogical Content Knowledge

Pedagogical content knowledge refers to a specific type of knowledge that is exclusive to educators. It involves the ability of teachers to connect their understanding of teaching methods (pedagogical knowledge) with their expertise in the subject matter they teach. Here is a snapshot from a video: the teacher is instructing the students to illustrate the concepts of force, and motion through Newton's Law of motion, which they successfully execute. By employing this approach, any misconceptions can be easily identified and effectively addressed.




MODULE IMPLEMENTATION OF FORCE AND MOTION AT GGC GEZAWA KANO ID NUMBER 3313

Above is a student implementing the Newton's law of motion.

C. General Pedagogical Knowledge

General pedagogical knowledge encompasses the broad understanding of principles and strategies related to classroom management and organization across various subjects. Pedagogical approaches can be categorized into five main types: constructivist, collaborative, reflective, integrative, and inquiry based. The image provided depicts the incorporation of constructive, collaborative, and integrative approaches in the learning process among students.



Presentation: The teacher present his lesson by using the following step:

STEP I: The teacher explain the topic by correctiing the misconceptions of the students about motion

STEP II: The teacher lead the students to identify the causes of motiins in their environment

III: The teacher guide the students to identify types of motion and their examples

Formative assessment: The teacher solve questions together with the students & the student ask question where they are lost

Association (LO) The teacher called out some of the students to demonstrate and explain some concepts written on the chalkboard.

Evaluation: The teacher evaluate the lesson based on the topic taught

Summary: The teacher summaries what is written on the chalkboard

Conclusion: The teacher conclude the lesson by given them assignment

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	49
Teachers	12
Teacher Educators	6
Research fellow	6
Total	73

B. Frequency of posts

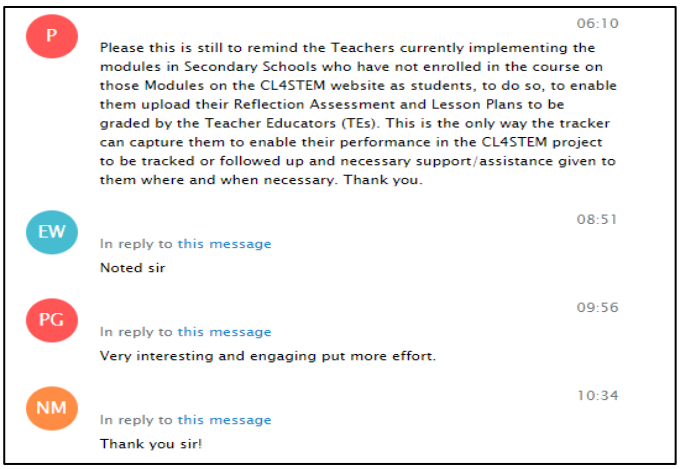
Table 7.1: Frequency of posts by content

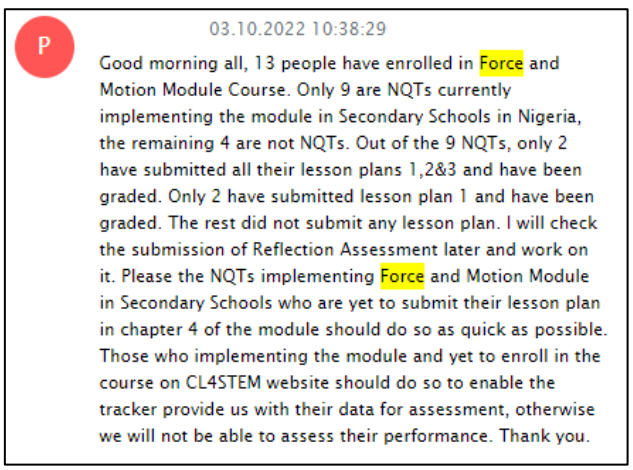
Type of Posts	Number of posts
PCK	21
UDL	3
Technical	4
Communication/ Administrative	34
Total	62

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	109
Images	253
External Links to other resources	8
Others	0
Total	370

C. Qualitative dialogues/ discussion threads





Class implementation on FORCE AND MOTION of lesson 1.1 FRAME OF REFERENCE. Discussion on video clips watched from CL4STEM physics modules in the class

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers:

The teachers participated satisfactorily bearing in mind that the teachers used ICT tools in the implementation module, their competency in utilization of ICT tools as well as provision of adequate ICT facilities are some of the ways to improve their performance. The practicals were performed by the teachers to the best of their ability as shown by the screenshot above and were excited to be using ICT facilities to teach.

B. Challenges:

Time constraints and lack of adequate ICT skills and facilities by the NQTs were the major challenges of module implementation.

C. Surprises:

The use of digital tools for interactions on CoP and in implementing the module in the classrooms were the major surprises for some NQTs being the first time to use ICT in teaching and interactions with colleagues far from them, especially on telegram. Also, Yes, there were surprises because some of the teachers were being introduced to using ICT to teach for the first time and were excited

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Physics

Work, Energy and Power

Authored by:
Dr. Jibrin Yabagi, Dr. Idris Kawo

1. Introduction

Energy is a word that teachers and students frequently encounter and use in day to day activities. Students often associate energy with phenomena such as force, motion, heat and electricity, but sound or light are often not seen by students to be forms of energy at all. For some students, energy is primarily associated with animals or humans; they see that only animals or humans can have energy. In addition, students are familiar with energy being purchased in the form of petrol or electrical energy to be used by cars or household appliances. Students know that we produce heat in our homes by burning wood or using electricity, but they often do not recognise that the energy has been transformed by the appliance into several other forms of energy (motion, heat, sound and light energy). These examples show that the meanings students have developed for the word 'energy' are less precise and more restricted than the way it is used in Physics. Therefore, the module discussed the scientific meaning of energy, different forms of energy, states of energy and differences between potential energy and kinetic energy.

A. Timeline of implementation:

4/07/2022 - 15th/08/2022

B. Learning objectives:

Learners should be able to:

i. Explain the meaning of energy in the context of Physics
ii. Identify and describe different forms of energy in real world scenarios
iii. Differentiate between potential energy and kinetic energy
iv. Identify contents from this lesson that you can use to teach the concept of energy in Physics in your class
v. Use recommended resources to help students to link between energy in daily life and energy in physics
vi. State the principle of conservation of energy
vii. Explain the meaning of energy transformation
viii. Describe real life examples of how energy is converted from one form to another
ix. Identify contents from this lesson that can be used as a resource in teaching your class
x. Explain, scientifically, the meaning of mechanical work done
xi. Write and interpret the formula for calculating mechanical work done
xii. Convert SI unit of work to different related units (xiii) Classify and explain common mistakes committed by students when solving mechanical work numerical problems
xiii. Identify the contents from this lesson that can be used a resource when teaching mechanical work done in your class
xiv. Explain the meaning of electrical energy and provide real life examples
xv. Derive different formulas for calculating electrical energy
xvi. Classify and explain different mistakes committed by students when solving numerical problems related to electrical energy
xvii. Identify contents from this lesson that can be used as a resource to teach work done by electrical energy in your class.
xviii. Explain properly the differences between energy, heat and temperature
xix. Describe the meaning and importance of thermal energy
xx. Classify and elaborate various errors committed by students when solving numerical problems related to thermal energy equation
xxi. Identify contents from this lesson that can be used a resource to teach thermal energy topic in your class

xxii. Explain the meaning and cause of heating effect of electric current (xxiv) Derive the equation for calculating the amount of heat produced in a conductor by electric current
xxiii. State how the heating effect of current is harnessed in various electric heating appliances
xxiv. Classify and explain various errors committed by students when solving numerical problems related to heating effect of electric current
xxv. Identify contents from this lesson that can be used as a resource to teach thermal energy dissipation in your class
xxvi. Explain the meaning of mechanical power as used in Physics
xxvii. State the SI unit of mechanical power and convert SI of power to different related units
xxviii. Classify and explain common mistakes encountered by some students when solving numerical problems related to mechanical power
xxix. Identify contents from this lesson that can be used as a resource to teach mechanical work in your class

C. Number of units: 4

i. UNIT 1: ENERGY
ii. UNIT 2: WORK
iii. UNIT 3: POWER
iv. UNIT 4: COURSE EVALUATION

D. Concepts covered

The concepts covered in this module are meaning and forms of Energy, Energy Transformation, Mechanical Work, Work Done By Electrical Energy, Thermal Energy, Thermal Energy Dissipation and Mechanical Power

E. Resources - activities, readings

Activities

Some activities included in this module are:

i. Familiarize students with the names of different forms of energy as well as the meaning of energy according to Physics.
ii. Understand the meaning of potential energy through everyday life examples.
iii. Understand the meaning of kinetic energy through everyday life examples.
iv. Demonstrating how potential energy can be converted to kinetic energy and back again using a simple pendulum
v. Demonstrating the understanding of work done according to physics definition

Readings

i. Read (some common misunderstandings about energy) and Case Study 1 (misunderstandings about energy) from a resource called: Probing Understanding: Work and Energy. This resource is available at:https://www.open.edu/openlearncreate/pluginfile.php/145520/mod_resource/content/2/SS09_AIE_Final.pdf.
ii. OpenStax CNX (2021). Newton's laws of motion - drawing free-body diagrams: University Physics Volume 1. https://courses.lumenlearning.com/suny-osuniversityphysics/chapter/5-7-drawing-free-body-diagrams/
iii. Urone, P.P., Hinrichs R, Dirks K and Sharma, M. (2020). Chapter 7: Work, Energy, and Energy Resources (Exercises). Physics Libretext, available at: https://phys.libretexts.org/Bookshelves/University_Physics/Exercises_(University_Physics)/Ex

ercises%3A_College_Physics_(OpenStax)/07%3A_Work_Energy_and_Energy_Resources_(Exercises)
iv. RERP (2016): Energy: Unit E1: Potential and Kinetic Energy. Strategic Education Research Partnership (RERP), 1100 Connecticut Ave NW Suite 1310, Washington, DC. Available online at: https://serpmedia.org/scigen/e1.3.html (accessed 12 January 2022).
v. Lopez, R (2021): Power: CK-12 Physical Science for Middle School, CK-12 Foundation.https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/13.3/primary/lesson/

F. Nature and purpose of assessments:

Formative and summative assessment to assess the impact of the module on teaching and learning of the concepts

2. Course completion rate

A. Overall completion

The overall completion rate for the module is given in Table 1. Four (4) participants from the focused NQTs and 13 out of 15 of the intervention others had between 81-100 % completion rate. One participant(1) from NQTs recorded completion rate within the range of 61- 80 %. Another participant(1) from Others recorded completion rate within the range 41 - 60% and another one(1) recorded completion rate within the range of 21 - 40%.

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%	0	0	0
21 - 40%	0	1	1
41 - 60%	0	1	1
61 - 80%	1	0	1
81 - 100%	4	13	17
Total	5	15	20

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and Others. All 20 participants (i.e 5 NQTs and 15 others) completed pretest, session plans, reflection and posttest tasks.

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5	15	20
Session plans	5	15	20
Reflection	5	15	20
Post tests	5	15	20

3. Time spent on the course platform

Most teachers spent less than 10 hours, in particular about Two(2) of the teachers from NQTs and ten (10) from the intervention groups. One participant from NQTs and Two(2) from Others spent between 10 - 20 hours, One (1) NQTs and two(2) participants from Others spent between 21 - 30 hours and One(1) participant each from both categories spent more than 30 hours. This demonstrate that most teachers about 75% spent less than 20 hours

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	2	10	12
10 to 20	1	2	3
21 to 30	1	2	3
More than 30	1	1	2
Total	5	15	20

4. Change from pre- and post- test

Average total score in pre-test__6.45
Average total score in post-test__6.75

Regarding the observed changes, there have been notable developments among the teachers. Specifically, two(2) teachers who were initially classified as Novices have advanced to the Emerging category. Conversely, two other teachers have regressed from the Emerging category and are now categorized as Novices. Furthermore, the data from both the pre and post tests revealed that six(6) teachers did not show improvement in their subject matter knowledge, as they were categorized as Emerging in both evaluations. Four(4) teachers progress from Emerging to Proficient. Two teachers who were categorized as proficient regressed to Emerging and four teachers did not show improvement as they were in Proficient category in both tests.

None of the participants from the both tests scored above 75%. However, there is a slight increase between averages of pretest (6.45) and post-test (6.75).

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		2		
	26-50% Emerging	2	6	4	
	51-75% Proficient		2	4	
	76-100% Accomplished				

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	2	3	8	7	20
2. Nature of Science/ Mathematics	2	7	9	2	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	4	3	12	1	20
4. Students' misconceptions & Learning Difficulties	4	3	11	2	20
5. Representation of the Content	11	1	4	4	20
6. Context for Learning	5	8	5	2	20
7. Curriculum knowledge	2	4	12	2	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	2	4	13	1	20
9. Classroom Management	2	2	14	2	20
10. Assessment	2	5	9	4	20
Total	36	40	97	27	200

A. Subject Matter Knowledge

Teachers who are well-versed in their subject matter are able to distill it down to its essential elements, making it simpler for the students to understand. Example, a teacher highlighted the learning objectives indicating essential concepts to be taught, skills to be developed, "By the end of this unit you should be able to:define 1 Power 2 Write and interpret the formula for calculating power.

1.***Learning Outcomes (LO)**:By the end of a lesson,the students should be able to define;1 power 2 write and interpret the formula for calculating the power
2.***Prerequisites**:The students have been taught energy and work
3. **Session Narrative**:1 The teacher defines the power as the rate of doing work or the amount of energy transfered or converted per unit time,the unit of the power is watt.2 The teacher write the formula for calculating the power i.e power=work done/time where work is measured in jouls,time in seconds and power is measured in watts,killowatts and megawatts

a. *What resources were used and how?* b. *Were you able to meet the needs of all types of learners as planned? (Yes/No/Partially) Justify.* c. *Which parts of the lesson did learners enjoy most? Which parts did they enjoy least?* **d.** *Did boys and girls participate the same way? Did learners from any of the marginalised groups (low socio-economic background, children with special needs, religious or linguistic minority etc.) participate differently? What were the differences? What could be the possible reasons?*	
	a.I used ammeter, rheotostat, compass, connected wires, battery, key, retordstand and clamp,to conduct a simple experiment which show the link between electricity and magnetism. **Because: students have misconceptions usually have is that magnetic field the current produce in the wire would in the same direction as the current.** **b. Yes, because I used simple experiment to make students misconceptions clearly through observation what is happening in reality,if link electricity and magnetism.** **c. The part that learners enjoy most is they can download compass by using smart phone.** **The part that learners did they enjoy least is accurate reading from ammeters. d.Yes,**

For knowledge of subject matter from the preceding table, at least 15 participants indicated in the preceding table showed Proficient and accomplished. At least 11 showed proficient and accomplished for the nature of science criteria. Two of the participants in each criteria demonstrated no change (Novice) in the preceding table and 10 in total demonstrate Emerging.

B. Pedagogical Content Knowledge

A particular kind of knowledge that is only available to educators is referred to as pedagogical content knowledge. It requires teachers to be able to link their knowledge of instructional strategies (pedagogical knowledge) with their proficiency in the subject matter they teach. Most teachers were able to understand and identify main teaching points for example: a teacher wrote " Power is measured in watts while Energy is measured in joules. SIMILARITIES; Both of them are scalar quantities".

1. ***Learning Objectives (LO): at the end of the lesson students students be able to:**

(i) Clearly state the differences between energy, heat and temperature

(ii) Describe the meaning and importance of thermal energy

(iii) Explain the meaning and cause of heating effect of electric current

(iv) Derive the equation for calculating the amount of heat produced in a conductor by electric current

(v) State how the heating effect of current is harnessed in various electric heating appliances

2. **Prerequistic knowledge**: students have been taught
a. Heat and heat transfer
b. Kinetic molecular theory of matter
c. Energy and forms of energy
d. Conductors and insulators
e. Ohm's law

From the preceding table, thirteen participants showed proficient and accomplished in instructional strategies criteria. At least thirteen(13) participants showed proficient and accomplished in Students' misconceptions & Learning Difficulties criteria, 8 showed proficient and accomplished in Representation of the Content, 7 showed proficient and accomplished in Context for Learning criteria and 14 showed proficient and accomplished in Curriculum knowledge.

2. ***Prerequisite:** Students are expected to be familiar with;(i) forms of energy,potential and kinetic energy, (ii)distinction between mass and weight, vector and scalar quantities and trigonometric ratios.

3. **Session Narrative** (Describe the flow of the lesson here. Also explain the pedagogic approach used in the lesson) Discussion and demonstration should be used;1.defination of work.e.g Work can be defined as the product of force and perpendicular distance in the direction of the applied force. CONCEPT OF WORK,thus; Work=force × distance

$W = F \times S$

Since, $F = ma$

$W = ma \times S$

In Physics, mechanical work done on a system by a constant force is defined as a **product of the component of the force in the direction of motion times the distance through which the force acts**.

C. General Pedagogical Knowledge

General pedagogical knowledge encompasses a wide-ranging comprehension of principles and tactics associated with classroom management and organization across diverse academic disciplines. Pedagogical methodologies can be classified into five primary types: constructivist, collaborative, reflective, integrative, and inquiry based.

Resources/ Materials	Text books
Formative assessment	The teacher gives the students the assignment.A robot has to move a 1000kg crate from the ground up to a shelf 3m above the floor.The robotcan do this in 4secs.What is the power rating of the robot?

At least 14 participants showed proficient and accomplished in Equity and Inclusion, 16 participants also showed proficient and accomplished in Classroom Management and at least 13 participants showed proficient and accomplished in Assessment.

a. How was the class organised (Whole class/Group/Individual Work)? *b. Were learners interacting with each other and how?* *c. How did you address the emotional aspect of learning (for example, learners who were anxious/ stressed out/ less participatory)?*	
	The classroom is group by group.b)the learner's interc with the teacher 4 more understanding &the teacher goes round the groups to see that the students are in right place.

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	93
Teachers	44
Teacher Educators	67
Research fellow	28
Total	232

B. Frequency of posts

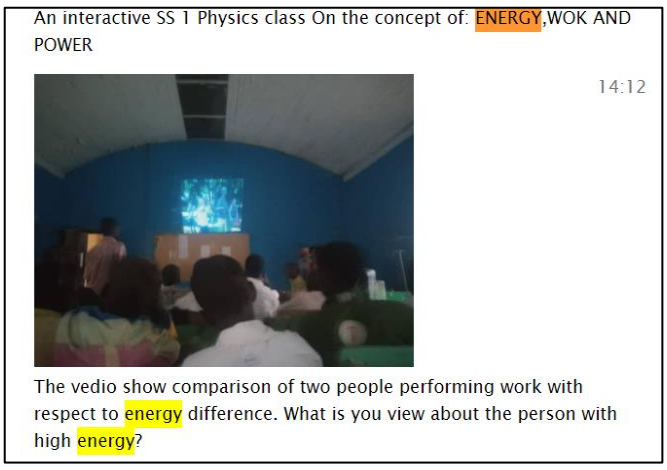
Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	27
UDL	19
Technical	49
Communication/ Administrative	137
Total	232

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	173
Images	47
External Links to other resources	10
Others	2
Total	232

C. Qualitative dialogues/ discussion threads



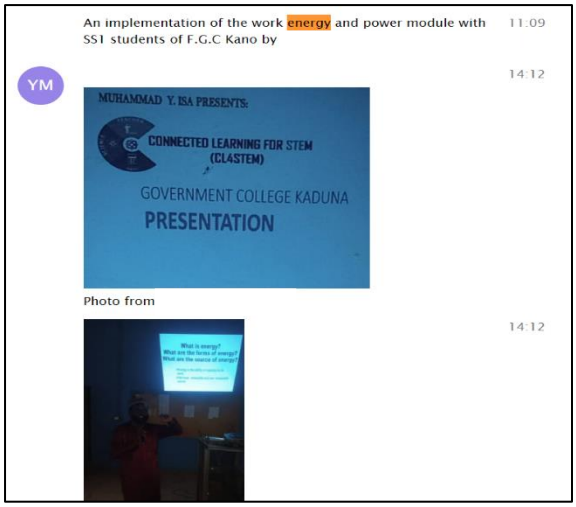


Figure 1: participants presenting in class for the students using ICT tools.

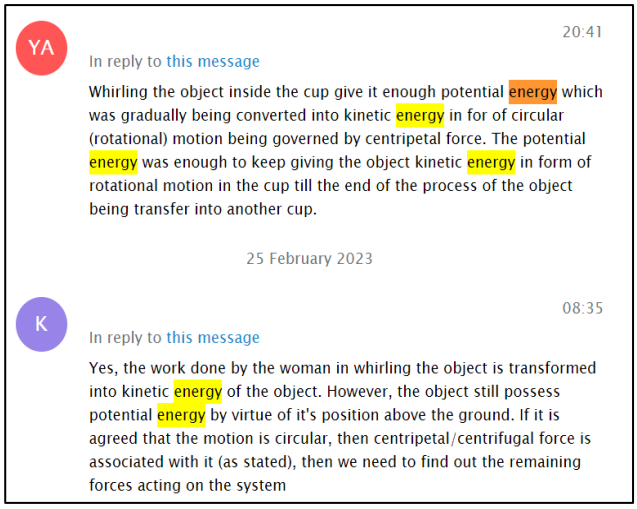


Figure 2: A screenshot of participants sharing knowledge

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

Given that the teachers used ICT tools in the implementation module, their proficiency in using ICT tools as well as the availability of adequate ICT facilities are some ways to improve their performance. The teachers participated satisfactorily. As can be seen from the screenshot above, the teachers enthusiastically used the ICT resources to teach the practicals to the best of their abilities.

B. Challenges:

Time constraints and lack of adequate ICT skills and facilities by the NQTs were the major challenges of module implementation.

C. Surprises:

The use of ICT tools for interactions on CoP and in implementing the module in the classrooms were surprises for some NQTs being the first time to handle the ICT tools in teaching and interactions.

D. Any changes required in the module design:

No changes required.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Physics

Electromagnetism

Authored by:
Dr Haliru Ibrahim

1. Introduction

Electromagnetism is an area in physics that deals with the interrelationship between electricity and magnetism. It is very interesting to learn that electricity can be induced just by mechanical movement of a conductor in a magnetic field, and that conversely; a current carrying conductor also creates a magnetic field around it. These two parameters create a force within the electromagnetic field. The electric field, the magnetic field and the force are all vector quantities; thus their magnitudes and directions are of great interest. Experiments confirmed that the relative directions of these parameters are perpendicular to each other. These interesting results lead to many applications, especially the electrical and electronic appliances around us, such as electric generators, fans, washing machines; in fact all electrical appliances are possible because of electromagnetism. This makes the physics of electromagnetism the father of electrical engineering.

This self-explanatory module has broken down and simplified to scratch the basic requirements of electromagnetism for both students and the NQTs. It is full of simplified and well explained activities, supported with diagrams, simulations and video clips. The possible misconceptions are well addressed; the PCK of the subject matter is well enriched, in fact the module is optimistic and well prepared for the digital learning era.

A. Timeline of implementation:

Nov 14th to Dec 20th 2022

B. Learning objectives

Unit 1: Magnetic field around a current carrying conductor

By the end of this lesson, you should be able to

i. Name the scientist who discovered the relationship between electricity and magnetism.
ii. Design the Oersted experimental setup and use it in the classroom.
iii. Determine the direction of magnetic field in a current-carrying conductor
iv. Explain the relationship between current and magnetic field.
v. Write the formula of magnetic field due to a straight wire carrying current
vi. Calculate the magnetic field at a point due to a straight wire carrying current.
vii. Use the RightHandThumb Rule to indicate the direction of the magnetic field given the direction of current or vice versa.

Unit 2: Magnetic field produced by a current carrying circular loops

By the end of this unit, you should be able to

i. Draw the magnetic field produced by current carrying loop
ii. Indicate the direction of the magnetic field at different positions of current carrying loop given the direction of the current and vice versa.
iii. Calculate the magnetic field at the center of current carrying loop
iv. Calculate the magnetic field at the center of current carrying loop

Unit 3: Electromagnetic force and application in dc motor and ac generator.

By the end of this lesson, you should be able to

i. Calculate the direction and magnitude of the magnetic force for moving charges and currents.
ii. Analyze the motion of charged particles in a magnetic field
iii. Apply the Right Hand Rule to find the direction of the velocity, magnetic field and magnetic force given any two of these.
iv. Apply the Right Hand Rule to find the direction of the current, magnetic field and magnetic force given any two of these.
v. Explain how a charged particle in an external magnetic field undergoes circular motion
vi. Describe how to determine the radius of the circular motion of a charged particle in a magnetic field
vii. Describe conditions that lead to the circular motion of a charged particle in the magnetic field
viii. Describe the condition that leads to the helical motion of a charged particle in the magnetic field
ix. Discuss the application of mass spectrometers, movement of charged particles in cyclotron
x. Identify the general equation for the torque on a loop of any shape.

Unit 4: Exploring the electromagnetic induction

By the end of this unit, you should be able to

i. Determine the magnetic flux linked through a surface given the strength, surface area and angle between the normal to the surface and the magnetic field.
ii. State the Faraday's law of electromagnetic induction
iii. Use Faraday's law to determine the magnitude of induced emf in a closed loop due to changing magnetic flux through the loop

C. Number of units:

Four

D. Concepts covered:

Magnetic field around a current carrying conductor, Magnetic field produced by a current carrying circular loops, Electromagnetic force and application in dc motor and ac generator, exploring the electromagnetic induction.

E. Resources - activities, readings:

You tube (Videos), web sites, diagrams, graphs, concrete models, Apps such as; Phyphox, PhET and AP sensor

F. Nature and purpose of assessments:

i. Templates for worksheets etc,
POE worksheet, deductive method worksheet

ii. Examples of questions
Quiz question, live question, higher order question, drawing diagrams

2. Course completion rate

A. Overall completion

The overall completion rate for the module is given in Table 1, All the 5 NQTs recorded 81-100 % completion rate while intervention (others) are spread across the completion rates with 4 participants within 1-20%, 1 participant each within 21-40%, 41-60% and 61-80% and 8 participants achieved 81-100% completion rate.

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%		4(20%)	**4(20%)**
21 - 40%		1(5%)	**1(5%)**
41 - 60%		1(5%)	**1(5%)**
61 - 80%		1(5%)	**1(5%)**
81 - 100%	5(25%)	8(40%)	**13(65%)**
Total	**5(25%)**	**15(75%)**	**20(100%)**

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and others. All 5 NQTs participants completed Pretest, Session plans, Reflection and Post test task, Also, all 15 participants from the intervention others completed the Pre test, Session plans and Post tests, although only 18 participants (all NQTs, and 13 out of 15 of the intervention others) were able to complete reflection .

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5 (25%)	15(75%)	**20(100%)**
Session plans	5 (25%)	15(75%)	**20(100%)**
Reflection	5 (25%)	13(65%)	**18(90%)**
Post tests	5(25%)	15(75%)	**20(100%)**

3. Time spent on the course platform

Table 3 shows time spent on moodle platform by participants, 3 NQTs and 11 intervention, others spent less than ten (10) hours. Two (2) participants from NQTs and one (1) other spent within the range of 10 - 20 hrs. Only 3 participants from the intervention others spent within the range of 21-30 hours.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	3 (15%)	11 (55%)	14 (70%)
10 to 20	2 (10%)	1 (5%)	3 (15%)
21 to 30		3 (15%)	3 (15%)
More than 30			
Total	5 (25%)	15 (75%)	20 100%)

4. Change from pre- and post- test

Average total score in pre-test__5.3
Average total score in post-test_5.0

Pre-Test:

i. Pretest data obtained shows two (2) teachers were evaluated as Novices
ii. Seventeen (17) were evaluated to be Emerging and only (1) of the teachers was evaluated as Proficient with a score between 51-75%.

Post-Test:

i. Post test data shows that two (2) teachers evaluated as Novices improved to become Emerging.
ii. Five (5) out of the 17 teachers evaluated as Emerging regressed to becoming Novices.
iii. Ten (10) teachers evaluated at pretest as Emerging remained as Emerging after post test and the remaining two (2) teachers progressed into becoming Proficient after the post test.
iv. Only one (1) teacher regressed from Proficient to Emerging after the post test.

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		2 (10%)		
	26-50% Emerging	5 (25%)	10 (50%)	2 (10%)	
	51-75% Proficient		1 (5%)		
	76-100% Accomplished				

5. Practice

Table 5

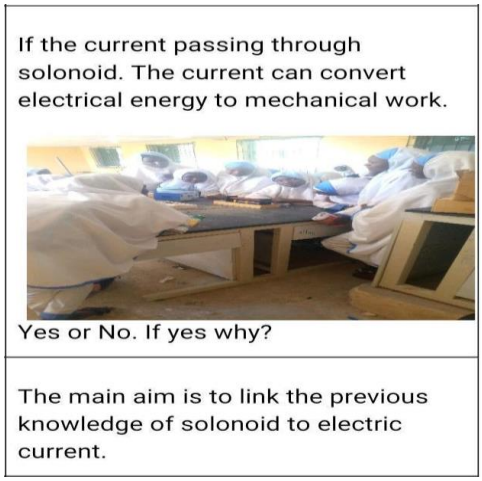
Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter		5 (25%)	12 (60%)	3 (15%)	20 (100%)
2. Nature of Science/ Mathematics		5 (25%)	14 (70%)	1 (5%)	20 (100%)
B. Pedagogical Content Knowledge					
3. Instructional Strategies		2 (10%)	16 (80%)	2 (10%)	20 (100%)
4. Students' misconceptions & Learning Difficulties		4 (50%)	16 (30%)		20 (100%)
5. Representation of the Content		2 (10%)	15 (75%)	3 (15%)	20 (100%)
6. Context for Learning		1 (5%)	19 (95%)		20 (100%)
7. Curriculum knowledge		2 (10%)	16 (80%)	2 (10%)	20 (100%)
C. General Pedagogical Knowledge					
8. Equity and Inclusion		2 (10%)	17 (85%)	1 (5%)	20 (100%)
9. Classroom Management		1 (5%)	14 (70%)	2 (10%)	20 (100%)
10. Assessment		2 (10%)	18 (90%)		20 (100%)
Total		26	160	14	200

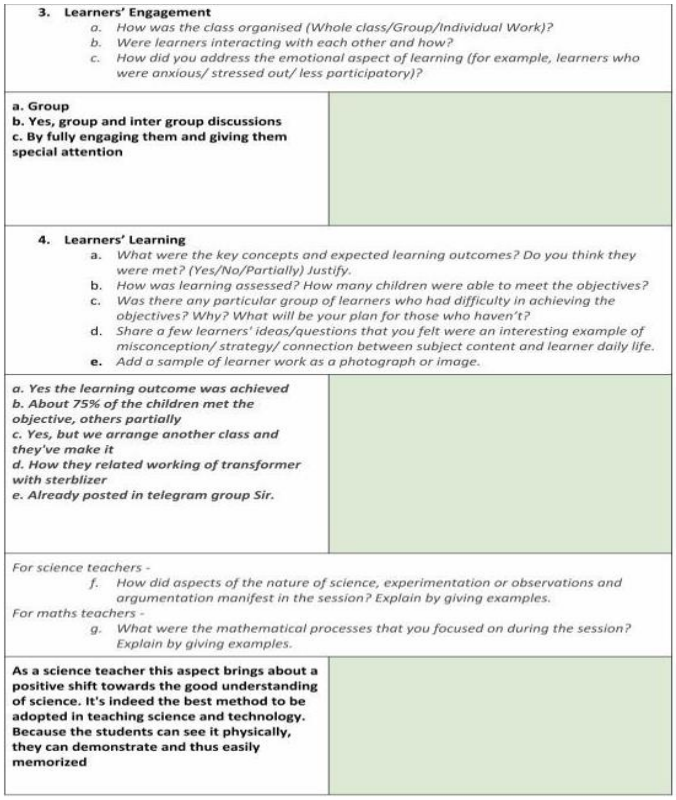
A. Subject Matter Knowledge

Mastery of the subject matter by the teachers means that they can simplify the topic into main points that can easily be understood by the learners. With this, teachers can match the instructional materials to be used, leading to a smooth flow of teaching learning process. For instance, below is a teacher trying to explain to the students the link between electricity and magnetism (Oersted discovery). Example, the teacher explained the meaning of magnetism as the force exerted by magnets when they attract or repel each other.

This student`s involvement in the physical activity clearly demonstrates mastering of the subject matter. Moreover, on the right is another teacher trying to explain to the students the factors affecting the strength of the magnetic field generated by a solenoid.

Below here also is another teacher exploring the energy interchange that occurs in electromagnetic induction. This is interesting because the students can easily capture and state the energy interchange occurring in many electromagnetic appliances, such as electric fan, washing machine, electric iron, kettle and so on.





B. Pedagogical Content Knowledge

Pedagogical content knowledge is a type of knowledge that is unique to the teachers, and is based on the way teachers relate their pedagogical knowledge (what they know about teaching) to their subject matter knowledge (what they know about what they teach). Below is a snap of a video; the teacher is directing the children to demonstrate the directions of force, field and motion using the right hand rule, which they did. Any misconception can easily be traced in this way and can be addressed appropriately.

C. General Pedagogical Knowledge

General pedagogy can be seen as a cross-curricular principle and strategies of classroom management and organization. Pedagogical approaches can be classified into five; constructivist approach, collaborative, reflective, integrative, and inquiry based approach. From the image below; one can see that it captures constructive, collaborative and integrative approaches among the learners.

Moreover, in the following portions of the session plans by an NQT; the formative evaluation questions have really captured the reflective and inquiry based forms of general pedagogy.

15 minutes	Determining the relationship between magnetic field due to current carrying wire, the distance R from the wire and current passing through the wire	15 minutes
To allow for more practical at home	* How do magnetic fields vary with current? * How does the magnetic field vary with the distance? * What would happen if you reverse the direction of the current * Can you think of any other ways (other than Right Hand Thumb rule) to represent the direction of the magnetic field?	To review and point out the key points of the lesson
Get carbon board to design right hand rule to demonstrate the different direction we have base on magnetic field..	Straight copper wire, ammeter, 3 dry cell batteries, battery holder, mobile compass, switch, 2 retort stands and 3 clamps, cardboard.	Teacher ask students few questions from the lesson so far
	Teacher goes round the class assessing and correcting the activities of the students	From our previous observation:- * How do magnetic fields vary with current? * How does the magnetic field vary with the distance?
Real object		Writing materials

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	32
Teachers	15
Teacher Educators	36
Research fellow	6
Total	89

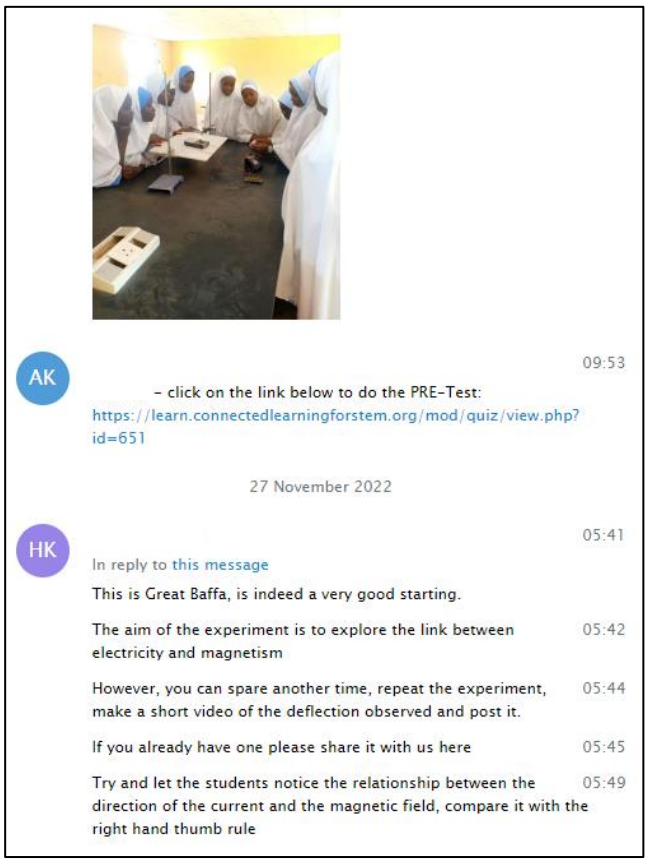
B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	3
UDL	7
Technical	23
Communication/ Administrative	7
Total	40

Table 7.2: Frequency of posts by type

Type of Posts	Number of posts
PCK	3
UDL	7
Technical	23
Communication/ Administrative	7
Total	40



AK 09:53

– click on the link below to do the PRE-Test:
https://learn.connectedlearningforstem.org/mod/quiz/view.php?id=651

27 November 2022

HK 05:41

In reply to this message

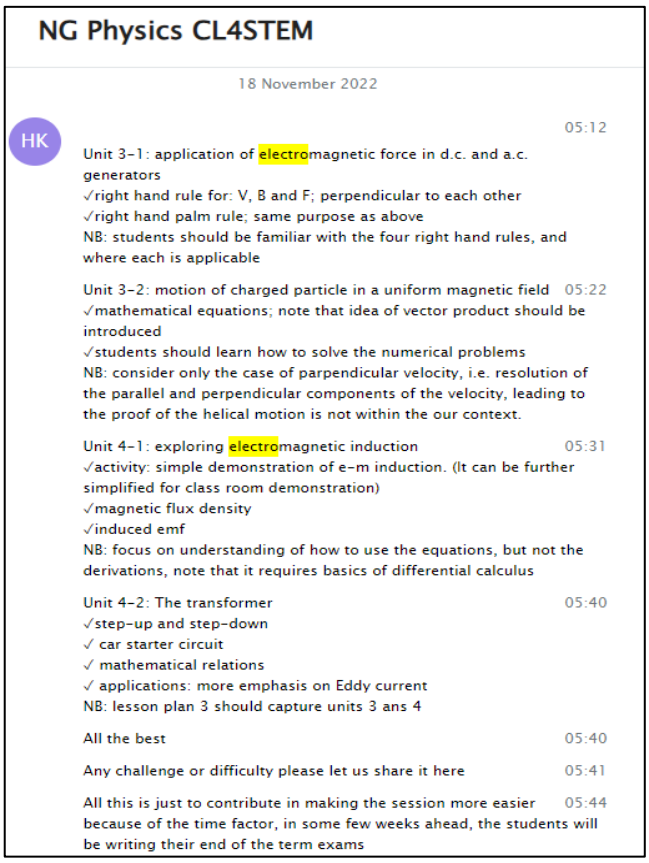
This is Great Baffa, is indeed a very good starting.

The aim of the experiment is to explore the link between electricity and magnetism 05:42

However, you can spare another time, repeat the experiment, make a short video of the deflection observed and post it. 05:44

If you already have one please share it with us here 05:45

Try and let the students notice the relationship between the direction of the current and the magnetic field, compare it with the right hand thumb rule 05:49



NG Physics CL4STEM

18 November 2022

HK 05:12

Unit 3-1: application of electromagnetic force in d.c. and a.c. generators
✓right hand rule for: V, B and F; perpendicular to each other
✓right hand palm rule; same purpose as above
NB: students should be familiar with the four right hand rules, and where each is applicable

Unit 3-2: motion of charged particle in a uniform magnetic field 05:22
✓mathematical equations; note that idea of vector product should be introduced
✓students should learn how to solve the numerical problems
NB: consider only the case of parpendicular velocity, i.e. resolution of the parallel and perpendicular components of the velocity, leading to the proof of the helical motion is not within the our context.

Unit 4-1: exploring electromagnetic induction 05:31
✓activity: simple demonstration of e-m induction. (It can be further simplified for class room demonstration)
✓magnetic flux density
✓induced emf
NB: focus on understanding of how to use the equations, but not the derivations, note that it requires basics of differential calculus

Unit 4-2: The transformer 05:40
✓step-up and step-down
✓ car starter circuit
✓ mathematical relations
✓ applications: more emphasis on Eddy current
NB: lesson plan 3 should capture units 3 ans 4

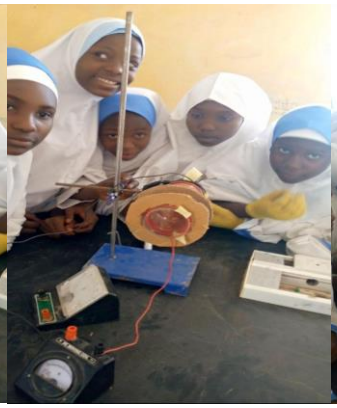
All the best 05:40

Any challenge or difficulty please let us share it here 05:41

All this is just to contribute in making the session more easier because of the time factor, in some few weeks ahead, the students will be writing their end of the term exams 05:44

C. Qualitative dialogues/ discussion threads

The image on the right is a snap of a video clip, the teacher is instructing the students to demonstrate Fleming's right hand rule. This activity is highly inclusive and demonstrative, the teacher and the students are fully engaged. Each of the students can then lead another group to perform the same task; and this is knowledge transfer. The image presented below also shows student engagement, meanwhile the students are females but one can notice their amused faces which indicate the enjoyment of the ongoing lesson.



7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

Actually the teacher`s participation during the implementation is optimum and wonderful within the stipulated time. Going through their lesson plans and what they posted in the CoP show that the teachers absolutely follow the module. The NQTs have clearly demonstrated their quick response to this new teaching strategy; activity based learning, where students are fully engaged. Some of the teachers reported to have organized tutorial classes for students with difficulty in understanding. The teachers combined the use of available resources during their sessions together with the OER (videos, simulations and related images available there in the module). During the implementation some teachers use projectors while others use their mobile phones to display videos and simulations. This blended learning process has brought up a rapid positive shift in teaching and learning process. However, the availability of digital resources and networks in some areas has become a challenge.

B. Challenges

Most of the challenges faced during the implementation are network problems. For this particular module, another challenge is the limited time because students were about to start the end of term examination. However, flexibility of the module and its simplified nature also helped students with difficulty with learning.

C. Surprises

I underestimated most of the schools to have well equipped computer laboratories, but the outcomes even from remote piloted areas is highly impressive. This shows the level of recognition and impact of the designed modules.

D. Any changes required in the module design

The modules are ok, only that this electromagnetism module has captured almost all the contemporary areas needed within the context. So my observation is that; the force and motion module is supposed to be designed in either of the two ways:

i. To treat and cover up all dynamics related topics so that the students would have a very good understanding of the theme, just like how work energy and power was designed. This will involve forces in fluids (liquids and gasses)
ii. To treat both dynamics and kinematics and cover all the necessary areas required within the curriculum. This will involve other forms of motion such as circular motion, rotational motion and simple harmonic motion.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Mathematics

Algebra

Authored by:
Prof. Garba Shuaibu, Dr. Fatima Shehu Kabir

1. Introduction

Algebra is an aspect of Mathematics which usually learners find difficult to learn, it deals with sets and relations of objects, cases, or things. This module will allow newly qualified teachers (NQTs) to identify, learn, understand, form and apply the various aspects of the topics to be covered with students while teaching this module namely; simple equation, linear inequalities and simultaneous linear equations as well as able to identify, plan and address various students misconceptions in algebra. In addition, the module will allow NQTs to find out relevant resources for teaching the topics.

A. Timeline of implementation in the country:

May/June to 14th September, 2022

B. Learning objectives:

The module will explore algebra topics consisting of algebraic expressions, simple equations, inequalities in one variable, simultaneous linear equations in two variables. It also examined the case studies of students' thinking, their understanding, and misconceptions as well as resources to address the concepts.

C. Number of units:

Three (3)

D. Concepts covered:

i. Simple equation
ii. Linear inequalities
iii. Simultaneous Linear Equations

E. Resources:

Youtube (Videos), web sites, text books, outdoor activities and classroom activities such as picking stones, sticks, drawing and sketching of different diagrams.

F. Nature and purpose of assessments:

The nature of assessment in the module consists of diagnostics, formative, summative and use of multiple modes of assessment such as pre-test, post-test and self-reflection assignments. Similarly, the purpose of assessment involved the ability to learn, understand and apply the various concepts of algebra in the module as well as able to identify and address students' misconceptions, allow NQTs to create and evaluate their own lesson plans, and find out relevant resources for teaching the topics.

2. Course completion rate

A. Overall completion

The overall completion rate for the module is given in Table 1, All the 5 NQTs recorded 81-100 % completion rate while intervention (others) are spread across the completion rates with 1 participant within 41-60%, 3 participant within 61-80% and 11 participants achieved 81-100% completion rate,

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%			
21 - 40%			
41 - 60%		1 (5%)	1 (5%)
61 - 80%		3 (15%)	3 (15%)
81 - 100%	5 (25%)	11 (55%)	16 (80%)
Total	5 (25%)	15 (75%)	20 100%)

B. Assessment completion rate

Table 2 shows assessment rate completion for NQTs and Others. All 20 participants (i.e 5 NQTs and 15 others) completed pretest, session plans, reflection and posttest tasks.

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5 (25%)	15 (75%)	20 (100%)
Session plans	5 (25%)	15 (75%)	20 (100%)
Reflection	5 (25%)	15 (75%)	20 (100%)
Post tests	5 (25%)	15 (75%)	20 (100%)

3. Time spent on the course platform

Table 3 displays the duration of time that participants dedicated to the Moodle platform. The focus group consisted of five (5) teachers referred to as NQTs, while the remaining 15 teachers were part of the intervention group. Among the NQTs, three (3) teachers spent less than 10 hours, and the remaining two (2) teachers spent between 10 to 20 hours on the platform. Regarding the intervention group, ten (10) teachers spent less than 10 hours, four (4) teachers spent between 10 and 20 hours, and only one (1) teacher spent more than 30 hours on the platform.

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	3 (15%)	10 (50%)	**13 (65%)**
10 to 20	2 (10%)	4 (20%)	**6 (30%)**
21 to 30			
More than 30		1 (5%)	**1 (5%)**
Total	**5 (25%)**	**15 (75%)**	**20 (100%)**

4. Pre and Post Tests Average Scores

Average total score in Pre-test_7.70
Average total score in Post-test_10.53

Pre-Test:

i. Among the teachers who took the pre-test, 1 teacher was evaluated to be a Novice indicating they demonstrated 0-25% proficiency
ii. Nine (9) teachers were evaluated to be Emerging
iii. Eight (8) teachers were evaluated to be Proficient and lastly, two (2) were evaluated as Accomplished.

Post-test:

i. After the post-test, one (1) of the Novice teacher improved significantly to become an Accomplished
ii. Five (5) among the Emerging teachers progressed to becoming Proficient and the other four (4) became Accomplish after post-test
iii. Two (2) among the 9 Proficient dropped to Emerging, four (4) remained as Proficient and two (2) improved to Accomplished.
iv. And lastly, the two (2) Accomplished at pre test dropped to Proficient at post-test

Table 4

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice				1 (5%)
	26-50% Emerging			5 (25%)	4 (20%)
	51-75% Proficient		2 (10%)	4 (20%)	2 (10%)
	76-100% Accomplished			2 (10%)	

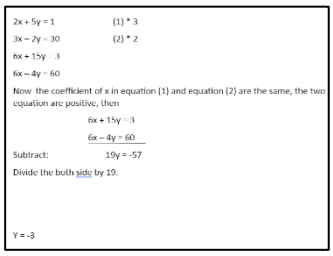
5. Practice

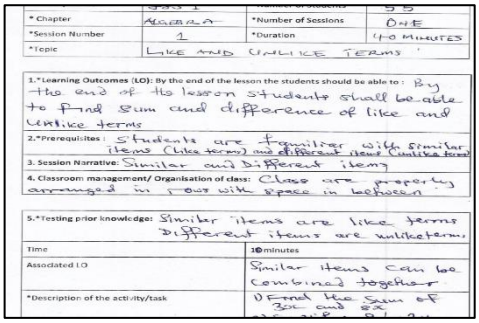
Table 5

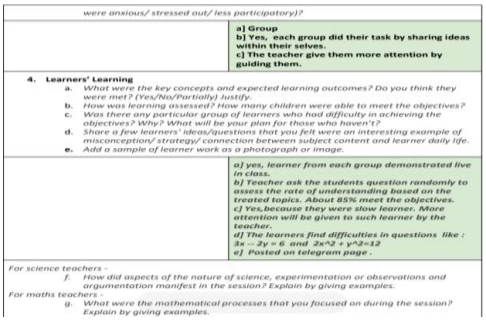
Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter		2	17	1	20
2. Nature of Science/ Mathematics		1	18	1	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies		4	15	1	20
4. Students' misconceptions & Learning Difficulties	1	4	14	1	20
5. Representation of the Content	1	5	12	2	20
6. Context for Learning		12	4	4	20
7. Curriculum knowledge		1	15	4	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	1		16	3	20
9. Classroom Management	2		13	5	20
10. Assessment		4	15	1	20
Total	5	31	139	23	200

A. Subject Matter Knowledge:

When teachers have a deep understanding of the subject matter, they have the ability to condense the topic into key points that are easily comprehensible for the students. As a result, teachers can select appropriate instructional materials, ensuring a seamless flow in the teaching and learning process. They also asked questions on working out problems on simple linear inequalities and simultaneous equations from real life through buying and sellings, they reflected on their students' setting arrangement, the achievement of the lesson objectives and need for improvement.

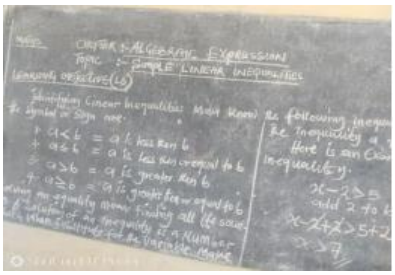






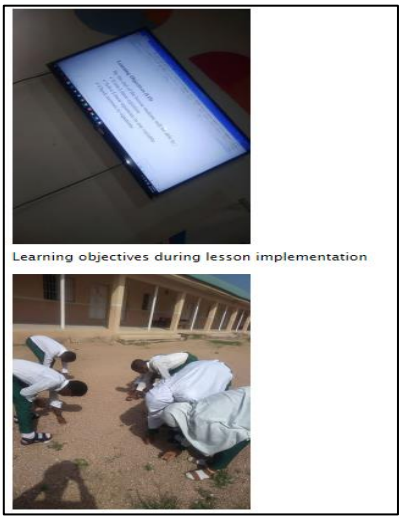
B. Pedagogical Content Knowledge:

Pedagogical content knowledge refers to a specific type of knowledge that is exclusive to educators. It involves the ability of teachers to connect their understanding of teaching methods (pedagogical knowledge) with their expertise in the subject matter they teach. By employing this approach, any misconceptions can be easily identified and effectively addressed. From the teachers' lesson plan 1 and 2, they demonstrated proficiency in the use of instructional strategies through giving adequate explanation, examples, and interconnections between the various concepts of linear inequalities and other topics, On curriculum knowledge, some of the teachers used appropriate hierarchical sequence of basic concepts in teaching each topic and they were able to demonstrate how they relate with other topics or concepts.



C. General Pedagogical Knowledge

General pedagogical knowledge encompasses the broad understanding of principles and strategies related to classroom management and organization across various subjects. Pedagogical approaches can be categorized into five main types: constructivist, collaborative, reflective, integrative, and inquiry-based. The image provided depicts the incorporation of constructive, collaborative, and integrative approaches in the learning process among students.


Learning objectives during lesson implementation

Teachers' lesson plans indicated the use of multiple modes of classroom interactions like asking students to answer or solve problems, taking the students outside the classroom to pick stones, objects and so forth.

On the right are students picking Stones for activities given to them

Time	35 minutes
Description of the activity/task/ *based on UDL principles*	About Simultaneous linear equation: Two or more linear equations that all contain the same unknown variables re called a system of simultaneous linear equations. Solving such a system means finding values for the unknown variables which satisfy all the equations at the same time. Activity: Teacher will ask groups of students to solve the question below Question1: Solve the equations $3x - 2y = 2$ and $7x + 3y = 43$ Ways of solving Simultaneous linear equation The most common ways of solving simultaneous linear equations are: (i) Elimination Method (Addition/Subtraction) (ii) Substitution Method Teacher's Impute on Elimination method:

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	10
Teachers	15
Teacher Educators	10
Research fellow	8
Total	43

B. Frequency of posts

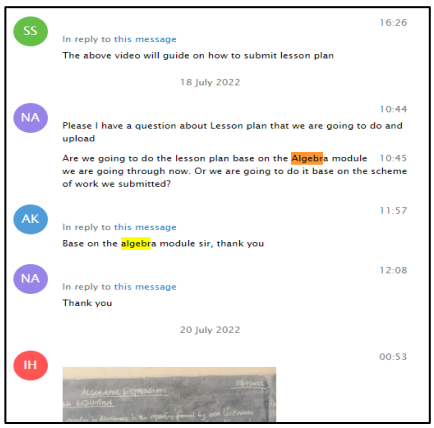
Table 7.1: Frequency of posts by content

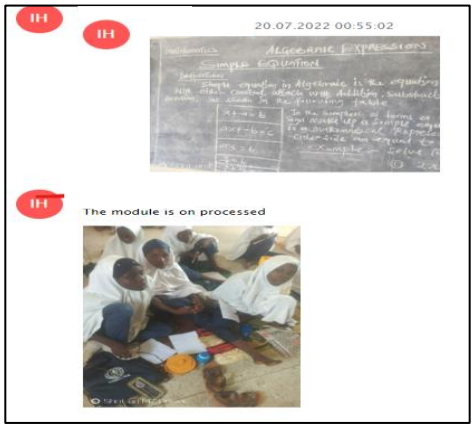
Type of Posts	Number of posts
PCK	10
UDL	5
Technical	15
Communication/ Administrative	13
Total	43

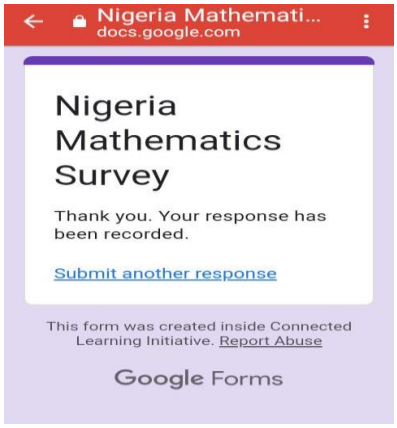
Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	16
Images	10
External Links to other resources	10
Others (Appreciation, encouragement, clarification, etc)	7
Total	43

C. Qualitative dialogues/ discussion threads







7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers

The teachers participate actively in the CL4STEM module launching workshop, completion of foundation and pedagogical modules exercises exposes many of the teachers to technical knowledge of Information technology devices. The practical activities in the modules and during the module implementation in the classroom with the students improve greatly the teachers professional competence in the subject. There is a need to have similar activities and training for the teachers in order to improve their competence.

B. Challenges

The problem of network services militates the smooth running of the CL4STEM activities coupled with lack of iphone or smartphone by some of the project's teachers due to the current economic hardship.

C. Surprises

The surprising part of this project is how within a short time many teachers learn to join and work through zoom meetings, post information on telegram and be able to design lesson plans based on the CL4STEM template.

D. Any changes required in the module design

The change required in the module design may likely be on the number of activities to be reduced to minimal.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data

Subject : Mathematics

Geometry:

Authored by:
Dr Aliyu Umar Abubakar, Dr Ibrahim Abdullahi

1. Introduction

Geometry is a topic in Mathematics that have made some learners have a confusing perspectives to understanding the forms of shapes, planes and objects. These are mostly seen as a form of misidentification of shapes.

These concepts could prove a bit tricky to learn, it deals with sizes, pattern, areas, parameters among other related properties in geometry. Interestingly, some perceptions could be seen as misconceptions depending on the learner and the Teacher as objects, cases, or things are modelled. This module will allow newly qualified teachers (NQTs) to identify, learn, understand, form and apply the various aspects of the topics to be covered with students while teaching this module namely; common shapes (triangle, square, rectangle circle, and trapezium etc), properties, formula to find area, perimeter and address various students misconceptions in understanding shapes and its properties in geometry.

In addition, the module will allow NQTs to find out relevant resources for teaching the topics.

A. Timeline of implementation:

The timeline for the implementation of the module was four (6) weeks between: 12th September – November 14th

B. Learning objectives:

Student should be able to know how and when to use the formulas of finding the areas and perimeter of the plane shapes, equations, linear inequalities and simultaneous equations

C. Number of Modules:

Five (5) Module Lessons

i. Module 1: Area and perimeter
ii. Module 2: Types of Transformation
iii. Module 3: Coordinate Transformations
iv. Module 4: Transformations (Area and perimeter)
v. Module 5: Mensuration of Plane Shapes

D. Concepts covered:

Problem solving of areas and perimeter of some of the plane shapes examples of word problems relating to plane shapes, transformations, and mensuration of plane shapes

E. Resources:

Youtube (Videos), web sites, text books, outdoor activities and classroom activities

i. https://youtu.be/9d7GIzlO7bo
ii. New General Mathematics (Nigeria) was also used
iii. Some physical resources such as cubes, papers were used to make plane shapes and also transformed.

F. Nature and purpose of assessments:

The nature of assessment in the module consist of diagnostics, formative, summative and use of multiple modes of assessment such as pre-test, post-test and self-reflection assignments.

Similarly, the purpose of assessment involved the ability to learn, understand and apply the various concepts of geometry in the module as well as able to identify and address students' misconceptions, allow NQTs to create and evaluate their own lesson plans, and find out relevant resources for teaching the topics.

2. Course completion rate

A. Overall completion:

From our data obtained from the module which was in turn filled in the tracker, we present the following NQTs and intervention group teachers as it relates to their respective participations.

Table 1: The Completions Analysis for Maths NQTs

	NQTs	Others	Total
1 - 20%	-	-	-
21 - 40%	-	-	-
41 - 60%	-	2	2
61 - 80%	-	-	-
81 - 100%	5	13	18
Total	5	15	20

From the Table 1: 5 main focus NQTs, recorded a good participation ratio. The intervention group also participated adequately which are marked as others. However, two 2 teachers did not complete some of the activities on the modules, as they failed to submit their lesson plan and reflection plan.

B. Assessment completion rate

For the Evaluation, the Lesson plans were submitted and graded accordingly. From the Geometry group, all NQTs submitted for grading. However, from the COP group, observations and reviews were shared with most of the NQTs that either submitted a scanty lesson plan or incomplete documents. It was also observed that some of the NQTs submitted image scans of the lesson plan while a good number submitted in MS-Word format and PDF documents. Find below the status of the Lesson Plans from the Mathematics group.

Table 2: Summary Table for Activities

	NQTs	Others	Total
Pre test	5 (100%)	15 (100%)	20 (100%)
Session plans	5 (100%)	14 (93%)	19 (95%)
Reflection	5 (100%)	14 (93%)	19 (95%)
Post tests	5 (100%)	15 (100%)	20 (100%)

Table 3 depicts that most of the teachers completed the activities of the module leaving only 2 participants who did not complete theirs.

3. Time spent on the course platform

Table 3: Time spent by teachers on Moodle platform

Hours spent	NQTs	Others	Total
Less than 10	4 (20%)	8 (40 %)	12(60%)
10 to 20	1 (5%)	7 (35 %)	8 (40%)
21 to 30	-	-	-
More than 30	-	-	-
Total	5(100%)	15 (100%)	20 (100%)

From the table observed above, it shows that 4 (20%) of the NQTs spent less than 10 hours in completion of the module. From our records, only 1 (5%) of the NQT required slightly above 10 hours to finalize. With the completion time of 10 hours, 10 minutes. From the Intervention group known as others on the record, 8 (40%) teachers took less than 10 hours to complete the module. while 7(35%) of the teachers completed the module within the range of 10 to 20 hours. However, none of the teachers took more than 20 hours on the module.

4. Change from pre- and post- test

Average total score in pre-test_6.15
Average total score in post-test_7.15

There was significant variation between the pre-test and post test scores with a difference of 1.00 average increases can be observed. This indicates teachers' development has taken place and the CL4STEM program might have an overall positive impact on the teachers' professional development. It should be noted that the pre-test and post test scores of 20 teachers were utilised for the analysis to derive both the average total scores and the findings as revealed in table 4.

Table 4: Change from pre- and post- test

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice	1	1	-	-
	26-50% Emerging	1	5	4	1
	51-75% Proficient	-	2	4	1
	76-100% Accomplished	-	-	-	-

Table 4 shows the trend of how the teachers' progressed using their pre-test and post-test scores as indicators of advancement or otherwise as follows:

i. The pretest score categorized only two (2) teachers as novice. Out of which one (1) progressed to emerging. While the other one remained at novice level after the evaluation from their post-test score.
ii. The pre-test emerging category also shows advancement of four (4) teachers from emerging to proficient after the evaluation of the post-test score. Furthermore, the one (1) teacher progressed from emerging to accomplished category as observed from their post-test score. However, five (5) participants remained in the emerging category and one (1) teacher regressed back to even after participating in the program.

iii. The proficient category had seven (7) teachers based on their pretest scores out of which 4 remained uninfluenced by the program, as their post-test scores did not change their category and two (2) of the teachers experienced drawbacks due to a step down into the emerging category. Furthermore, one (1) progressed to the accomplished category as indicated by the post-test score.

iv. In general, the teacher development program had a positive impact on eight (8) out of twenty (20) teachers analyzed, as they progressed to higher categories of teacher development expertise. Also, three (3) teachers experienced drawbacks due to a step down to a lower category according to their post-test score. This is partly attributed to a number of factors such as health constraints, commitments from a place of work and financial constraints (internet connection is not readily available and expensive). The success is attributed to follow-up calls on CoP and school visits, prompt technical support, increased interest, acceptance and observed added value, and cooperation from stakeholders particularly principals and students among others. Thus, the experiences of the program have become more meaningful in the teachers' professional development.

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	2	8	10	0	20
2. Nature of Science/ Mathematics	0	11	9	0	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	0	4	14	2	20
4. Students' misconceptions & Learning Difficulties	3	11	6	0	20
5. Representation of the Content	1	5	11	3	18
6. Context for Learning	0	9	10	1	20
7. Curriculum knowledge	1	3	16	0	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	1	8	11	0	20
9. Classroom Management	2	0	17	1	20
10. Assessment	0	13	4	3	20
Total	10	72	108	10	200

A. Subject Matter Knowledge

The data generated from the teachers' lesson plans and reflection plans, shows that equal number of teachers fall between emerging and proficient as regards to their ability to demonstrate knowledge of the subject area of geometry. And they are able to incorporate these concepts into their lesson activities with students to better enhance their understanding and retention of the concepts.

i. "the teacher introduces the lesson by asking the students some questions about previous lesson and link it up with the present lesson"
ii. "The teacher is aware of the subject and able of employ creative and imaginative means to enhance the learning experience of the students"

B. Pedagogical Content Knowledge

From the teachers' lesson plan 1, 2 and 3, they demonstrated proficiency in the use of instructional strategies through giving adequate explanation, examples, and interconnections between the various concepts of areas, parameters and other topics in geometry. On Representation of the Content, three (3) of the teachers proficiently leveraged the features of resources appropriately (TPACK) to achieve learning outcomes.

i. " The teacher guides the students to find the area and perimeter of figures formed from Geogebra"
ii. "Laptop and Smart phone to Display the lesson objectives, Picture, play video, and other resources like Red Metal decorated world Shape, paper for solving equations, and graph sheets for plotting points."

C. General Pedagogical Knowledge

Equity and inclusion have been taken care of proficiently by teachers as captured from the teachers' lesson plans through the use of strategies for giving equal opportunities for all the learners to participate and respond to various questions and activities. Teachers' lesson plans indicated the use of multiple modes of classroom interactions like asking students' to answer or solve problems, taking the students outside the classroom to picks stones, objects and so forth.

i. "Initially, the lesson taught was organized for the whole class together. after which I grouped the class for the lesson activities and each group with their own activities"
ii. "All students are girls in my school and special needs are given them more and special consideration during the lesson"

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	152
Teachers	211
Teacher Educators	108
Research fellow	10
Total	481

Table 6 implies that posts were mostly made frequently by NQT and Other Teachers as represented in order of Teachers > NQTs > Teacher Educators > Research fellow

B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	155
UDL	52
Technical	258
Communication/ Administrative	16
Total	481

Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	268
Images	135
External Links to other resources	40
Others	38
Total	481

Table 7.1 shows that postings on Technical issues outnumbered other categories of posts. This implies that technical issues are one of the major challenges experienced in this project.

Note: a post made on the CoP platform may contain one or more links, images or videos. In Table 5.2, each of the post types was considered a post and they were counted individually.

C. Qualitative dialogues/ discussion threads

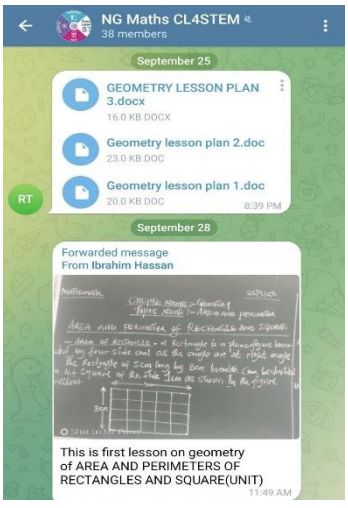


Figure 2: A submission to the Telegram group

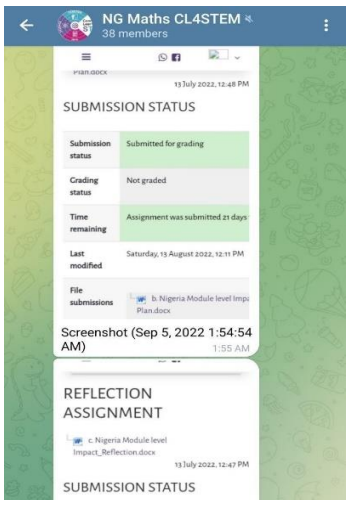


Figure 2: Evidence of the Reflection Submission

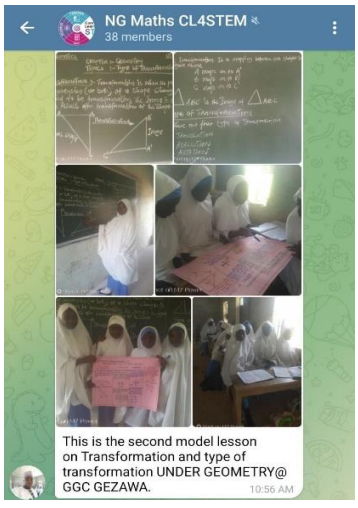


Figure 3: Cross-section of the class by NQT

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Challenges

Some teachers are not tech-savvy, so they upload handwritten scanned copies of lesson plans and reflection reports. Also, a number of individuals face obstacles in effectively putting the module into practice due to the presence of other school activities and the constraints of the school calendar.

B. Any changes required in the module design

Other activities that promote engagement on the platform should be integrated. And also, the provision of resources that help improve their technical skills.

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

Subject : Mathematics

Ratio and Proportions

Authored by:
Dr. Aliyu Alhaji Zakariyya, Prof. Abdulwaheed Adelabu Salihu

1. Introduction

Proportional reasoning is one of the crucial mathematical ideas students develop over the school years. It is a good indicator of learners' understanding of the relationship between two quantities through one to one correspondence at primary level. Proportional reasoning forms the basis for understanding measurement, conversion among units of measurement and therefore a foundation concept for comparing quantities. At middle and secondary levels, the understanding of proportional reasoning integrates understanding of rational numbers and related multiplicative concepts, and at the same time, it lays the foundation for more complex concepts of mathematics. Proportional reasoning has been an umbrella term that covers the thinking behind many concepts like equivalent fractions or equivalent ratios, rates, algebraic representation of ratios, direct and inverse variations, from scaling and to similarity, trigonometry and even concepts like probability. Percentages have proved to be quite useful in many mathematical citations including situations related to commercial mathematics involving dividend, discounts and budgets. These ideas will therefore form an important part of financial literacy for students and useful to empower them to use mathematics more meaningfully in their contexts.

A. Timeline of implementation:

The timeline for the implementation of the module was six (6) weeks
3rd/10/2022 To 21st/11/2022

B. Learning objectives

Identify the key concepts and ideas needed to strengthen students understanding of proportions, percentages and equivalent fractions. To connect proportions and percentages and understand how they are related to each other. The teachers should be able to use different representations of representing proportional situations. Connect proportional representation with real life situations.

C. Number of units:

Three (3)

D. Concepts covered

Concepts covered include: Ratios, fractions, proportion and percentages. Sub-topics are unit ratio, relationship between ratios and fractions, equivalent ratios, representation and modeling of percentages, fractional percentages and exploring scale drawings

E. Resources - activities, readings

Youtube (Videos), web sites, text books, outdoor activities and classroom activities
https://demo-clix.tiss.edu/softwares/Tools/Ratio-Patterns/Activity1/ new general mathematics book 2
https://phet.colorado.edu/sims/html/proportion-playground/latest/proportion-playground_en.html
Polypad – Virtual Manipulatives – Mathigon

F. Nature and purpose of assessments

The nature of assessment in the module consist of diagnostics, formative, summative and use of multiple modes of assessment such as pre-test, post-test and self-reflection assignments. The purpose of assessment involved the ability to learn, understand and apply the various concepts of proportion and percentages in the module as well as been able to identify and address students' misconceptions, allow NQTs to create and evaluate their own lesson plans, and find out possible relevant resources for teaching the topics.

2. Course completion rate

A. Overall completion

Table 1: Course completion rate by teachers

	NQTs	Others	Total
1 - 20%	-	-	-
21 - 40%	-	1	1
41 - 60%	-	-	-
61 - 80%	-	1	1
81 - 100%	5	13	18
Total	5	15	20

Table 1 shows that all the 5 NQTs recorded between 81% and 100% completion rate. Thirteen (13) out of fifteen (15) intervention group teachers recorded between 81% and 100% completion rate. While one (1) each recorded completion rates between 21% and 40% and 61% and 80% respectively.

B. Assessment completion rate

Table 2: Teachers' assessment completion rate

	NQTs	Others	Total
Pre test	5 (100%)	14(93%)	19(95%)
Session plans	5(100%)	14(93%)	19(95%)
Reflection	5(100%)	14(93%)	19(95%)
Post tests	5(100%)	15(100%)	20(100%)

Table 2 shows 95% completion rate in pre-test(one teacher didn't submit) teachers for both NQTs and Intervention others. However, (5) NQTs and fourteen (14) out of fifteen (15) intervention group teachers completed the session plans. On reflections and post tests, the NQTs recorded 100% completion while the intervention group recorded 93% completion rate for reflection and 100% completion rate for post-test. The overall completion rate is satisfactory.

3. Time spent on the course platform

Table 3: Time spent by teachers on Module platform

Hours spent	NQTs	Others	Total
Less than 10	4(80%)	14(93%)	18 (90%)
10 to 20	1(20%)	1(7%)	2 (10%)
21 to 30	-	-	-
More than 30	-	-	-
Total	5(100%)	15 (100%)	20(100%)

Table 3 shows most of the teachers both the NQTs and intervention teachers, spent less time on the Module platform. 4 out of the 5 NQTs and 14 out of 15 intervention teachers spend less than 10 hours on the platform. It can be seen that only 2 teachers (1 NQT and 1 Intervention teacher) spend between 10-20 hours on the platform. Finally, no teacher spends from 20-30 hours or above on the platform. Some reasons may be advanced for this low time spent, first may not be unconnected with the internet connectivity and the data subscription rate in Nigeria. The second reason may be the schools and home schedules of most of the teachers. The third may have to do with the computer literacy level of most of the teachers.

4. Change from pre- and post- test

Average total score in pre-test_5.40
Average total score in post-test_6.50

There was no significant variation between the pre-test and post test scores, however, a slight difference of 1.10 average increases can be observed. This may indicate teachers' development has taken place and the CL4STEM program might have an overall positive impact on the teachers' professional development. It should be noted that the pre-test and post test scores of 20 teachers were utilised for the analysis to derive both the average total scores and the findings as revealed in table 4.

Table 4: Change from Pre test to Post test

Number of teachers		Post Test			
		Novice	Emerging	Proficient	Accomplished
Pre test	0-25% Novice		2	1	-
	26-50% Emerging		12	1	-
	51-75% Proficient	-	1	3	-
	76-100% Accomplished	-	-	-	-

Table 4 shows the trend of how the teachers' progressed using their pre-test and post-test scores as indicators of advancement or otherwise as follows:

i. For the pre test novice category, two(2) teachers progressed to Emerging after posttest and one other(teacher) progressed to Proficient.
ii. The pre-test emerging category, twelve(12) participants remained in the emerging category even after participating in the program and also one (1) teacher progressed from emerging to proficient after the evaluation of the post-test score.

iii. The proficient category had four(4) teachers based on their pretest scores. One (1) regressed to emerging and three(3) remained in Proficient thus, no improvement after the test.

iv. In general, the teacher development program had a positive impact on 4 out of 20 teachers analyzed, as they progressed to higher categories of teacher development expertise. Also, one(1) teacher experienced drawbacks due to a step down to a lower category according to their post-test score. This is partly attributed to a number of factors such as health constraints, commitments from a place of work and financial constraints (internet connection is not readily available and expensive). The success is attributed to follow-up calls on CoP and school visits, prompt technical support, increased interest, acceptance and observed added value, and cooperation from stakeholders particularly principals and students among others. Thus, the experiences of the program have become more meaningful in the teachers' professional development.

5. Practice

Table 5

Criteria	Number of teachers				Total
	Novice	Emerging	Proficient	Accomplished	
A. Subject Matter Knowledge					
1. Knowledge of Subject Matter	4	2	14	0	20
2. Nature of Science/ Mathematics	3	0	17	0	20
B. Pedagogical Content Knowledge					
3. Instructional Strategies	3	11	6	0	20
4. Students' misconceptions & Learning Difficulties	6	4	10	0	20
5. Representation of the Content	5	6	9	0	20
6. Context for Learning	10	0	10	0	20
7. Curriculum knowledge	3	0	17	0	20
C. General Pedagogical Knowledge					
8. Equity and Inclusion	9	4	3	4	20
9. Classroom Management	9	0	10	1	20
10. Assessment	15	1	3	1	20
Total	67	28	99	6	200

A. Subject Matter Knowledge

When teachers are well-versed in their subject, they are able to extract it into key ideas that are simple for the students to understand. Because of this, teachers are able to choose the right teaching resources, ensuring that the teaching and learning process runs smoothly. In many cases, the teachers have demonstrated the use of diverse sets of resources. Let's look at an example of a teacher trying to explain the multiplicative relationship between two quantities in the image below. The teacher demonstrates a clear understanding of the subject matter.

5.*Testing prior knowledge: The students were asked questions based on their previous class (percentage)	
Time	5 minutes
Associated LO	Students will be able to represent quantities in the ratio form.
*Description of the activity/task/ *based on UDL principles*	**Activity:** Comparison between two quantities A & B is expressed as A:B. The notation A:B represents the quotient when A is divided by B. Ratios are often written for quantities of the same type. This comparison is a multiplicative relationship between two quantities. For example, Sonam's weight is 25 kg and his father's weight is 75 kg. In this case, the ratio of Sonam's weight to his father's weight is written as 25:75. For example, "There are 3 blue squares to 1 yellow square" can be shown in diagram as: After explaining with the example, students can be asked to solve the problems in the worksheet.

B. Pedagogical Content Knowledge

The teacher's competences in presenting the conceptual approach, relational understanding, and adaptive reasoning of the subject matter are included in the pedagogical content knowledge. By enhancing both teaching and learning methods, effective pedagogical abilities enhance the learning environment. Example, a teacher wrote on the reflection report that "learners interact with each other to carry out group activities and don't interact while doing individual work". This enhances students' understand and to avoid any misconceptions about the topic.

3. Learners' Engagement *a. How was the class organised (Whole class/Group/Individual Work)?* *b. Were learners interacting with each other and how?* *c. How did you address the emotional aspect of learning (for example, learners who were anxious/ stressed out/ less participatory)?*	
	a. Individual work and group work depending on the activity given to them **b. The learners interact with others while carrying out group activities and does not interact with each other while carrying out individual work as in activity 2 and 1 respectively. (Depending on the type of activity given)** **c. I involved them fully by asking them questions**

C. General Pedagogical Knowledge

The broad understanding of concepts and methods for organising and managing a classroom across a variety of subjects is referred to as general pedagogical knowledge. The lesson reflections shows how the classrooms were managed and provided equity between the students.

For classroom engagement, most teachers used multiple modes of classroom interaction, grouping and demonstrations and most teachers used summative assessment to grade the students.

a. I used the following resource: 1. lesson note on White Marker board. 2.marker to write on the board 3. Paper for solving equations 4. mathematical sets **b.** Yes. Because I was able to move round all the divers learners groups and give the maximum supports they needed, no student with special need among them. **c.** The learners enjoyed the activity session most. The least session they enjoyed is the solution of the question that asks to draw pie chart. **d.** Both boys and girls participate the same way without any diversification of religious and ethnicity. Both students with low and high Socio-economic background were treated equally.	

EVALUATION: The teacher evaluates the lesson by asking the students to convert the following.

i. 0.75 to fraction. ii. 3/4 to decimal

SUMMARY: The teacher summarizes the lesson in brief and allow the students to ask questions.

CONCLUSION: The teacher concludes the lesson by giving the students assignments:

1.Evaluates the following

i. 21.08 + 13.72

ii. 134.24 + 21.07

iii. 86.512 - 22.052

iv. 205.392 - 713.227

6. Social learning in CoPs

A. Frequency of posts

Table 6: Frequency of posts by participants

Role	Number of posts
NQTs	9
Teachers	2
Teacher Educators	5
Research fellow	3
Total	19

B. Frequency of posts

Table 7.1: Frequency of posts by content

Type of Posts	Number of posts
PCK	2
UDL	2
Technical	5
Communication/ Administrative	10
Total	19

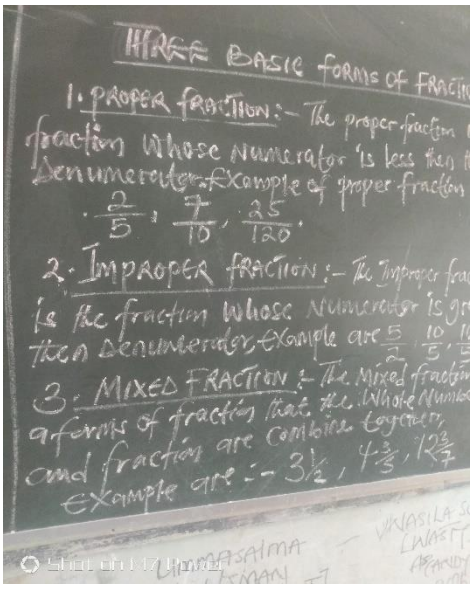
Table 7.2: Frequency of posts by type

Type of post	Number of posts
Text only	45
Images	20
External Links to other resources	5
Others	5
Total	75

C. Qualitative dialogues/ discussion threads

The pictures above showed students in group works during proportion session.

CONCLUSION



The teacher concludes the lesson by giving the students assignment:

There are 12 girls and 18 boys in a certain class.

i. What fraction of the class is boys? Girls?
ii. What percent of the class are girls?For any 18 boys there are 12 girls. How do you write it in ratio form?
iii. If there are 24 boys,how many girls are there?

Resources/ Materials:

Pencil, Notebook, hair oil, cream and toothpaste.

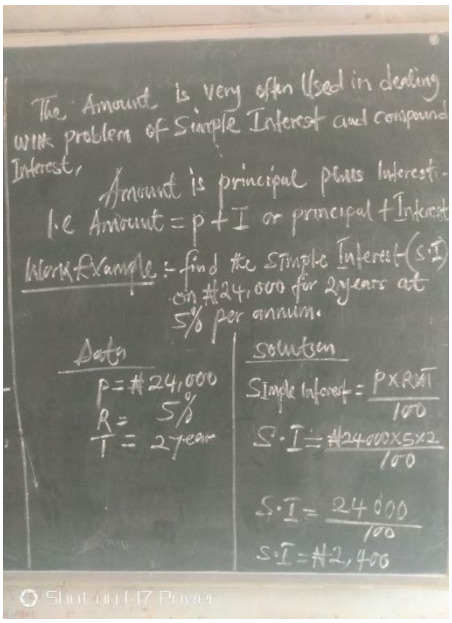
Students will visit this link: Egyptian Fractions – Mathigon to further explore fractions and eventually connect it to ratios.

Activity 1: In this activity, students will be using a digital tool called a pattern tool. When the problems related to scale factor, scaling up and scaling down are solved numerically, they are not able to learn these concepts. This tool will allow students to scale and shrink the patterns in such a way that the visual appearance of it remains the same. These activities will help students to think multiplicatively by scaling a given pattern up or down.

Task 1: The grid boundary for a scaled up or down pattern is given and students are asked to find the scale factor in the given grid.

7. Teacher Educator's reflection on the overall implementation (Moodle and CoP)

A. Participation of teachers



As for the module implementation, most of the teachers try their outmost best to implement if. We are aware of cases where some teachers have to create some extra hours in order to meet up and manage both the school schedules and module implementation. However, only few of the NQTs do participate in the COPs. Some of them ask few questions and hardly post anything. This can be improved by posing some challenging activities of novel problems. Below are some of their responses in the Cop.

Teacher 1: Hello Team, let us hasten up to complete our tasks of the open module
Teacher 2: I have uploaded my session Plan assignment 1 and 2 waiting for grades
Prof. Garba: They will be graded

Teacher 3 [12/7/2022 12:09 PM]: Thanks Almighty God I have finished all activities in all modules
Tecaher 1 [12/7/2022 8:44 PM]: Congratulations my man

B. Challenges

i. Some of the NQTs have challenges with writing their lesson plans following the module format.
ii. Some also have challenges of internet services and poor network.
iii. Some do have challenges of actually implementing the module because of other school activities and school calendar.
iv. Some schools' environment are not really contusive for proper implementation of the modules

C. Any changes required in the module design

i. More content or illustrations on Pedagogical Content Knowledge (PCK should be included
ii. More content or illustrations on Universal Design Learning (UDL) should be included
iii. Word problems relating to current issues should be increased
iv. Questions and assessment activities should be more of Higher Order Thinking

Data Sources Used

1. Moodle completion rate raw data
2. Moodle time spent raw data
3. Teacher pre test and post test data
4. All teachers' lesson plans and reflections
5. Teachers' responses for the pre and post test surveys
6. Telegram CoP group data download for the during of the module

This work is supported by the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX), a joint endeavour with the International Development Research Centre (IDRC), Canada. The views expressed herein do not necessarily represent those of IDRC or its Board of Governors.

IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

Canada

GPE Transforming Education

www.connectedlearningforstem.org

IBRAHIM BADAMASI BABANGIDA UNIVERSITY
Lapai

Samtse College of Education

THE OPEN UNIVERSITY OF TANZANIA
Since 1992
Quality Education for All

RE-IMAGINING FUTURES
TISS