Complementary CL4STEM Module: Competency-Based Digital Skills Training for STEM Teachers - Iringa District Council

TANZANIA REPORT

United Nations
Educational, Scientific and
Cultural Organization

UNESCO Chair on
Teacher Education and Curriculum
Open University of Tanzania
Dar es Salaam, Tanzania

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Executive Summary

This report documents the implementation and outcomes of the Competency-Based Digital Skills Training for STEM Teachers delivered as a complementary module under the CL4STEM initiative in Iringa District Council. The module was developed at the intersection of two converging drivers. First, it was designed to complement and deepen earlier CL4STEM project phases by translating learner-centered pedagogy into concrete digital classroom practice. Second, it responds directly to recent national reforms in education and digital policy that require teachers to deliver competency-based, digitally enabled, and inclusive learning.

The training focused on how teachers plan, teach, assess, and reflect using digital tools that are practical in low-connectivity school environments. It moved beyond digital awareness to emphasize classroom application, ensuring that technology supports real learning outcomes.

The programme was delivered fully online through Moodle and Zoom and engaged STEM teachers from nine secondary schools in the council. Twenty-four teachers completed all required components and applied their learning directly in their classrooms through a compulsory capstone project. The module was built on pedagogical foundations developed through earlier CL4STEM phases and translated them into daily digital teaching practice aligned with national expectations. The training followed a structured pathway consisting of five learning units, a Training of Trainers component, and a classroom-based capstone. Teachers were guided to design lessons that focus on what learners can do in real tasks. Competency-based teaching principles were applied alongside TPACK to align content, pedagogy, and technology, while UDL supported inclusive lesson design. Teachers worked with simulations, collaboration platforms, open educational resources, and selected AI tools used responsibly and in line with national guidance.

Evidence from assessments and classroom practice shows clear improvement in teachers' digital competence. Pre- and post-test results indicate measurable learning gains, while capstone data show that most teachers were able to translate training into real classroom action. Teachers used at least two digital tools in their lessons, with simulations and digital assessments improving learner understanding and engagement, especially in abstract STEM topics.

Teachers reported increased confidence and readiness to apply digital tools and to support colleagues. Many described the capstone as the most valuable part of the training because it required immediate classroom use. Over ninety percent of participants expressed willingness to train peers, creating a strong foundation for council-wide expansion.

Challenges included internet instability, limited access to devices, and time constraints. Teachers responded by prioritizing low-bandwidth tools, sharing devices, and supporting one another through peer groups. Their suggestions emphasized blended delivery, school-based sessions, more practice time, and stronger support through Teacher Resource Centres.

District leadership engagement during dissemination confirmed readiness to scale up the programme. The council committed to using school clusters and TRCs to coordinate training and monitoring. Teachers favored classroom observation, digital lesson evidence, and peer learning communities over routine reporting, pointing to a practice-focused scale-up approach.

The module aligns with the competency-based curriculum, the National Education and Training Policy, the National Digital Education Strategy, the National AI Guidelines in Education, and the National Digital Education Guidelines for Schools and Teacher Colleges. It translates policy expectations into practical classroom action while reinforcing the pedagogical foundations of earlier CL4STEM modules.

Overall, the Competency-Based Digital Skills Training for STEM Teachers demonstrates that when strong pedagogy is combined with digital competence and policy alignment, real classroom change is achievable. The experience in Iringa District Council shows that with peer leadership, practical support, and use of existing systems, digitally enabled competency-based teaching can be sustained and scaled across public secondary schools.

Acknowledgements

We would like to express our sincere gratitude to the International Development Research Centre (IDRC), Canada, for funding this research project under the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX). Our heartfelt thanks go to the Tata Institute of Social Sciences (TISS), India, for their expert guidance and advice as technical consultants, which played a significant role in the successful completion of the project.

We also extend our gratitude to the CL4STEM project partners from Ibrahim Badamasi Babangida University (IBBUL), Nigeria, the consortium lead under Prof. Tajordeen Mustapha, and Samtse College of Education (SCE), Bhutan, for the continuous collaboration and shared expertise throughout the project, for which we had bi-monthly governance meetings. We are deeply thankful to the teachers under four different subjects leaders (L. Songoro, E. Kahise, K. Lydia and D. Paul) and school heads led by O. Nosa, officials from the ministries related to education and local government authorities, the Iringa region education office, and Iringa District Council director, the DEO the main beneficiary A. Nkwera and the team whose invaluable cooperation and support, despite their busy schedules, were crucial to the success of this project. We appreciate the support of the Open University of Tanzania (OUT) and the UNESCO Chair in Teacher Education and Curriculum, especially Prof. Alex Makulilo, the OUT Vice Chancellor, and Prof. Elifas Bisanda, the UNESCO Chairperson of Teacher Education and Curriculum Development at OUT, whose guidance was invaluable. Special thanks to the OUT Project team, led by Dr. Edephonce Nfuka, for their exceptional work in this project implementation. These were Prof. Paul Ikwaba, Dr. Hariet Hellar, Dr. Hassan Mateka, and Mustapha Kiswanya. This team, along with Medard Rembesha (Research fellow), Shadrack Mbogela and Albert Ishengoma (e-learning experts), and Hintay Baran (project accountant), played a key role in the project management, module development and delivery, data collection and analysis, report writing, and output dissemination.

Lastly, we are grateful to the Commission of Science and Technology (COSTECH), which originally granted research clearance, and to the Ministry of Education, Science and Technology (MoEST) and the President's Office, Regional Administration and Local Government (PO-RALG) for fostering an enabling environment for successful project implementation.

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Abbreviations

AI	Artificial Intelligence
CBE	Competency-Based Education
CL4STEM	Connected Learning for STEM
CoP	Community of Practice
CPD	Continuous Professional Development
DC	District Council
DEO	District Education Officer
GPE-KIX	Global Partnership for Education – Knowledge and Innovation Exchange
HOTIE	Higher Order Thinking with Inclusion and Equity
IBBUL	Ibrahim Badamasi Babangida University, Lapai
ICT	Information and Communication Technology
IDRC	International Research Development Centre
LMS	Learning Management System
MoEST	Ministry of Education, Science and Technology
OER	Open Educational Resources
OUT	Open University of Tanzania
PCK	Pedagogical Content Knowledge
SCE	Samtse College of Education
SNA	Social Network Analysis
STEM	Science, Technology, Engineering, & Mathematics
TE	Teacher Educator
TISS	Tata Institute of Social Sciences
ToT	Training of Trainers
TRC	Teacher Resource Centre
TPACK	Technological, Pedagogical, And Content Knowledge
TPD	Teacher Professional Development
UDL	Universal Design for Learning

1.0 INTRODUCTION

1.1 Background

The Connected Learning for STEM (CL4STEM) initiative aimed to improve how STEM subjects are taught by expanding the use of digital tools, open resources, and innovative teaching approaches. The Open University of Tanzania has been leading this work in Tanzania and has worked with Iringa District Council since the early phases of CL4STEM. Specifically, this report is about the finalized project on Competency-Based Digital Skills Training for STEM Teachers.

This Competency-Based Digital Skills Training for STEM Teachers, which is a CL4STEM complementary module, extended prior initiatives by focusing on digital skills that STEM teachers need in teaching the new competency-based and digital-oriented basic education curriculum. The module also responded to the council's plan to improve digital readiness in all its schools. It used an online delivery mode to reach teachers consistently and help them apply digital tools directly to their subjects and classroom needs.

Furthermore, the development of this "Competency-Based Digital Skills Training for STEM Teachers" was based on the fact that Modern digital education emphasizes empowering teachers with the competencies to access, create, collaborate, teach, and reflect on the teaching and learning process and experiences through open, engaging, and intelligent technologies (Figure 1). Educators are increasingly using Open Educational Resources (OER) to find, adapt, and share freely licensed materials that enhance inclusivity and collaboration. Responsible and ethical use of OER, such as adhering to Creative Commons licensing and maintaining academic integrity. Teachers can use collaboration and assessment tools such as Zoom, Kahoot, and Moodle, as well as access, create, and use interactive simulations such as PhET, GeoGebra, and BioDigital Human, fostering engaged and active STEM learning.

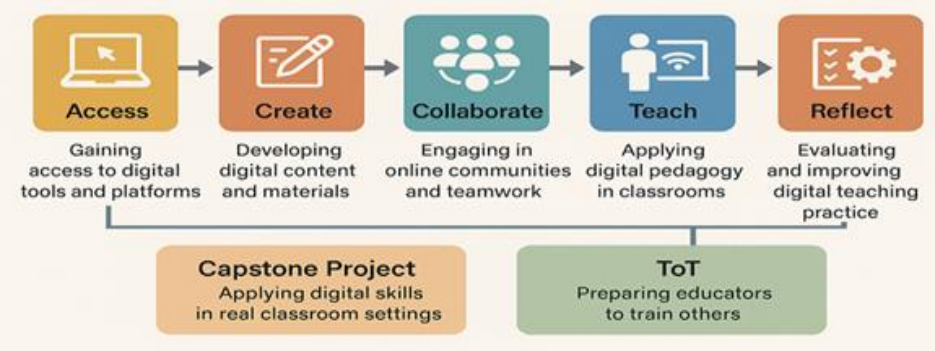


Figure 1: Competency-Based Digital Skills Training for STEM Teachers approach

The growing integration of Artificial Intelligence (AI) in education further expands these possibilities. Teachers can now apply AI tools to design adaptive, multiple-representing, and balanced technological, pedagogical, and content lessons as well as generate quizzes, support multilingual classrooms, provide real-time feedback, and strengthen personalized and competency-based learning. Ethical considerations such as bias, misinformation, and plagiarism are key in aligning AI use with national guidelines that require its responsible use. All these digital tools and associated approaches, such as competency-based Teaching and Learning, TPACK, and UDL, together redefine the teacher's role from content consumer to creative digital innovator, advancing inclusive, data-informed, and sustainable education for all.

This report, at the end of the project, which created a structured path for teachers to explore tools, build skills, and apply what they learned in the classroom, covers the implementation approach, content development and validation process, training delivery, capstone work, dissemination, and eventually recommendations

1.2 Project Objectives

This CL4STEM complementary module aimed to:

a) Build practical digital skills that STEM teachers can use in planning, delivering, and evaluating learning
b) Support teachers to create digital lesson activities that match the new competency-based and digitally enabled curriculum.
c) Strengthen teachers' understanding of TPACK, UDL, and active learning approaches.
d) Improve teachers' ability to use OER, digital collaboration tools, simulations, and AI tools.
e) Provide an opportunity for each teacher to apply digital tools through a classroom capstone activity.
f) Encourage teachers to share skills with others using a ToT approach and gather information on what is needed for a council-wide scale-up plan.

These objectives reflect both national goals for improving digital competence and the council's plan to improve classroom teaching through digital means.

1.3 Description of the CL4STEM Complementary Module

The module, Competency-Based Digital Skills Training for STEM Teachers, consisted of five units, a training of trainers (ToT), and a capstone project, where in ToT, teachers were prepared to train their peers in schools and the council clusters, and in the Capstone project, integrating at least two digital tools while applying the competency-based TPACK and UDL approach. This approach focuses on what the learners can do in real tasks. It blends three ideas into one classroom practice, i.e., teach for skills, not coverage (competency-based); match content, teaching methods, and tools (TPACK); and design lessons that fit learner differences (UDL). The whole package builds teacher competency, focusing on digital skills that are practically applied and aligned with what they teach in Biology, Chemistry, Physics, and Mathematics. The units, also shown in Figure 2, are:

Unit 1: Competency-Based Digital Skills - How to design tasks & organise lessons using digital tools.

Unit 2: Digital Access, Delivery, and Collaboration - Using tools such as Moodle, Zoom, WhatsApp, and Google to encourage online & offline collaboration, discussions, and engagement.

Unit 3: ICT for Professional Development - How digital tools support CPD and the Safe and responsible use of digital platforms to advance teacher applied digital competencies in STEM.

Unit 4: Open Educational Resources (OER) - Locating OER and adapting localised content.

Unit 5: AI in Education - Using AI tools safely and responsibly for content generation and reviews.

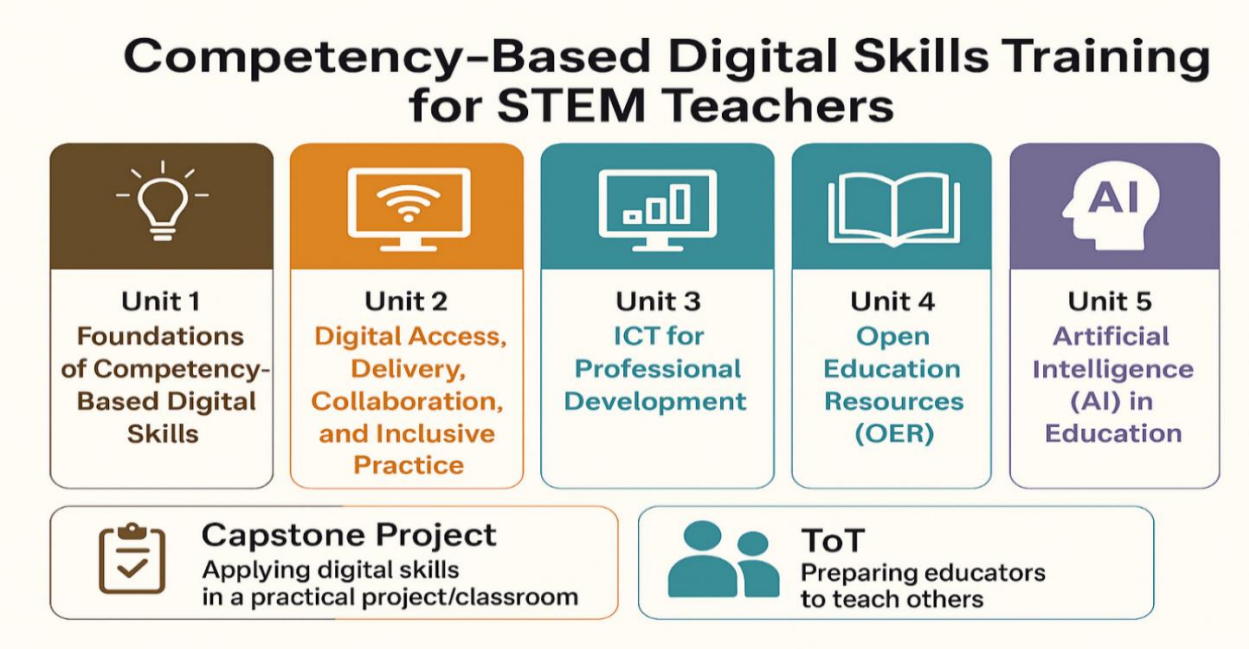


Figure 2: The CL4STEM complementary module content

2.0 IMPLEMENTATION APPROACH AND OUTCOME

2.1 Participant Profile – Who Was Trained and Why

A total of 30 secondary school STEM teachers, 23 being males and 7 females, participated in this complementary module, coming from nine (9) secondary schools (Table 1) located in Iringa District Council (DC).

The selection was guided by:

a) Their earlier involvement in CL4STEM modules and involved activities

b) Their willingness to adopt digital tools in the classroom

c) Their ability to support peers during scaling up in their schools and the council

d) The council's intention to strengthen digital teaching in all its schools

Teachers covered four STEM subjects: Biology, Chemistry, Physics, and Mathematics. This variation enabled the relevance testing of digital tools across various subjects and topics.

Table 1: Participating schools and STEM teachers in the training

S/N	School name	Number of Teachers	Gender		Subject
			M	F	
1.	Kibena	1		✓	Basic Maths
2.	St. Mary's Ulete	2	✓		Chemistry
				✓	Biology
3.	Tanangozi	5	✓		Biology
			✓		Basic Maths
			✓		Chemistry
				✓	Physics
			✓		Biology
4.	Ifunda Technical	3	✓		Physics
			✓		Chemistry
			✓		Basic Maths
5.	Lipuli	4	✓		Physics
			✓		Chemistry

				✓	Basic Maths
				✓	Biology
6.	Mgama	5		✓	Chemistry
			✓		Basic Maths
			✓		Biology
			✓		Physics
			✓		Physics
7.	Lumuli	4	✓		Physics
			✓		Basic Maths
			✓		Chemistry
			✓		Biology
8.	Lyandembela	4	✓		Physics
			✓		Basic Maths
			✓		Chemistry
			✓		Biology
9.	Bread of life	2		✓	Biology
			✓		Physics
	Total No. of Teachers	30	23	7	

2.2 Content Development

2.2.1 Phase 1 - Content Development and Its Deployment in Moodle

The starting point for the module was the digital skills section of the TISS (Teacher Instructional Support System) training package. The OUT team adapted this material to reflect the needs of Iringa DC schools.

This involved:

- Integrating OER materials from our partners in India (TISS) and other sources relevant to STEM in Tanzania
- Adding practical examples, scenarios, and reflections based on local classroom experiences
- Including tools that work well under low-connectivity conditions

- Introducing AI tools that teachers should use responsibly
- Aligning unit content with the New Competency-Based Curriculum as
- Integrating relevant aspects from the National Education and Training Policy (2023)
- Integrating relevant aspects from the National Digital Education Strategy and guidelines
- Adjusting tasks to match the realities of rural and urban schools
- Updating the structure to strengthen collaboration and digital assessment
- Uploading to Moodle the content, including all involved illustrations.

The final content was uploaded to Moodle and structured into five units with readings, activities, examples, case studies, reflections, and quizzes. This also applies to additional coverage on the ToT and Capstone project.

2.2.2 Phase 2 – Validation Sessions

a) Educators' Validation Session

Educators from OUT involved in the project reviewed the modules before teachers interacted with them. This was done directly in Moodle. Their review focused on:

- Appropriate and accurate content
- Relevance of application to STEM subjects
- Alignment with current national policies and priorities
- Clarity of instructions
- Appropriateness of tools selected for secondary schools

Their feedback helped to strengthen their application across the STEM subjects and improve the flow of instructions across the units.

b) Teachers' Validation Session

A sample of teachers from each subject involved, Physics, Chemistry, Biology, and Mathematics, reviewed the material next. This was done directly in Moodle. They focused on:

- Whether the content is suitable and the tasks are practical
- Clarity of instructions and steps
- Suitability of tools in their school settings and level

- Time needed to complete the content and the involved assignments for self-assessment and submission
- How each digital tool and approach fits into STEM lesson delivery

Their feedback led to some improvement for clearer explanations, better tool choices, and sharpened capstone instructions. This resulted in the content that was used throughout the training, as shown in one of the screenshots from Moodle.

2.3 Content Delivery

2.3.1 Phase 1 – Online Training Delivery

The full training was delivered online using Moodle for content access, discussions, and assignment submission, as well as Zoom for live sessions. Teachers completed one unit at a time and attended live sessions from 3:00 PM to 6:00 PM.

Key elements included:

- Unit content delivery, discussion, and practical assignments
- Quizzes at the end of each unit
- Demonstrations on how to use digital tools
- Question-and-answer sessions
- Reminders, sharing of experience, and educators/peer support via Community of Practice (CoP) via WhatsApp.

Teachers progressed through the module steadily. The online model made it possible for them to attend and get consistent support even when they were in movement within or beyond the council.

2.3.2 Phase 2 - Capstone Implementation in their Real Classrooms

After completing the five units and ToT, teachers applied what they learned in real classrooms. Each teacher selected a topic from their subject and used at least two digital tools to support classroom delivery. Tools used, among others, were PhET simulations, GeoGebra, Quizizz, Otter.ai, ChatGPT, Copilot, and NotebookLM. This also applies to OER such as OER Commons.

Through a questionnaire on capstone project implementation views, teachers shared reflections on how the tools helped learners understand the topic, and any challenges faced in classrooms, what

changes they noticed in student engagement, and how these tools could fit into future lessons.

Among 24 teachers who completed the training and responded to that questionnaire on the capstone project, 21 teachers, who represent 87.5%, reported having implemented the capstone project in the classroom (Figure 3). This indicates a high level of adoption and acceptance of the capstone project as a teaching and learning strategy. The widespread implementation suggests that most teachers recognize the value of capstone projects in promoting applied learning, integration of knowledge, and development of higher-order skills among learners.

Conversely, a small proportion of teachers (3 teachers, representing 12.5%) reported that they did not implement the capstone project. This may imply the presence of certain challenges or constraints, such as limited time, insufficient training, lack of resources, or uncertainty about implementation guidelines. Overall, the results suggest that while capstone project implementation is largely successful, targeted support may be required to enable full participation by all teachers.

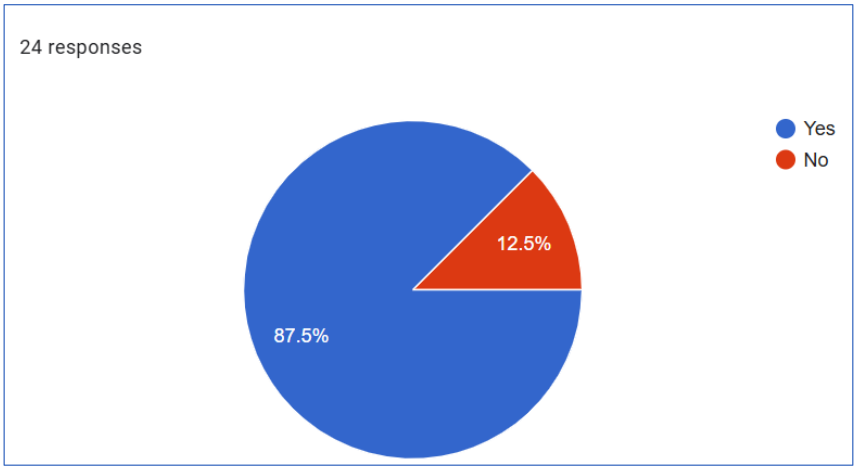


Figure 3: Capstone project completion

2.4 Gender, Ethics, and Safeguarding

Gender and ethics were central to the implementation, as Gender balance was considered when selecting participants. All teachers provided consent before joining the training (Figure 4), and their data from Moodle, Zoom, and surveys was kept confidential. Teachers learned safe digital practices, especially when using AI tools, and no safeguarding issues were reported at any stage.

Figure 4: Teachers' consent before joining the training and associated surveys.

2.5 Training Content, Delivery, Assessments, and Implementation

2.5.1 Training Content and Activities (Survey-Guided Themes)

The training content was organised into five units delivered through Moodle (Figure 5). Each unit included readings, demonstrations, case studies, self-check activities, and assignments. The Zoom sessions supported teachers with live explanations and tool practice. The content and activities followed the themes used in the evaluation survey.

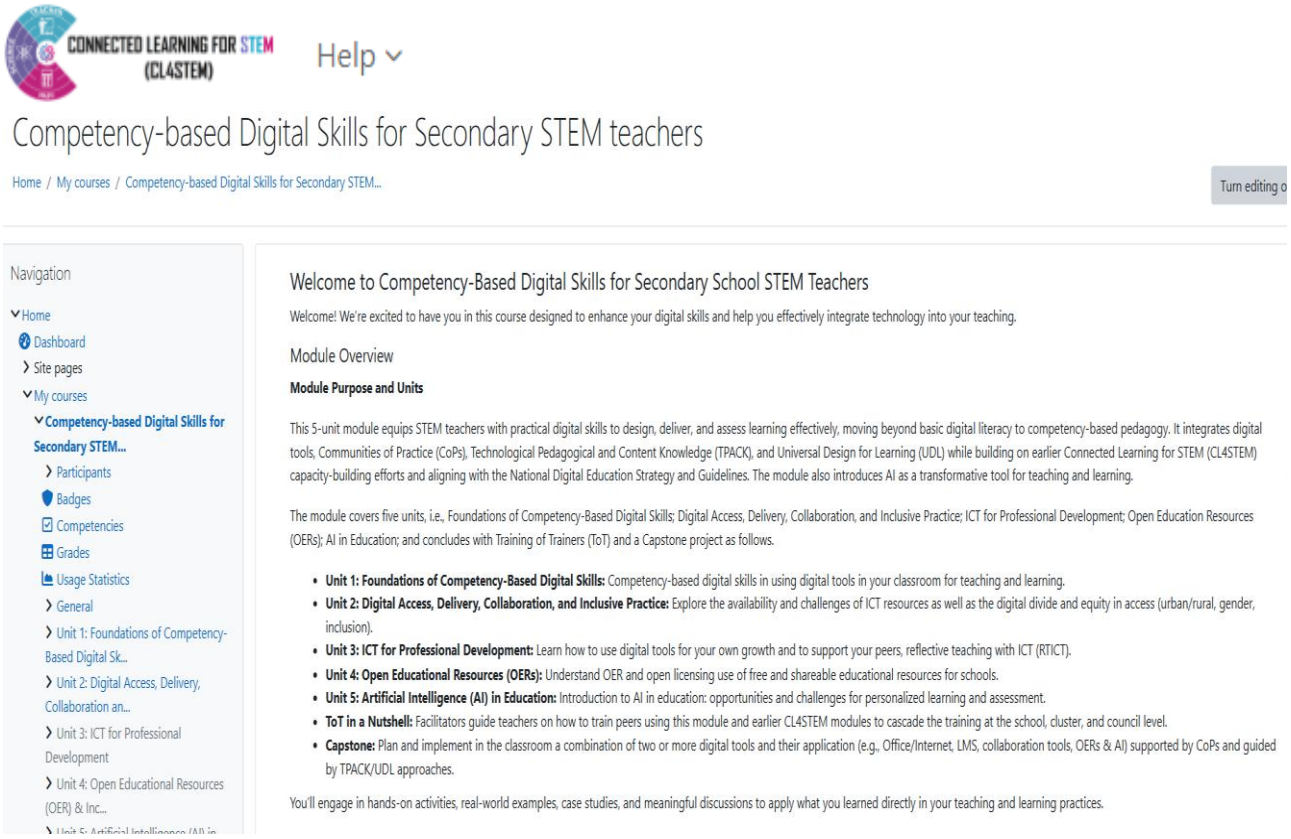


Figure 5: Content organisation into units delivered through Moodle

a) Course Experience

Teachers interacted with a sequence of learning materials designed to improve digital teaching skills. This included Structured daily units, Clear guidance for completing tasks, Examples and practical demonstrations, Zoom sessions for walkthroughs of key tools and their use in teaching and learning, and Spaces for questions and discussions on challenges. This combination helped teachers follow a clear progression from basic skills to practical classroom use.

b) Usefulness and Application of Content

The content focused on applying digital tools to STEM lessons through Competency-based lesson planning, supporting the use of Technology in Pedagogy and Content through TPACK principles, using digital collaborative tools, and adapting OER. Others are introducing digital assessment, using AI tools for content generation, planning, and reflection, and supporting inclusive delivery through UDL principles. Teachers shared that they gained new ideas for planning lessons and organising digital activities.

c) Assessment and Practical Activities

Assignments and quizzes helped teachers grow their skills in a step-by-step manner. Teachers completed five quizzes, five assignments, a digital capstone, and Self-reflections in Moodle (Figure 6). These tasks made it easier to check progress and apply skills in real situations.

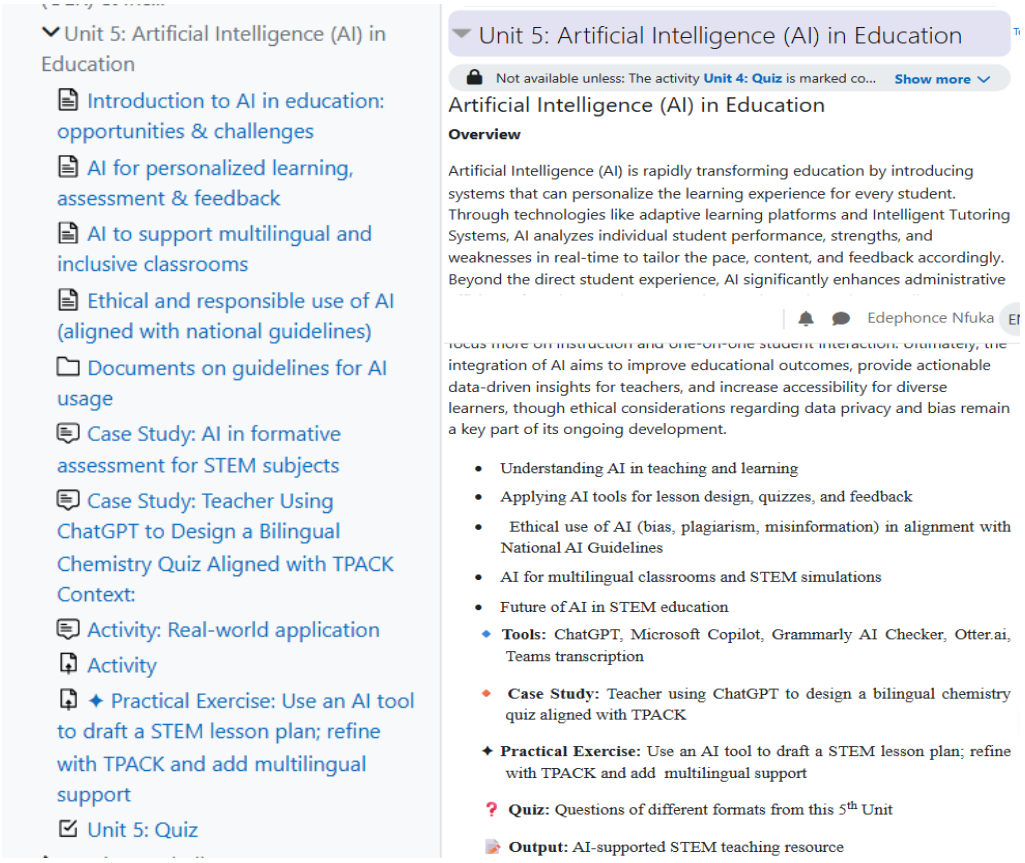


Figure 6: Sample of Activities undertaken in a unit

2.5.2 Teacher Engagement (Survey-Guided Themes)

Engagement was measured through Moodle activity logs, Zoom attendance, assignment submissions, and reflections. The survey themes guide the structure below:

a) Participation and Completion

Teachers (24) completed the required activities throughout the five units. Key engagement patterns included Active submission of assignments (Figure 7), participation in Zoom sessions, and presence on WhatsApp for interaction & support. One dropped early & 5 didn't make it to the end.

S/N	Teacher's Name	Why, finding, adapting, and sharing OER	Searching for OERs in recognized repositories	Licensing OER under Creative Commons and accessing OER Commons platforms	Topic 2 Resource Folder	Activity 2.1 - Identifying licenses in documents and various rich media resources.	Activity 2.2 - Exploring practical Creative Commons licensing	Activity 2.3 - Recognizing the Meaning of Creative Commons Licenses	Embedding OER into interactive simulations (PhET, GeoGebra, BioDigital Human)	Responsible and ethical use of OER content	Case Study: Integrating OER into Interactive STEM Simulations and Moodle	License an OER under Creative Commons and access OER Commons platform	Unit 4: Quiz	Documents on guidelines for AI usage	Case Study: AI in formative assessment for STEM subjects	Case Study: Teacher Using ChatGPT to Design a Bilingual Chemistry Quiz Aligned with TPACK Context:	Activity: Real-world application	✦ Practical Exercise: Use an AI tool to draft a STEM lesson plan; refine with TPACK and add multilingual support	Unit 5: Quiz	Introduction to ToT	Activities for STEM teaching in any secondry school classroom	The Capstone Experience in STEM Teaching	Post Test
1	Anna David Mwakasekele	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Asifiwe Simon Mwamakula	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Athumani Mohamedi Mkumba	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	Augusto Bernado Tweve	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Batwel Ngahega	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Christopher Mkepule	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	Cyprian Mwasallah	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	Daniel Lutitu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	Emmanuel Jonathan Kahise	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
10	Ezekia Jasti Dabba	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	Fabian Kalinga	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Fabiana Petro Mohele	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Furaha Said Makunga	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	Hilalio Msanze	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
15	Jane Mbata	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	Juhudi Nyemba	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	Linus Paul Songoro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	Lydia Anthony Kayanda	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	Maurine Augustino Muro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	Nolick S. Kavikule	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
21	Paul Mbilinyi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	Paul Nkalango Daud	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	Rahim Msigala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	Rose Ezekiel	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	Salum Bundu Matela	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	Silasi Augustino Kipako	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	Vedasto Dallu	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	Witness Ernest Msavi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
29	Zacharia Luambano	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Figure 7: Course completion generated from Moodle shows activities done by those who finished

b) Support and Guidance

Teachers received ongoing support from OUT facilitators. Forms of support included Step-by-step

explanations of digital tools, Quick responses in WhatsApp, Extra guidance during Zoom sessions, and Clarifications on capstone expectations. Teachers noted that this support helped them stay on track.

c) Use of Digital Tools

Teachers explored a range of tools during the training. Most used included PhET, GeoGebra, Quizizz, Google tools, Moodle tools (quizzes, assignments), AI tools (ChatGPT, Copilot, NotebookLM), and OER platforms. Teachers gained confidence in applying these tools to STEM topics.

d) ToT Readiness

These areas contained themes from engagement, increased confidence, willingness to try new tools, and interest in supporting colleagues. The majority of teachers expressed interest in leading peer training in their schools or clusters. Analysis of the questionnaire responses reveals that out of 24 participating teachers, 22 (91.7%) expressed a willingness to train their peers (Figure 8). This overwhelming majority reflects a strong teacher culture of collaboration, professional commitment, and knowledge exchange. The prevalence of such attitudes suggests that peer-led initiatives could serve as a viable mechanism for capacity building, mentorship, and the long-term sustainability of professional development programs within the school, clusters, and the Council as a whole.

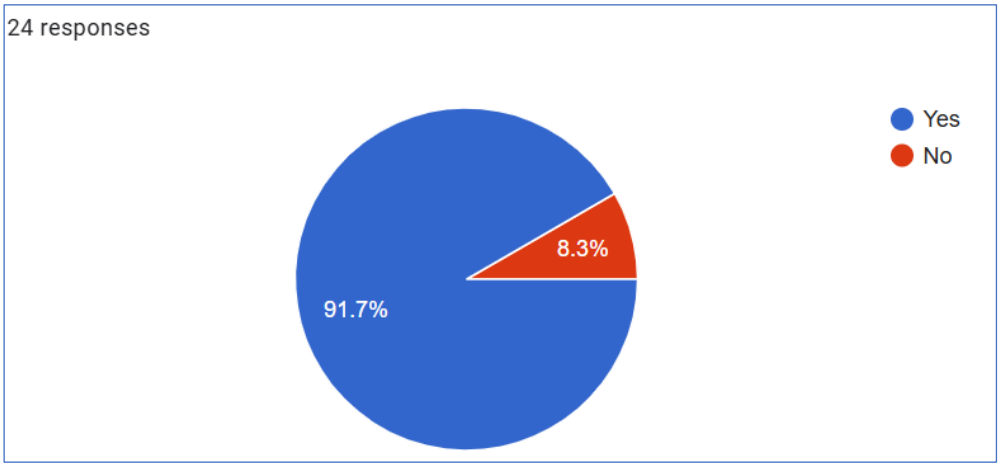


Figure 8: ToT readiness - teachers willing to train peers

In contrast, only 2 teachers (8.3%) reported unwillingness to engage in peer training. While this minority response does not significantly alter the overall trend, it highlights potential barriers that may warrant further investigation. Possible explanations may include individual workload constraints, limited confidence in instructional capacity, insufficient prior experience, or other personal and organizational factors.

Overall, the findings indicate a highly supportive environment for peer training initiatives, with minimal resistance that could be addressed through encouragement, recognition, or additional support.

2.5.3 Capstone Classroom Implementation

The capstone reinforced practical application. Teachers taught using digital tools that matched their lesson topics. Teachers used at least two digital tools to teach a STEM concept. Engagement in capstone work included designing a digital lesson, using simulations, introducing collaborative work, and sharing reflections (Figure 9). The Teachers completing the capstone were at 87.5%.

Physics Group Work – TPACK approach

STEM LESSON PLAN: Projectile Motion

Subject: Physics / Integrated Science

Topic: Projectile Motion

Class Level: O-Level (Form II or III)

Duration: 80 minutes (Double Period)

Language of Instruction: English

Teaching Framework: TPACK (Technological, Pedagogical, and Content Knowledge)

1. Learning Objectives

- Define projectile motion and identify examples in daily life.
- Describe the horizontal and vertical components of projectile motion.
- Use technology (simulation or video) to visualize the path of a projectile.
- Calculate basic parameters such as time of flight, range, and maximum height.
- Design & perform a simple experiment or simulation demonstrating projectile motion.
- Communicate findings

2. TPACK Framework Integration

TPACK Element	Application in Lesson
Content Knowledge (CK)	Understanding of projectile motion, horizontal & vertical components, and relevant equations.
Pedagogical Knowledge (PK)	Inquiry-based, collaborative, and experiment-driven learning.
Technological Knowledge (TK)	Use of PhET Simulation – 'Projectile Motion', videos, and data recording tools.
TPACK Integration	Students use simulations and digital tools to visualize and analyze projectile motion while applying physics and math concepts collaboratively.

Figure 9: Part of an Example of a Capstone project implemented in a Physics class

Observed outcomes included better understanding of abstract ideas in STEM, improved student interest, more interaction during lessons, and increased teacher confidence. Teachers shared that using digital tools helped them organise their lessons more clearly and explain difficult concepts more effectively.

2.5.4 Pre- and Post-Test Assessment

The Pre and post-test assessments measured changes in teacher understanding of digital skills and the integration of teaching and learning in their subjects.

a) Pre-Test and Post-Test Assessment

Before beginning the online training, teachers completed a pre-test designed to assess their baseline digital skills, familiarity with digital tools, and readiness for competency-based digital pedagogy. This diagnostic assessment helped facilitators understand teachers' starting levels and tailor the training emphasis accordingly.

At the end of the training, teachers completed a post-test. The pre-test and post-test were the same questions that evaluated improvements in digital literacy, use of digital tools for STEM instruction, competency-based lesson design, and application of TPACK, UDL, and OER principles. The comparison between pre-test and post-test results provided measurable evidence of growth in digital skills and their integration in teaching and learning as a direct outcome of the training.

b) Pre-test and Post-test Analysis Report

This report includes a graphical analysis of pre-test and post-test performance for the 24 participating teachers. The charts illustrate the overall improvement and individual performance changes resulting from the training.

The comparison between pre-test and post-test results shows a great overall improvement in teachers' digital competency following the training. The average pre-test score was approximately 6.2, indicating a moderate baseline level of digital skills, while the average post-test score increased to about 8.0, demonstrating significant growth after completing the course activities and interactive sessions. This represents an overall learning gain of roughly +1.8 points, confirming that the training, despite time constraints, had a positive impact on strengthening teachers' skills

in digital pedagogy, use of STEM simulations, online learning tools, and competency-based instructional approaches (Figure 10).

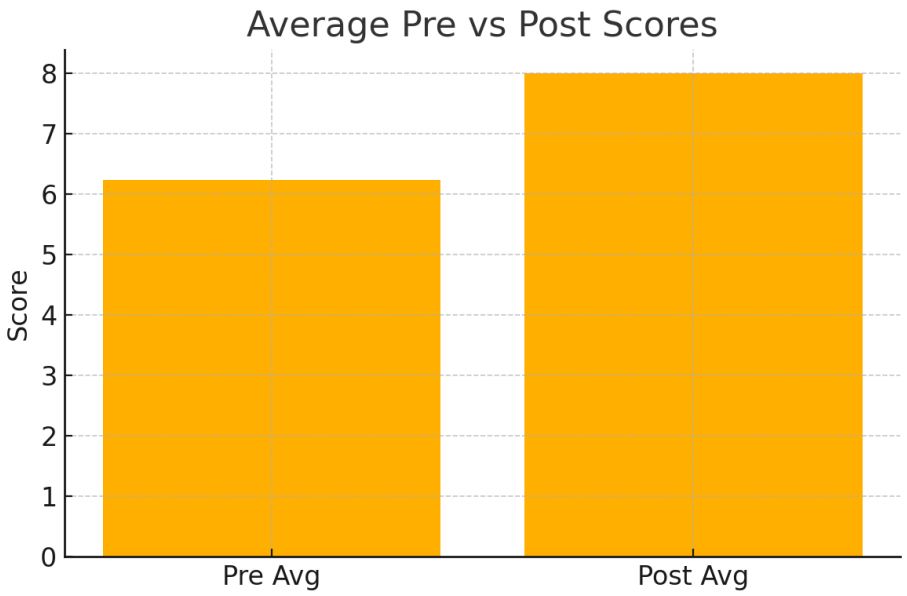


Figure 10: Average Pre-test vs Post-test Scores

Furthermore, the pre- and post-test analysis shows that out of all participating teachers, the majority demonstrated clear improvement in their digital skills. Only four teachers recorded a decline, which may be attributed to connectivity challenges, lower engagement due to other pressing activities around that time of the year, or limited digital competency at the start of the training. These teachers may require additional follow-up support or guided practice to reach competency.

One teacher showed almost no change, indicating stable performance with minimal skill gain. In contrast, nineteen (19) teachers showed meaningful improvement, with several achieving moderate gains between +1 and +3 points (Figure 11). Notably, five teachers made exceptional progress, improving by +4 to nearly +5 points, demonstrating strong mastery of digital tools, Moodle activities, and competency-based digital pedagogy. Generally, the pattern of improvement across teachers confirms a positive training impact, with most participants (about 80%) gaining confidence and competence in applying digital skills for STEM teaching.

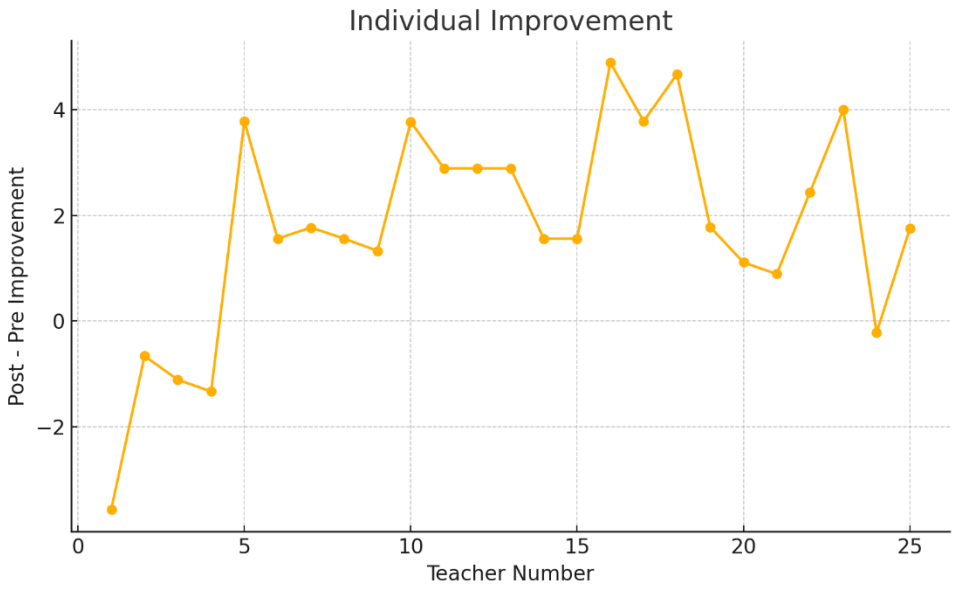


Figure 11: Individual Improvement Scores

Overall, the pre-test and post-test comparison provides evidence that the training was impactful, achieving its intended outcome of enhancing teachers' digital literacy and competency-based digital pedagogy skills.

3.0 TEACHERS' END OF THE COURSE EVALUATION FINDINGS

The teacher evaluation at the end of the course was conducted using a structured Google Form. It collected quantitative ratings, qualitative reflections, and inputs for scaling up the training. The results, among others, help the council understand what worked well, what to adjust, and how best to expand the training to all secondary schools across the council. The themes below follow the structure of the survey tool.

3.1 Quantitative Findings

The evaluation captured ratings on course experience, skills gained, tool confidence, ToT readiness, and suitability for scale-up.

3.1.1 Course Experience

Teachers rated the clarity, flow, and usefulness of the course modules. Items included clarity of explanations, relevance of training content, ease of following Moodle units, and helpfulness of Zoom sessions.

The course experience ratings indicate a high level of participant satisfaction and affirm the overall effectiveness of the training program (Figure 12). Teachers consistently reported that the course was well designed, pedagogically sound, and aligned with their professional development needs, particularly in enhancing digital competency for STEM instruction. The structure, sequencing, and clarity of instructional materials were viewed favourably, as were the opportunities for interactive engagement and practical application of tools such as PhET, GeoGebra, Moodle, and AI-assisted tools and platforms.

Participants also acknowledged the facilitators' expertise and the quality of instructional support provided throughout the training. Although a minority of respondents highlighted challenges related to time demands and the volume of activities, these concerns did not substantially diminish the overall positive appraisal of the course. Collectively, the course experience ratings demonstrate that the training offered a rigorous, relevant, and impactful learning experience that contributed meaningfully to teachers' digital pedagogical development.

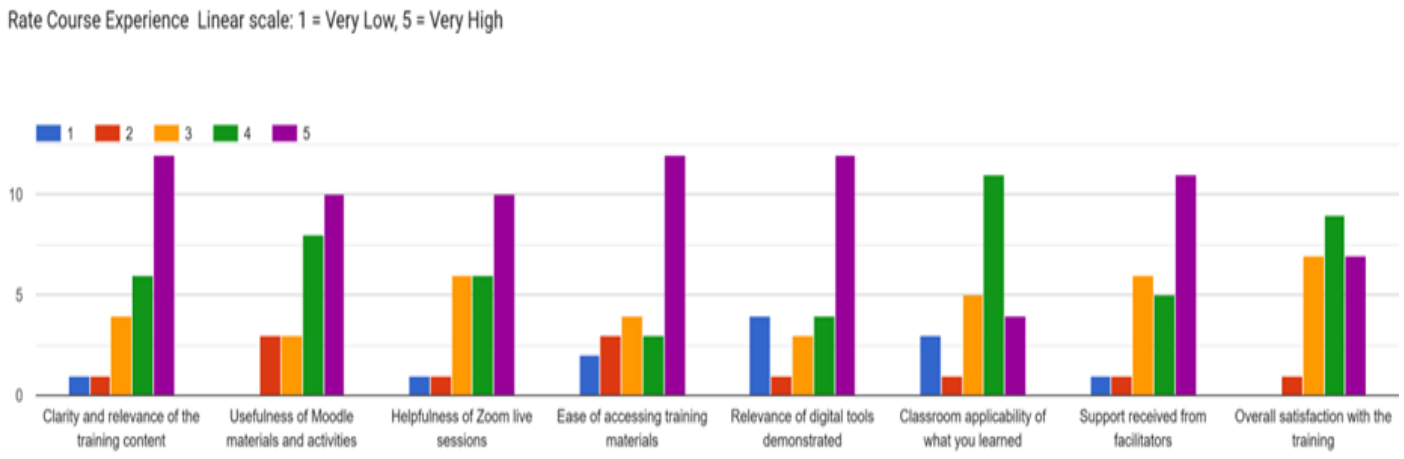


Figure 12: Course experience rating

3.1.2 Digital Skills Gained

Teachers assessed how much their digital skills improved. Items included confidence using digital tools, ability to design digital tasks, confidence using simulations, ability to use OER, and digital collaboration skills.

The training resulted in substantial gains in teachers' digital skills and pedagogical competence, as reflected in their evaluation responses and post-training performance. Participants reported increased confidence in integrating digital tools such as PhET, GeoGebra, AI tools and platforms, and OER resources into STEM instruction. They also demonstrated improved skills in designing competency-based digital lessons, creating assessments using digital applications, and navigating learning management systems such as Moodle (Figure 13).

The hands-on activities and interactive demonstrations strengthened teachers' ability to apply TPACK and UDL principles alongside the use of AI to generate a lesson plan, enabling them to design more engaging and learner-centered learning activities and experiences. While the level of growth varied among participants, the overall results indicate that the training enhanced teachers' readiness to implement digital pedagogy effectively in their classrooms.

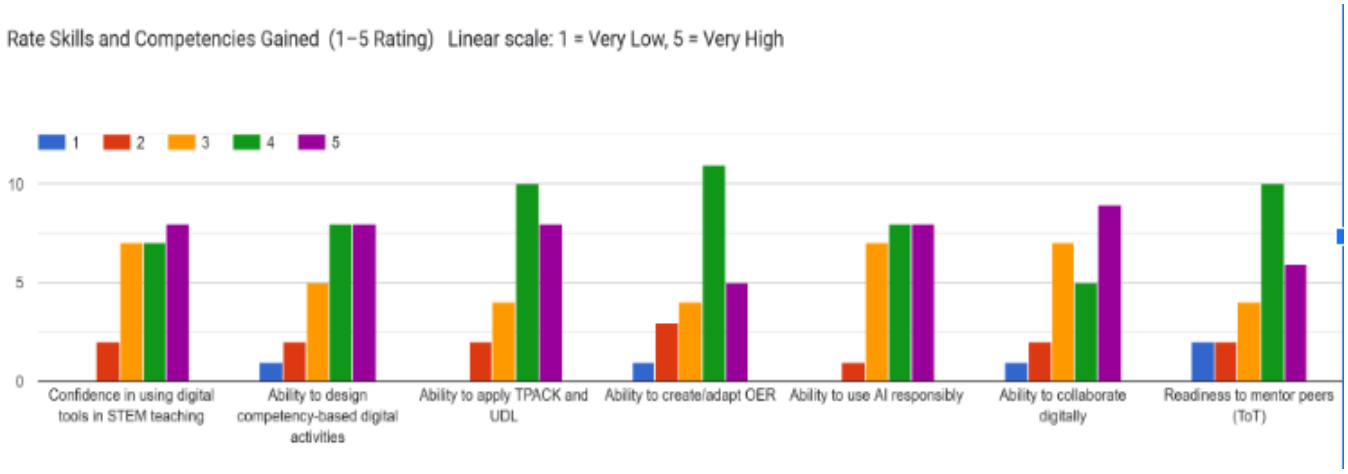


Figure 13: Digital skills improvement rating

3.1.3 Confidence in Applying Tools in Classrooms

Teachers rated how confident they felt using tools introduced during training. This included using PhET and GeoGebra, Quizizz or similar platforms, OER and Google tools,

and AI tools for lesson planning and designing of lesson activities.

Figure 14 shows that teachers used a wide variety of digital tools to prepare content, create assessments, and support classroom delivery. AI-based tools such as ChatGPT, Copilot, and NotebookLM appear most frequently, showing that teachers are increasingly relying on artificial intelligence (AI) to help generate lesson materials and streamline planning tasks. PhET simulations and GeoGebra also stand out as highly used tools, reflecting strong engagement with interactive STEM resources for demonstrating scientific and mathematical concepts. Productivity tools like Word, Excel, and PowerPoint remain widely used, indicating that traditional digital tools continue to play an important role in everyday lesson preparation and delivery.

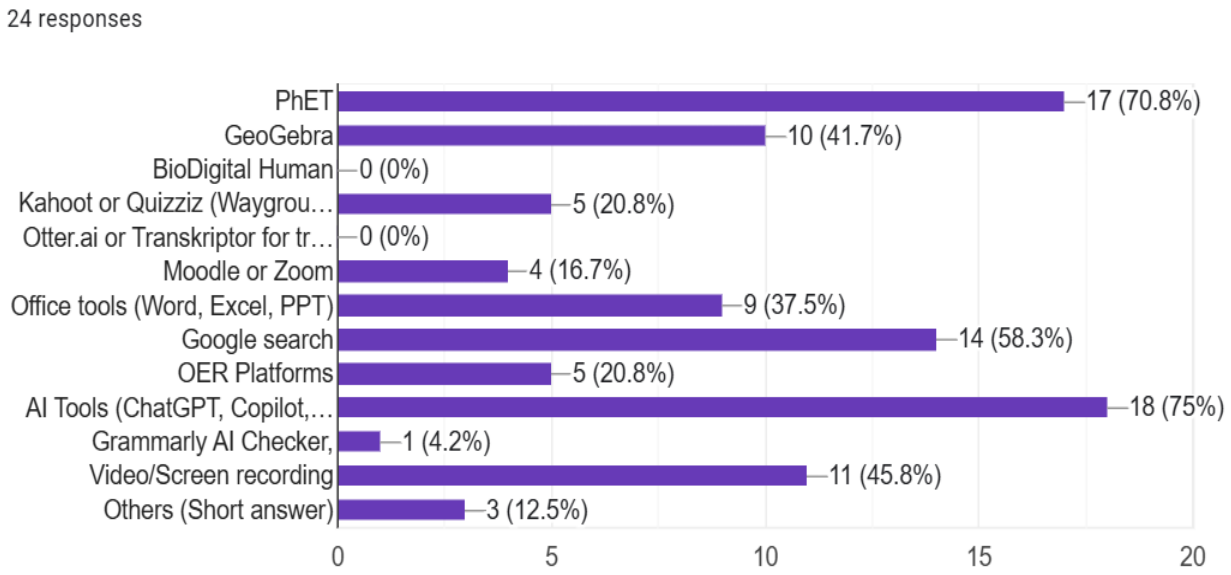


Figure 14: Application confidence rating

Google Search and OER platforms were also mentioned often, suggesting that educators actively seek online resources to enrich their teaching. Meanwhile, the increasing adoption of video and screen-recording tools further supports CBE implementation by enabling the creation of demonstrations, step-by-step skill explanations, and self-paced learning resources. In contrast, tools such as Kahoot, Quizizz, Moodle, Zoom, and other specialized platforms were reported less

frequently, implying selective but purposeful use for assessment, feedback, and learner engagement activities.

Overall, the pattern of digital tool usage suggests that teachers are effectively blending artificial intelligence, interactive simulations, productivity software, and online resources to support the core principles of Competency-Based Education, particularly learner-centered instruction, practical skill development, flexible learning, and continuous assessment.

3.1.4 ToT Readiness

Teachers rated their readiness to train peers in their schools or council clusters. This finding helps the council prepare school-based and cluster-based support plans. The percentage of teachers ready to train others is 91.75%, as indicated earlier, which puts the council in a position to scale it up.

3.1.5 Importance of Capstone Project

Teachers rated how useful the capstone was in helping them apply new skills, and as it was indicated earlier, the teachers completing the capstone and indicating its usefulness were at 87.5%.

3.1.6 Preferred Delivery Model for Scale-Up

Teachers selected the training model that would work for a council-wide rollout. Options included Online, Blended, Face-to-face, School-based and cluster-based sessions.

Survey results reveal that face-to-face workshops emerged as the most preferred training modality, selected by 14 teachers (58.3%). This strong preference (Figure 15) highlights the critical role of direct interaction, experiential learning, and immediate feedback in competency-based Education (CBE). Such workshops provide opportunities for teachers to actively demonstrate competencies, engage in hands-on practice, and collaboratively refine instructional and assessment strategies, thereby reinforcing the practical orientation of CBE.

Online training modalities (Moodle and Zoom) and blended learning approaches were each endorsed by 9 teachers (37.5%). This indicates a growing acceptance of flexible, technology-enhanced professional development models that align with CBE principles of accessibility, self-paced learning, and continuous professional growth. Blended learning, in particular, integrates the

strengths of both online and in-person formats, thereby accommodating diverse learning needs, institutional contexts, and training cost-effectiveness.

School-based sessions, selected by 8 teachers (33.3%), reflect a notable interest in localized, context-specific professional development. These sessions facilitate the direct application of competencies within the teaching environment, enhancing relevance and enabling immediate transfer of skills to classroom practice.

By contrast, cluster-based sessions were chosen by only 5 teachers (20.8%). This relatively low preference may be attributed to logistical challenges or a stronger inclination toward personalized and institution-specific training formats. Nevertheless, cluster-based approaches remain valuable for fostering peer learning and promoting cross-institutional exchange of best practices in CBE.

Overall, the findings suggest that while teachers increasingly value flexible and technology-supported training options, interactive, practice-oriented, and contextually grounded delivery modes remain central to effective CBE implementation. A strategic combination of face-to-face, blended, school-based, and cluster-based training modalities is therefore recommended to optimize teacher competence and ensure the sustained adoption of digitally enabled CBE practices.

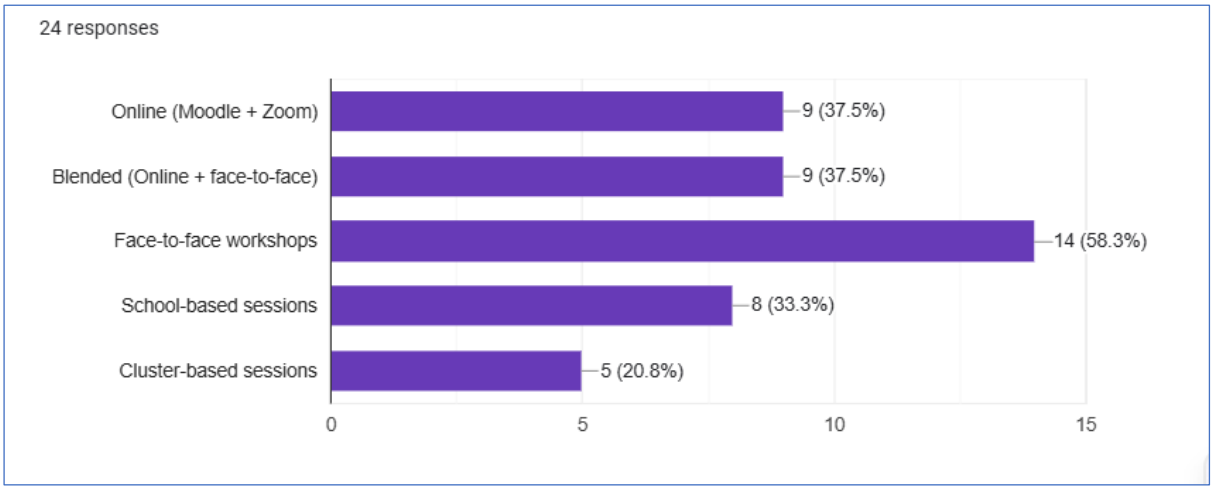


Figure 15: The Preferred delivery model for scaling-up in the Council

3.1.7 Monitoring Methods for Scale-Up

Teachers identified preferred monitoring methods for the council. Options included Moodle tracking, classroom observation visits, quarterly cluster review meetings, monthly school-based reports, TRC support, and WhatsApp groups (Community of Practice - CoP) (Figure 16).

The questionnaire results indicate that classroom observation visits were the most preferred monitoring method, selected by 17 of the 24 respondents (70.8%). This finding suggests that teachers regard direct classroom observation as the most effective mechanism for monitoring competency-based Education (CBE) during scale-up, as it enables real-time assessment of instructional practices and learner engagement.

Moodle-based digital submissions were identified by 11 respondents (45.8%), demonstrating that nearly half of the teachers value technology-supported platforms for submitting instructional and assessment evidence. This reflects the increasing importance of digital monitoring tools in facilitating systematic tracking of CBE implementation.

Additionally, 8 respondents (33.3%) reported using WhatsApp or Communities of Practice (CoP) for progress tracking, while quarterly cluster review meetings and end-of-term evaluations were each selected by 7 respondents (29.2%). These approaches indicate moderate support for collaborative and periodic monitoring mechanisms that promote reflection, peer learning, and shared accountability.

By contrast, monthly school reports were the least preferred option, selected by only 4 respondents (16.7%). This suggests that routine reporting, in isolation, may be perceived as insufficient for capturing the complexities of classroom-level digitally enabled CBE implementation.

Overall, the findings reveal a clear preference for practice-based and evidence-driven monitoring strategies. Classroom observations, complemented by digital submissions and collaborative progress-tracking mechanisms, appear to represent the most appropriate and effective approaches for monitoring digitally enabled CBE implementation during scale-up. These results underscore the need for monitoring frameworks that balance direct observation with technology-enhanced and

peer-supported practices to ensure comprehensive and sustainable evaluation of CBE implementation.

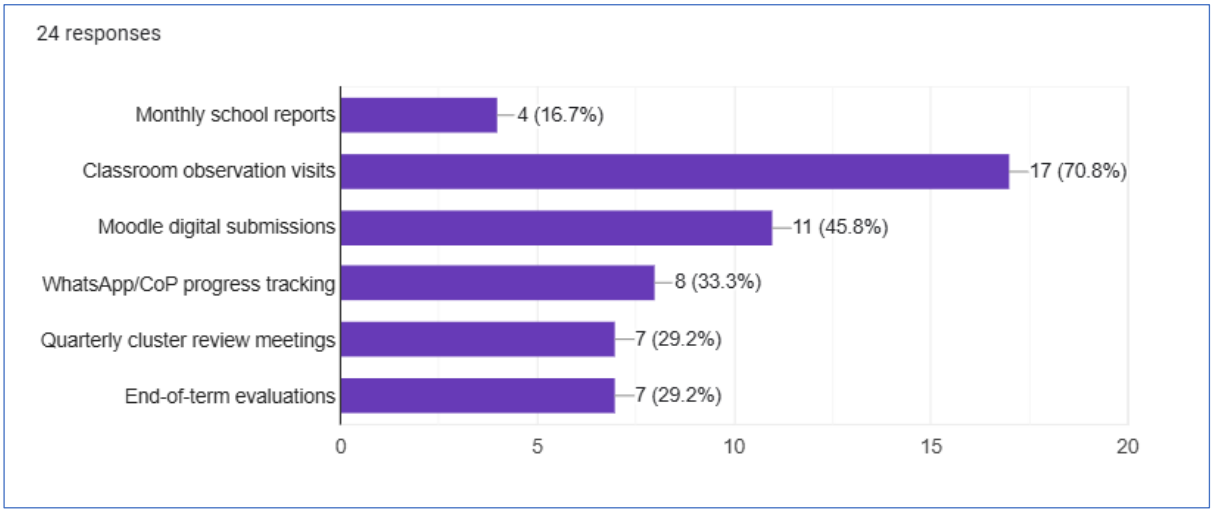


Figure 16: Selected monitoring methods for scaling up in the Council

3.2 Qualitative Findings

Teachers provided written comments covering what they valued, what challenged them, and what support they need for future rounds and scale-up.

3.2.1 Most Valuable Aspects of the Training

The most valuable aspects of the training, as noted in teachers' written comments, included exposure to new digital tools, the ability to design digital activities, the usefulness of the capstone project, practical examples used in the modules, and Step-by-step demonstrations.

Broadly, qualitative responses to the questionnaire indicate that teachers perceived multiple components of the training as valuable, with a strong emphasis on artificial intelligence (AI) and digital pedagogical tools. The most frequently mentioned valuable aspect was the use of AI in teaching and learning, including its application in lesson preparation, instructional delivery, and professional development. Teachers highlighted AI as a key innovation that enhanced efficiency, creativity, and learner engagement, as also cited by one of them, *"Use of AI in the teaching and learning process was effective and time saving."*

Interactive digital tools, particularly GeoGebra and PhET simulations, were also repeatedly identified as highly valuable. Teachers described these tools as interesting and effective, especially for supporting the visualization of complex concepts and promoting active, experiential learning, as cited by one of them, *"The most valuable part of the course is likely the hands-on experience with GeoGebra and other tools, as well as the opportunity to collaborate with other educators to develop STEM-based lessons that integrate computational thinking and problem-solving skills. The course helped us to develop practical skills and strategies for incorporating these concepts into our teaching, making learning more engaging and effective for our students."* The hands-on nature of these tools was viewed as particularly beneficial in strengthening practical skills and aligning teaching practices with competency-based Education principles.

Additionally, respondents emphasized the importance of Open Educational Resources (OER), noting that these resources enabled flexible, cost-effective, accessible, and location-independent learning. The shift from reliance on traditional chalk-and-board methods to digital platforms was seen as a significant improvement, supporting anytime and anywhere learning.

Several teachers also valued the integration of ICT for professionalism and continuous professional development, indicating that the training enhanced their confidence and competence in using technology for instructional purposes. Frameworks such as Technological Pedagogical And Content Knowledge (TPACK) and Universal Design for Learning (UDL) were highlighted as valuable for guiding effective lesson preparation and delivery, particularly in aligning technology use with pedagogy and content knowledge, and the inclusiveness aspects in teaching and learning, as one of them pointed out, *"Linking TPACK, UDL and technology in lesson preparation and delivery was interesting and effective."*

Furthermore, opportunities for collaboration, Training of Trainers (ToT), and Communities of Practice (CoP) were identified as beneficial, enabling teachers to share experiences, co-develop STEM lessons, and integrate computational thinking and problem-solving skills into their teaching. Overall, many respondents indicated that almost all components of the training were valuable, reflecting a high level of satisfaction and perceived relevance of the course content.

These findings suggest that the training effectively supported competency-based teaching by combining AI, interactive digital tools, pedagogical frameworks, and collaborative learning opportunities to enhance teachers' instructional practices.

3.2.2 Challenges Faced During Training

Teachers mentioned challenges that affected participation and practice, including connectivity issues, limited access to devices, and the first-time use of some digital tools.

The most frequently reported challenge relates to infrastructure constraints, particularly unstable or inadequate internet connectivity and unreliable electricity. Several teachers reported frequent internet interruptions, network barriers, and power outages, which disrupted lesson delivery, especially during simulations and online activities, as also cited from one of them here, "*Internet issues were mostly a challenge, thus unable to practice fully some of the learned aspects fully any time the subject deems so"*. In some cases, teachers recommended the provision of alternative power sources, such as generators, to ensure continuity of learning.

A second major challenge identified was the shortage of ICT devices, including computers, laptops, tablets, and projectors. Many teachers indicated that the limited availability of these tools restricted effective classroom implementation, often forcing them to rely on group work rather than individual hands-on practice, as also cited from one of them here, *Challenge which I face is lack of computer or laptop and projector which can support teaching and learning in my school."* This shortage was viewed as a significant barrier to fully realizing the principles of digitally enabled competency-based Education, which emphasize active learner participation and individual skill development.

Teachers also highlighted limited digital literacy among students as a key challenge. Several respondents noted that many learners are not familiar with using digital tools for learning purposes, which slowed lesson progress and required additional instructional support, as also cited by one of them, "*Challenges facing most of my students are that they are not familiar with using digital tools in learning due to the unavailability of such digital facilities*". This challenge was sometimes compounded by language barriers, particularly for students with lower academic proficiency, further affecting their ability to engage with digital and competency-based learning activities.

Pedagogical challenges were also reported, including difficulties in supporting lower-achieving students, particularly in abstract subjects such as geometry. Some teachers suggested that tools like GeoGebra could be more effectively utilized to enhance the visualization and understanding of complex concepts, provided that adequate resources and training are available, as also cited by one of them, *the hardship in helping lower achievers capture understanding of geometry figures, of which I see the use of GeoGebra might be useful."* Additionally, large class sizes were reported as a constraint, limiting teachers' ability to provide individualized support and effectively monitor learners' competency development. Some respondents also indicated challenges in responding comprehensively to questionnaire items due to time constraints, leading them to select only the most relevant responses.

Overall, the findings suggest that while teachers are motivated to implement competency-based and digitally enhanced teaching approaches, systemic challenges related to infrastructure, resources, learner preparedness, and class size continue to hinder effective implementation. Therefore, these inputs help shape scaling up and future improvement support within the schools and the council as a whole.

3.2.3 Suggestions for Improvement

Teachers shared areas for strengthening future rounds, including more examples for specific STEM topics, shorter lesson demonstrations, school-based support sessions, and more practice time with AI tools.

Analysis of teachers' qualitative responses regarding areas for improvement in future training rounds revealed several consistent themes related to training modality, time allocation, resource availability, pedagogical support, and inclusivity.

A dominant theme across responses was the strong preference for face-to-face training, either exclusively or in combination with online delivery. Many respondents emphasized that future rounds should adopt a blended approach, integrating both theoretical sessions and practical, hands-on activities conducted face to face, as one of them said, *"to be more practical, the course should be presented face to face and online".* Teachers indicated that such an approach would better support skill acquisition, particularly for Training of Trainers (ToT), and enhance understanding

through direct supervision during practice sessions.

Closely related to this was the call for increased time for practical activities. Several respondents reported that the time allocated for practice was insufficient and recommended extending the duration of the training or reducing the daily content load, as one of them said, *"Time for practice should be increased, and to practice the lesson under your supervision, not only to make an online session*." Suggestions included limiting daily sessions to shorter durations to reduce fatigue and improve concentration, as well as extending the overall training period to allow deeper engagement with digital tools such as GeoGebra.

Availability of digital resources emerged as another critical area for improvement. Teachers noted that although digital skills were taught, many schools lack essential ICT tools such as laptops, tablets, and reliable internet access. Respondents recommended that future training programs provide or facilitate access to digital devices and internet bundles to enable meaningful participation and practical application of acquired skills.

Participants also highlighted the need for clearer guidance and structured support, including prior orientation before the start of the program. Suggestions included providing step-by-step instructions, clearer explanations of expectations, and examples of good practice to help participants better understand how to engage with the training. Additionally, respondents emphasized the importance of follow-up support, feedback mechanisms, and opportunities for questions and clarification beyond scheduled sessions.

Another emerging theme relates to inclusivity and participation. Some teachers recommended that future programs should be more inclusive by involving teachers from more schools, supporting participants with disabilities, and encouraging timely completion of assigned activities. This reflects a desire for broader reach, equitable participation, and stronger accountability mechanisms. Overall, the findings indicate that while the training was valued, its effectiveness could be significantly enhanced through greater emphasis on hands-on, face-to-face learning; improved access to digital tools; extended and better-structured practice time; clearer instructional guidance; and inclusive program design. These improvements are closely aligned with the principles of Competency-Based Education, which emphasize active learning, adequate practice, learner

support, and equitable access to learning opportunities.

3.2.4 Teachers' Ideas on Scaling Up in the Council

Teachers' written reflections present a clear and grounded narrative on how the training can be expanded across the council. Their ideas focus less on ambition and more on what can work in real school conditions. Scale-up is seen as necessary, but only if it remains practical, supportive, and closely linked to classroom realities.

Many teachers explained that future expansion should happen where teaching already takes place. They described school-based delivery as the most realistic option, since it allows immediate practice and peer discussion without disrupting teaching schedules. One teacher captured this view by noting that training should be brought closer to teachers, stating that it is better *"to conduct the training at the school level so that teachers can practice directly in their own classrooms and support each other."*

Alongside this, teachers highlighted the value of combining face-to-face engagement with online follow-up. They viewed physical sessions as essential for demonstrations, guided practice, and confidence building, especially for new digital tools. Online platforms were described as useful for sharing materials, submitting tasks, and maintaining communication after the initial sessions. As one teacher explained, *"the course should be presented face to face and online so that teachers can understand the tools practically and then continue learning at their own pace."*

Teachers also framed scale-up as something that should build on existing council structures. School clusters and Teacher Resource Centres (TRCs) were repeatedly mentioned as natural coordination points. Clusters were described as familiar and trusted spaces for peer learning, while TRCs were seen as suitable hubs for organizing sessions, supporting follow-up, and monitoring progress without creating new administrative layers.

Access to shared digital resources featured strongly in teachers' narratives. They emphasized that materials used during the training should remain available to support new schools joining later. Teachers wanted to have ready examples, lesson samples, and demonstrations that would reduce uncertainty and ensure quality as the programme grows in schools with limited connectivity.

Peer support emerged as a defining element of teachers' ideas on scale-up. Many teachers expressed willingness to guide colleagues, provided there is basic support from school leadership and the council. They described a gradual, peer-led approach as more sustainable than one-time workshops, because it allows teachers to learn from someone who understands their subject, learners, and school context.

Overall, teachers' ideas on scaling up reflect a practical vision. They call for approaches that are simple, school-centered, and grounded in everyday teaching practice. The narrative emerging from their responses suggests that successful scale-up in the council will depend less on new systems and more on strengthening what already exists, while keeping teachers actively involved at every stage. Teachers expressed a strong interest in reaching all schools.

3.2.5 Support Needed to Train Their Peers

Teachers' reflections show strong readiness to support peer training, but they also make it clear that this role cannot be sustained without deliberate support. Across responses, teachers described peer training as a shared process that requires structure, resources, and recognition from schools and the council.

A recurring concern relates to the availability of training materials. Teachers explained that to guide colleagues effectively, they need clear and well-organized resources that they can rely on. They referred to the value of having prepared lesson examples, step-by-step guides, and demonstration materials like those used during the training. As one teacher explained, "*For us to train others well, we need clear materials and examples that we can follow and share with fellow teachers."*

Teachers also emphasized access to basic digital tools as a condition for successful peer training. Several noted that explaining digital approaches without devices limits understanding and confidence. They highlighted the need for shared laptops, projectors, or tablets during peer sessions so that colleagues can see and try tools directly. One teacher captured this challenge by stating, *"It is difficult to train others if there are no devices to demonstrate the tools we are teaching."*

Another theme in teachers' narratives is the need for ongoing mentorship and technical support. Teachers viewed peer training as a gradual learning process rather than a one-time activity. They expressed the need for continued guidance from facilitators or TRC coordinators, especially when facing technical problems or questions from colleagues. This backstopping was seen as important for maintaining confidence and ensuring accurate use of tools during scale-up.

Formal time allocation within school programmes was also highlighted. Teachers explained that peer training should be officially recognized in school schedules, rather than added informally after teaching hours. They suggested that staff meetings, departmental sessions, or CPD slots be used to support peer-led training, noting that formal scheduling encourages participation and reduces resistance.

Support from school leadership and TRC coordinators was described as essential. Teachers felt that endorsement from heads of schools and TRCs would legitimize their role as peer trainers and motivate others to engage. They also viewed TRCs as safe spaces for practicing facilitation skills, sharing experiences, and receiving feedback during the early stages of training peers.

Overall, teachers' responses show that the willingness to train peers already exists within the council. What they consistently ask for is simple and practical support. With access to materials, devices, mentorship, and protected time, teachers believe they can confidently extend digital skills training to colleagues and contribute meaningfully to council-wide improvement in teaching practice.

3.2.6 The Role of TRC Coordinators

Teachers' responses consistently position Teacher Resource Centre (TRC) coordinators as central actors in supporting scale-up across the council. In their narratives, TRCs are not viewed as external offices, but as practical anchors that connect schools, teachers, and the council in day-to-day professional learning.

Teachers described TRC coordinators as key facilitators who can bring structure and continuity to the scale-up process. They emphasized that TRCs already function as familiar meeting points, making them suitable venues for follow-up sessions, peer learning, and hands-on demonstrations. One teacher noted that *"TRC coordinators can help organize training sessions and bring teachers together so that learning continues even after the main training."*

Another strong theme in teachers' reflections is the monitoring and support role of TRCs. Teachers explained that TRC coordinators are well placed to observe progress across schools, identify gaps, and provide timely support. They viewed TRCs as neutral spaces where teachers can openly discuss challenges, seek advice, and receive guidance without the pressure of formal inspection. As one teacher stated, *"TRC coordinators should visit schools and support teachers practically, not only to check reports but to help solve challenges."*

Teachers also highlighted the role of TRCs in strengthening peer learning and collaboration. They suggested that TRC coordinators can help form subject-based or cluster-based groups where teachers regularly share experiences, lesson examples, and digital practices. Such coordination was seen as essential for maintaining momentum and avoiding isolation among teachers during scale-up.

In addition, teachers saw TRC coordinators as important links between schools and the council leadership. They explained that feedback collected by TRCs can inform council planning, resource allocation, and future training design. Through this role, TRCs were viewed as channels through which teachers' voices and classroom realities can reach decision makers more effectively.

Overall, teachers' responses portray TRC coordinators as enablers rather than supervisors. They are seen as organizers, mentors, and connectors who help translate training into sustained classroom practice. By strengthening the role of TRCs in coordination, mentoring, and feedback, teachers believe the council can support a smoother, more consistent, and more teacher-centered scale-up process.

4.0 DISSEMINATION ACTIVITIES

The dissemination and certificate award workshop marked the final phase of the Competency-Based Digital Skills Training for STEM Teachers implemented in Iringa District Council. The event served three main purposes: to share key outcomes of the training, to provide teachers with a platform to demonstrate classroom application of digital skills, and to engage district and national stakeholders on pathways for scaling up the initiative.

The workshop was organized by the Open University of Tanzania (OUT) under the UNESCO Chair in Teacher Education and Curriculum and was conducted online via Zoom on Wednesday, 3 December 2025 (Some event pictures in Annex A). It formed part of the CL4STEM Impact Grant supported by IDRC through GPE-KIX and brought together teachers, school leaders, Iringa District Council officials, national representatives, and the OUT-project team.

4.1 Key Participants Included

The workshop brought together a wide range of stakeholders involved in the training and its future expansion. Participants included the 24 STEM teachers from nine secondary schools who completed the module, heads of schools from Iringa District Council, and officials from the Iringa District Council, Ministry of Education, Science and Technology (MoEST), and the Prime Minister's Office – Regional Administration and Local Government (PMO-RALG). The organizer, the Open University of Tanzania, was represented by the Acting Deputy Vice Chancellor for Academic, Research, and Consultancy, who also participated alongside the CL4STEM project leader, team, and facilitators.

4.2 Main Activities Conducted During the Workshop

The workshop followed a structured programme that guided participants through the dissemination journey and its outcomes. Key activities included a welcome address from the OUT Acting Deputy Vice Chancellor for Academic, Research, and Consultancy, an overview of the CL4STEM complementary module from the project leader, presentations by each subject teacher representative, reflections from heads of schools, remarks from the District Education officer in the council and PMO-RALG, and the closing inputs from the MoEST. The programme also included a formal session for awarding digital certificates to teachers who completed the training.

4.3 Teachers' Contributions During the Workshop

Teachers played a central role in the dissemination process. Subject representatives from Chemistry, Biology, Mathematics, and Physics presented what they learned during the training and how they applied digital tools in real classroom contexts. They shared examples of using GeoGebra for mathematical visualization, PhET simulations and virtual labs for science concepts, digital quizzes and collaborative platforms for assessment, and AI tools for content creation, lesson planning, and assessment generation. Teachers also reflected on challenges encountered, changes observed in learner engagement, and practical strategies for scaling up this training within schools and across the council.

4.4 District Leadership Engagement

Iringa District Council leadership actively engaged with the dissemination outcomes. On behalf of the District Education Officer, appreciation was extended to the Open University of Tanzania, project partners, school leaders, and teachers for the successful completion of the module. The council outlined its intentions to scale up the training programme to all secondary schools by using Clusters/Teacher Resource Centres as training hubs, supporting trained teachers through a Training of Trainers approach, and integrating digital professional development into routine school supervision and planning.

4.5 National-Level Engagement

The Ministry of Education, Science, and Technology provided closing remarks during the workshop. The Ministry commended teachers for demonstrating improved digital competence and effective use of simulations, open educational resources, collaborative tools, and AI-supported lesson planning. The programme was acknowledged as aligned with national priorities, including the national digital education strategy and the national digital education guidelines for schools and teacher colleges, competency-based curriculum delivery, and responsible use of digital and AI tools in secondary education.

4.6 Outcome of the Workshop

The dissemination workshop concluded with the awarding of certificates to teachers who completed the training, with subject representatives receiving certificates on behalf of their peers during the live session, and all certificates were released digitally through Moodle to all teachers.

The workshop confirmed teacher readiness to apply digital skills and support peers, a commitment from Iringa District Council to scale up the programme, and national-level support for continued collaboration. Overall, the event consolidated lessons learned, validated classroom impact, and set a shared direction for council-wide expansion of competency-based digital skills training for STEM teachers.

4.7. Other dissemination – National Awareness Workshop on National Education Strategy

The Ministry of Education, Science and Technology organized a dissemination workshop on the developed National Digital Education Strategy and associated guidelines at the level of Universities, TVET, schools, and Teacher Colleges. The ministry invited all relevant stakeholders, including officials from relevant ministries and developing partners, as well as the heads of educational institutions, Vice chancellors, heads of teacher colleges and schools, more than 200 in total, and the permanent secretary of this ministry was the guest of honour. I was a presenter of one of the guidelines, the national digital education guidelines for schools and Teacher colleges, which is relevant to our CL4STEM module that we developed and delivered on competency-based digital skills in Iringa DC. So, I added as a relevant example of this kind of capacity building by OUT and its counterparts with IDRC/GPE-KIX support (Figure17) that guidelines should promote.

Figure 17: Inclusion of the CL4STEM in the National Digital Education Strategy/guidelines dissemination

5.0 CROSS-CUTTING ANALYSIS, READINESS, AND POLICY ALIGNMENT

The Competency-Based Digital Skills Training for STEM Teachers generated outcomes that extend beyond individual teacher development. Across implementation and dissemination phases, the programme revealed institutional conditions, behavioural shifts, and coordination mechanisms that determine whether digitally enabled teaching can be sustained and expanded within Iringa District Council. Teachers demonstrated not only skill acquisition, but also the ability to translate those skills into classroom practice. School leaders observed changes in lesson preparation and learner engagement. District leadership articulated clear intentions to scale it up, embedding digital professional development into routine systems. Taken together, these elements indicate a transition from a pilot intervention toward a council-level reform process.

5.1 Scaling-Up Prospects for Iringa District Council

The prospects for scaling up the training across all secondary schools in the council are strong. Teacher evaluation data, classroom capstone implementation, and dissemination dialogue all point to readiness at both practitioner and leadership levels. Teachers no longer framed digital tools as optional enhancements. They described them as practical supports for explaining abstract concepts, assessing competencies, and engaging learners. This shift in perception is critical for scale-up, as it signals internal ownership rather than external compliance. District leadership engagement during dissemination further strengthened these prospects. The council confirmed its intention to use existing structures, particularly Teacher Resource Centres and school clusters, to coordinate expansion. This reduces the need for new systems and supports sustainability.

5.1.1 Key Indicators of Readiness

Several indicators demonstrate readiness for council-wide expansion. Teachers completed a structured online programme and successfully applied skills through classroom capstone projects. They showed the ability to select tools appropriate to subject content and school context, including low-connectivity environments. School leaders reported observable improvements in teaching practice, while district leadership committed to integrating digital skills development into supervision and professional development routines. The successful use of Moodle, Zoom, and WhatsApp during the pilot further reduces uncertainty around delivery at scale. Most notably, more

than ninety percent of teachers expressed readiness to train peers. This creates a viable foundation for a Training of Trainers approach that can reach many schools without a high financial or logistical burden.

5.1.2 Teacher Preferences for Scale-Up

Teachers expressed clear views on how scale-up should be conducted. They favoured blended delivery models that combine face-to-face engagement with online follow-up. Face-to-face sessions were seen as essential for demonstrations and confidence building, while online platforms support continuity and flexible access. School-based and cluster-based sessions were preferred over centralized training. These approaches allow immediate classroom application and peer support within shared contexts. For monitoring, teachers emphasized classroom observation, digital submission of lesson evidence, and peer discussion through Communities of Practice (CoP), rather than reliance on routine reporting alone. These preferences point toward a scale-up model that prioritizes learning quality, practice, and reflection.

5.2 Challenges and Mitigation Measures

Despite strong readiness, the implementation process highlighted constraints that could affect scale-up if not addressed deliberately. These challenges reflect broader system conditions rather than weaknesses in the training design.

5.2.1 Challenges Observed

Teachers consistently reported infrastructure constraints. Unstable internet connectivity, high data costs, and electricity interruptions affected participation and classroom application. Limited access to laptops, projectors, and shared devices constrained hands-on learner engagement, often requiring group demonstrations. Differences in teachers' starting digital skill levels influenced learning pace. Large class sizes and varying learner digital literacy also affected implementation, requiring additional instructional support.

5.2.2 Mitigation Strategies Used in This Project

During the pilot, practical strategies helped reduce the impact of these constraints. WhatsApp was used to maintain support when Moodle or Zoom access was disrupted. Teachers were encouraged to work offline where possible and to begin with simple tools before

advancing to more complex applications. Step-by-step demonstrations and peer collaboration within subject groups helped teachers with lower initial confidence. These approaches showed that responsive support and flexibility can offset systemic limitations.

5.2.3 Suggested Support for Future Rounds

Teachers and leaders proposed targeted measures to strengthen future scale-up. These include using Clusters/Teacher Resource Centres as hands-on practice hubs, increasing time allocated for practical activities, and sourcing additional devices through partnerships. Formal recognition of digital professional development within school timetables was identified as essential. Short follow-up sessions after initial training were also recommended to reinforce practice and support teachers who progress more slowly.

5.3 Alignment with National Policies and Frameworks

The complementary module aligns closely with Tanzania's current education reform agenda. Its focus on competency-based teaching, digital skills, and responsible use of emerging technologies reflects national policy priorities, guidelines, and operational frameworks.

5.3.1 National Education and Training Policy 2014 version 2023

The policy emphasizes digital readiness, teacher competence, and learner-centered pedagogy. The training directly supports these goals by strengthening teachers' ability to design and deliver digitally supported lessons focused on competencies rather than content coverage.

5.3.2 New Competency-Based Curriculum

The curriculum requires interactive methods, real-life application, and continuous assessment. Through simulations, digital tasks, collaborative tools, and capstone projects, the module enabled teachers to operationalize these requirements in STEM subjects.

5.3.3 National Digital Education Strategy

The strategy calls for the effective use of digital tools and platforms across all education levels, from universities to TVETs and schools. By prioritizing tools that function in low-connectivity contexts and building teacher confidence, the module advances the strategy's practical intent beyond infrastructure provision alone.

5.3.4 National AI Guidelines in Education

The training introduced AI tools in a guided and responsible manner as per national guidelines. Teachers were supported to use AI for planning, reflection, and content development, while emphasizing ethical use, accuracy, and alignment with learning objectives.

5.3.5 National Digital Education Guidelines for Schools and Teacher Colleges

The module also aligns with the National Digital Education Guidelines for Schools and Teacher Colleges, which provide operational guidance specific to schools and teacher preparation contexts. At the school level, the guidelines emphasize embedding digital tools within everyday teaching and learning. The training responded by focusing on subject-based application of simulations, digital assessment, collaboration tools, and open resources in Physics, Chemistry, Biology, and Mathematics. The guidelines highlight teacher competence and continuous professional development as central to digital education. The structured units, live demonstrations, peer interaction, Training of Trainers approach, and classroom capstone projects directly support this requirement and promote sustainability at the school and council levels.

In terms of access and inclusion, the guidelines recognize varied connectivity and resource conditions. The module addressed this by prioritizing low-bandwidth tools, supporting offline work, and encouraging shared device use, aligning with equitable implementation expectations.
For teacher colleges, the guidelines stress preparing educators who can model effective digital pedagogy. The module's grounding in competency-based approaches, TPACK, and UDL mirrors expectations for teacher education and contributes indirectly to strengthening the broader teacher education ecosystem. The guidelines also emphasize safe and responsible use of digital and emerging technologies. The module's structured treatment of AI use reflects this emphasis, guiding teachers to apply AI purposefully without undermining pedagogical judgment.

Taken together, this chapter demonstrates that the Competency-Based Digital Skills Training has progressed beyond a pilot activity. It has generated clear evidence of readiness, identified realistic constraints and responses, and shown alignment with national policy and guideline frameworks. With structured support and deliberate coordination, Iringa DC is well-positioned to scale the programme in a manner that is teacher-led, sustainable, and grounded in classroom practice.

6.0 CONCLUSION AND RECOMMENDATIONS

This chapter consolidates lessons from the implementation, evaluation, and dissemination of the Competency-Based Digital Skills Training for STEM Teachers, while situating the module within two critical developments. First, the module was designed to complement and deepen earlier CL4STEM project phases by translating learner-centered pedagogy into concrete digital classroom practice. Second, it responds directly to recent national reforms in education and digital policy, which place stronger expectations on teachers to deliver competency-based, digitally enabled, and inclusive learning.

The convergence of these two drivers explains why this complementary module was necessary. Earlier CL4STEM phases strengthened pedagogy and collaboration, while national policy developments now require systematic use of digital tools, open resources, and responsible integration of emerging technologies in schools and teacher education institutions. This module was developed at the intersection of these needs.

6.1 Conclusion

The Competency-Based Digital Skills Training for STEM Teachers successfully strengthened teachers' capacity to respond to both evolving classroom demands and emerging national policy expectations. Teachers were supported to move from pedagogical understanding gained through earlier CL4STEM modules to structured, competency-based digital practice aligned with current reforms. The introduction of the National Education and Training Policy (2023), the new competency-based curriculum, the National Digital Education Strategy, the National AI Guidelines in Education, and the National Digital Education Guidelines for Schools and Teacher Colleges have raised expectations for how teaching and learning should be organized in schools. This training responded by equipping teachers with practical skills to integrate digital tools, simulations, open resources, and AI-supported planning into daily classroom practice. Rather than replacing earlier CL4STEM approaches, the module reinforced them. Learner-centered pedagogy, collaboration, and contextualized STEM teaching were strengthened through digital means. Teachers demonstrated how simulations, digital assessment, and AI tools can support competencies such as problem solving, inquiry, and application of knowledge. The Training of

Trainers approach and classroom capstone projects ensured that learning aligned with policy expectations was applied in real classrooms.

High completion rates, strong readiness to train peers, and observable classroom change confirm that the module achieved its dual purpose: extending CL4STEM practice and supporting implementation of national digital education reforms. District leadership engagement during dissemination further confirmed readiness to institutionalize these practices within council systems. The programme shows that policy-driven digital reforms are most effective when teachers receive structured, context-aware professional support.

6.2 Recommendations

a. Recommendations for the Open University of Tanzania

The Open University of Tanzania should continue positioning CL4STEM as a progressive professional development pathway that responds to national education and digital policy reforms. Future module development should explicitly map content to updated national policies and guidelines while showing how new competencies extend earlier CL4STEM pedagogical foundations. Subject-specific examples should demonstrate how digital and AI tools support competency-based curriculum requirements.

b. Recommendations for Iringa District Council

The council should embed this complementary module within both its CL4STEM capacity-building framework and its response to national education reforms. Scale-up plans should align digital professional development with the National Education and Training Policy (2023), the National Digital Education Strategy, and the Digital Education Guidelines for Schools and Teacher Colleges. Teacher Resource Centres (TRCs) should be used to support ongoing adaptation as policies continue to evolve.

c. Recommendations for Teacher Resource Centre Coordinators

TRC coordinators should support teachers in interpreting national digital education guidelines and translating them into classroom practice. They should help teachers connect policy expectations with practical tools introduced through CL4STEM, including simulations, OER, and AI-supported lesson planning. TRCs should serve as local policy-to-practice translation hubs.

d. Recommendations for Schools and School Leadership

School leaders should recognize that new national policies require changes in teaching practice, not only compliance. Digital tools should be integrated into lesson planning, assessment, and supervision as part of competency-based curriculum delivery. Teachers who completed CL4STEM modules should be supported to guide colleagues in aligning classroom practice with policy expectations.

e. Recommendations for Teachers

Teachers should continue strengthening their practice by linking earlier CL4STEM pedagogical approaches with digital competencies required under current national reforms. Digital and AI tools should be used purposefully to support competency development, inclusion, and assessment. Teachers should reflect on how policy changes influence their practice and share experiences through peer learning structures.

f. Recommendations for National-Level Stakeholders

National bodies should continue supporting district-led professional development models that translate policy into classroom practice. Clear communication of policy updates, practical guidance, and examples from initiatives such as CL4STEM will support effective implementation. Progressive, modular training approaches should be encouraged as national reforms in digital education continue to evolve.

This chapter confirms that the Competency-Based Digital Skills Training for STEM Teachers emerged from both project continuity and policy necessity. By complementing earlier CL4STEM phases and responding directly to national education and digital reforms, the module provides a coherent and scalable pathway for strengthening digitally enabled, competency-based STEM teaching in Tanzania.

ANNEXES

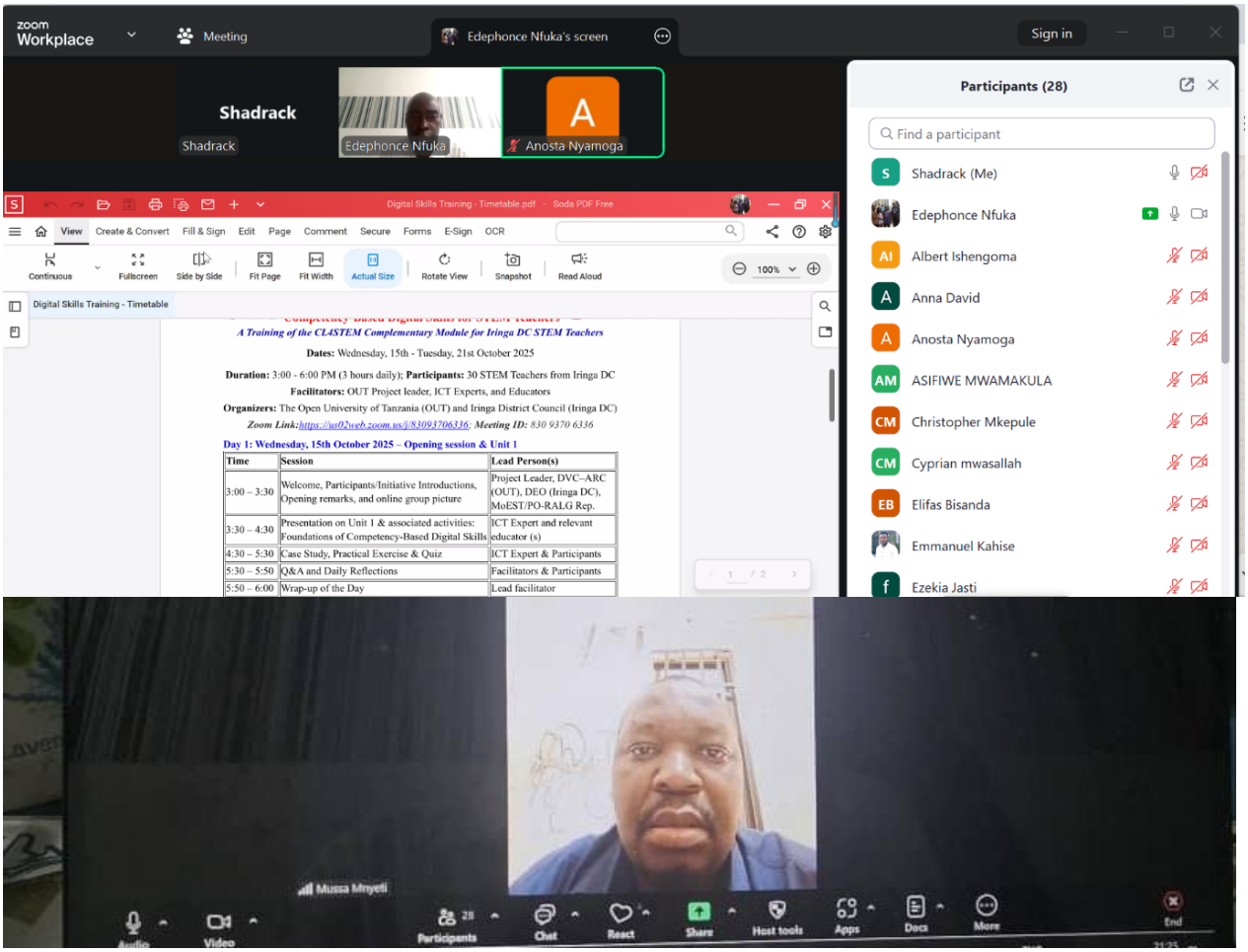
The annexes (A to I) provide supporting documentation for the implementation, evaluation, and dissemination of the Competency-Based Digital Skills Training for STEM Teachers.

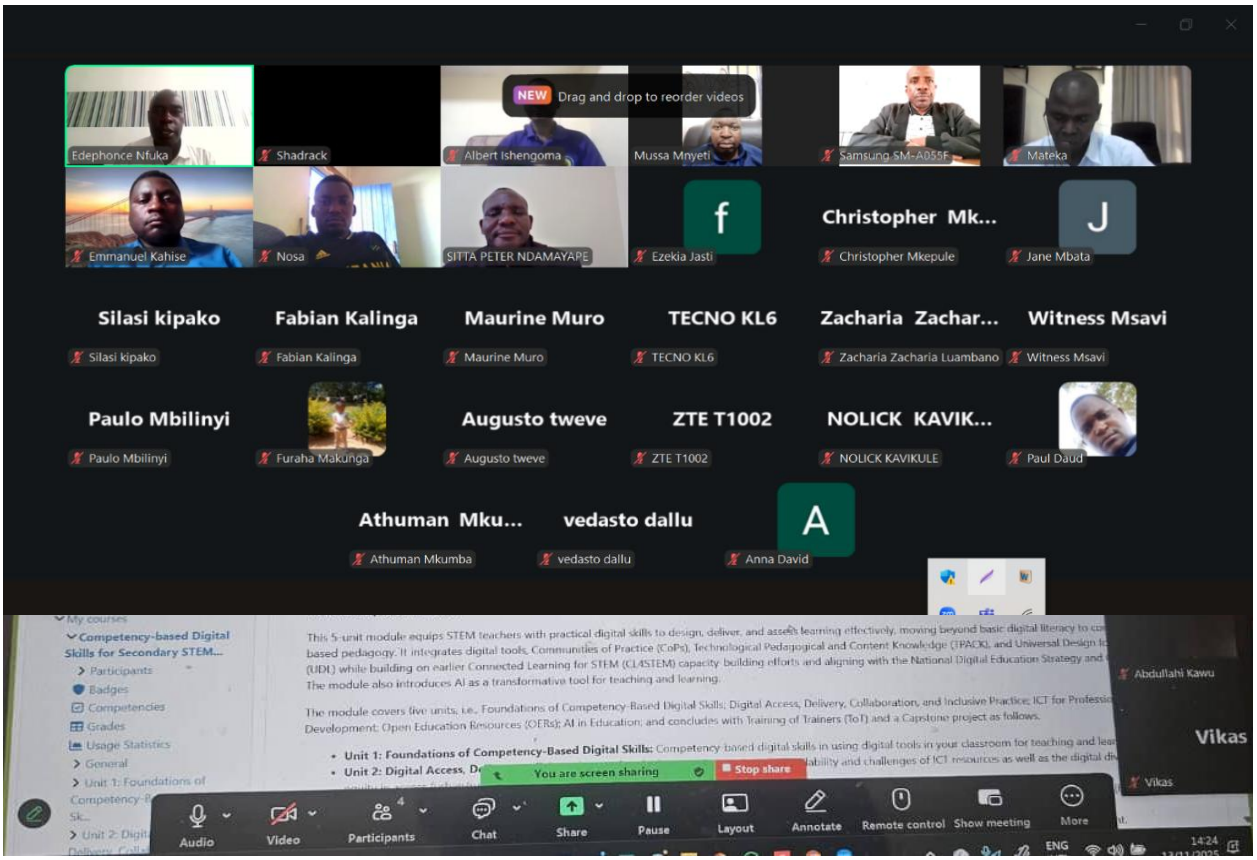
Annex A: Photos and Screenshots

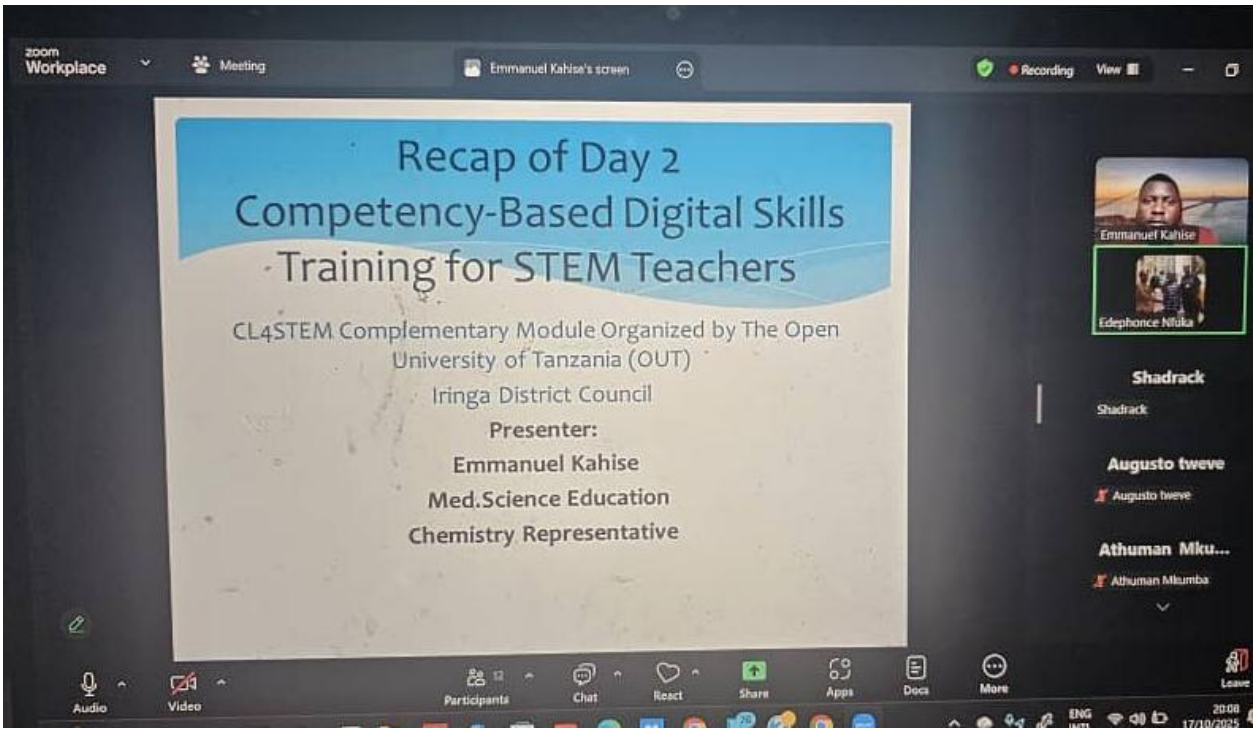
This annex includes selected screenshots and images from Zoom sessions, Moodle activities, the dissemination and certificate award workshop, and classroom capstone implementation. These visuals provide contextual evidence of participation, engagement, and practical application.

Module Training Sessions over Zoom

This training is also in the media with the title *"OUT trains STEM teachers - to empower STEM teachers with digital tools and innovative teaching approaches to enhance learning outcomes."* | https://www.diramakini.co.tz/2025/11/strengthening-stem-educationout.html




Edephonce Nfuka
Shadrack
NEW Drag and drop to reorder videos
Albert Ishengoma
Mussa Mnyeti
Samsung SM-A055F
Mateka
Emmanuel Kahise
Nosa
SITTA PETER NDAMAYAPE
Ezekia Jasti
Christopher Mk...
Christopher Mkepule
Jane Mbata
Silasi kipako
Fabian Kalinga
Maurine Muro
TECNO KL6
Zacharia Zachar...
Witness Msavi
Zacharia Zacharia Luambano
Paulo Mbilinyi
Furaha Makunga
Augusto tweve
ZTE T1002
NOLICK KAVIK...
Paul Daud
Athuman Mku...
vedasto dallu
Anna David
Competency-based Digital Skills for Secondary STEM...
Participants
Badges
Competencies
Grades
Usage Statistics
General
Unit 1: Foundations of
This 5-unit module equips STEM teachers with practical digital skills to design, deliver, and assess learning effectively, moving beyond basic digital literacy to
based pedagogy. It integrates digital tools, Communities of Practice (CoPs), Technological Pedagogical and Content Knowledge (TPACK), and Universal Design
(UDL) while building on earlier Connected Learning for STEM (CL4STEM) capacity building efforts and aligning with the National Digital Education Strategy and
The module also introduces AI as a transformative tool for teaching and learning.
The module covers five units, i.e., Foundations of Competency-Based Digital Skills; Digital Access, Delivery, Collaboration, and Inclusive Practice; ICT for Professio
Development; Open Education Resources (OERs); AI in Education; and concludes with Training of Trainers (ToT) and a Capstone project as follows.
Unit 1: Foundations of Competency-Based Digital Skills: Competency-based digital skills in using digital tools in your classroom for teaching and lea
Unit 2: Digital Access, D
ability and challenges of ICT resources as well as the digital di
You are screen sharing
Stop share
Abdullahi Kawu
Vikas
Audio
Video
Participants
Chat
Share
Pause
Layout
Annotate
Remote control
Show meeting
More
ENG
14:24


zoom Workplace
Meeting
Emmanuel Kahise's screen
Recording
View
Recap of Day 2
Competency-Based Digital Skills
Training for STEM Teachers
CL4STEM Complementary Module Organized by The Open University of Tanzania (OUT)
Iringa District Council
Presenter:
Emmanuel Kahise
Med.Science Education
Chemistry Representative
Emmanuel Kahise
Edephonce Nfuka
Shadrack
Shadrack
Augusto tweve
Augusto tweve
Athuman Mku...
Athuman Mkumba
Audio
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Participants
Chat
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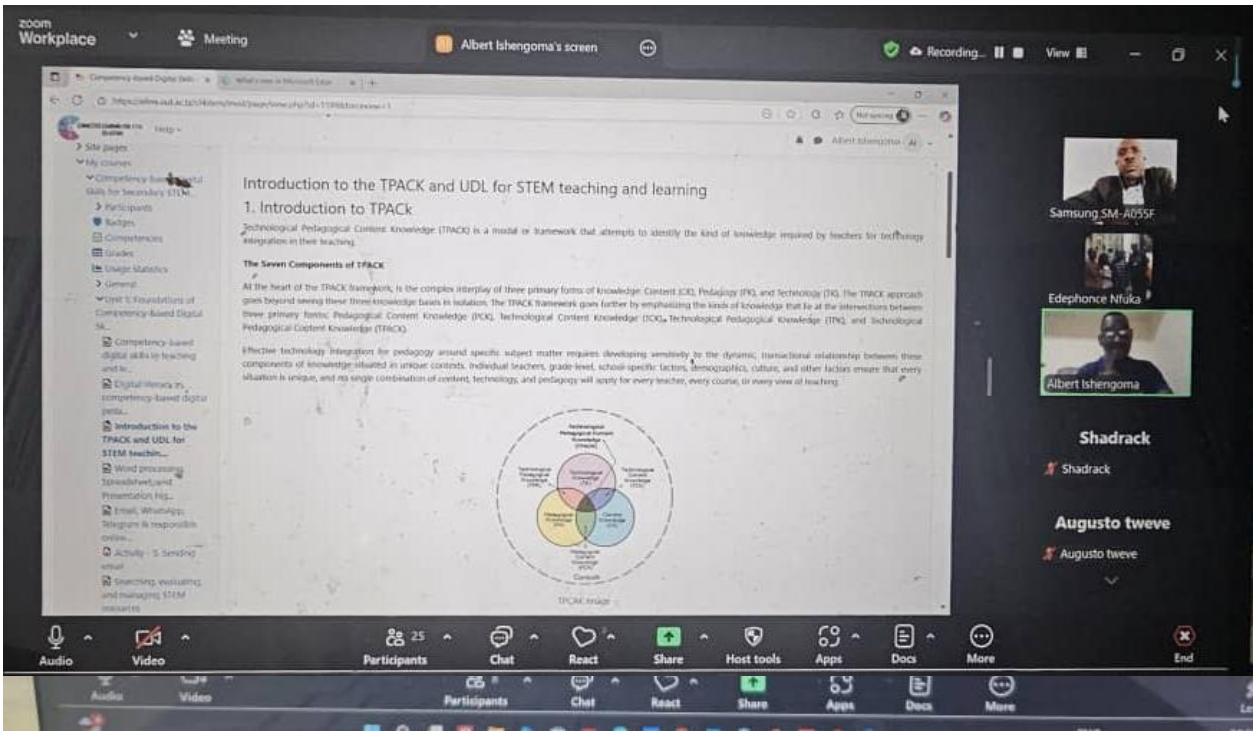
17/10/2025

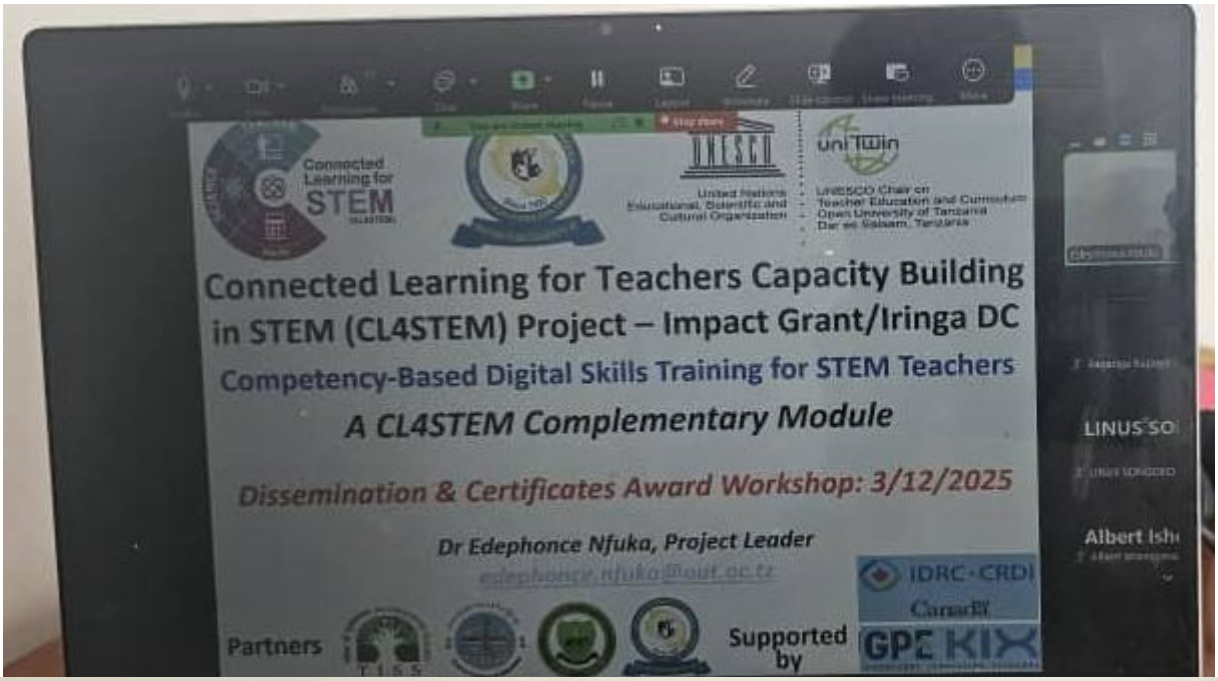
Teachers Content and Educators Validation Workshops

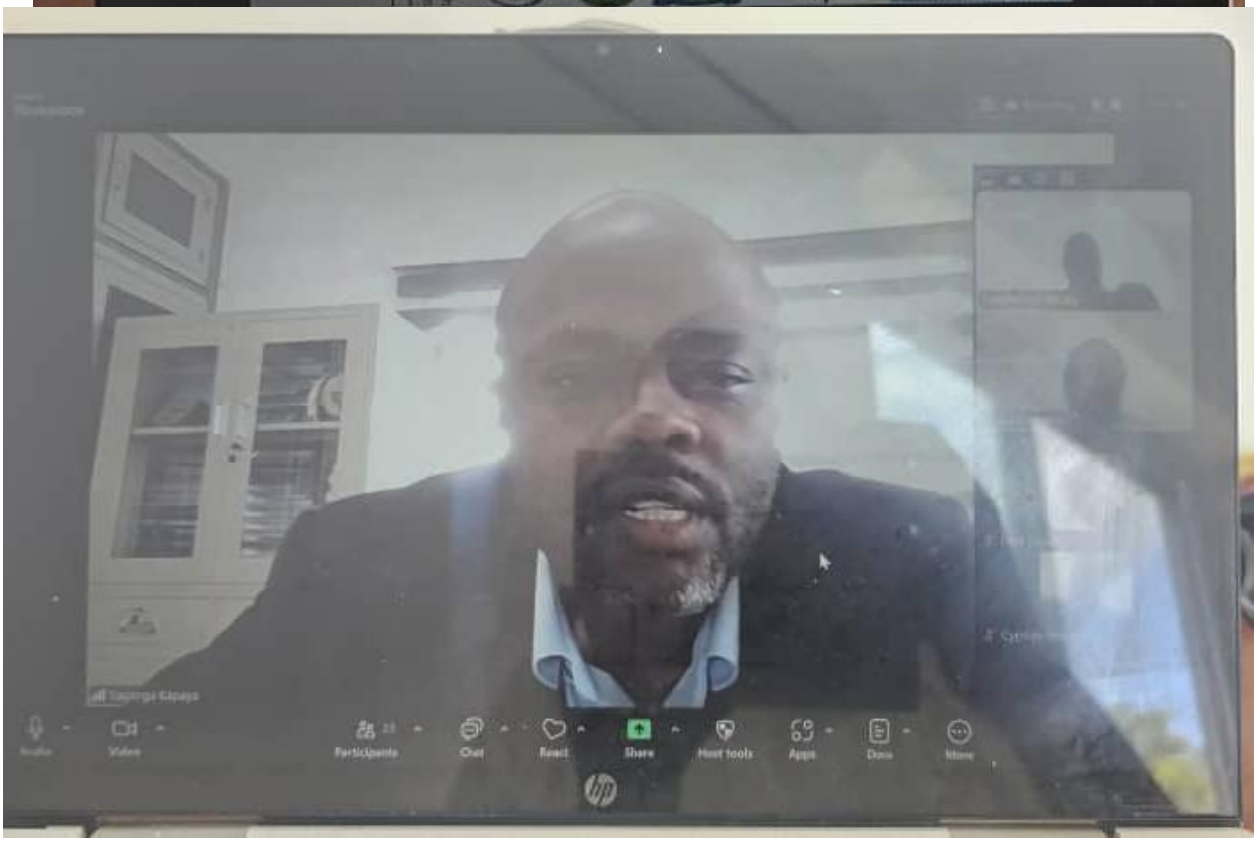


Dissemination and Certificates Award Workshop Schedule

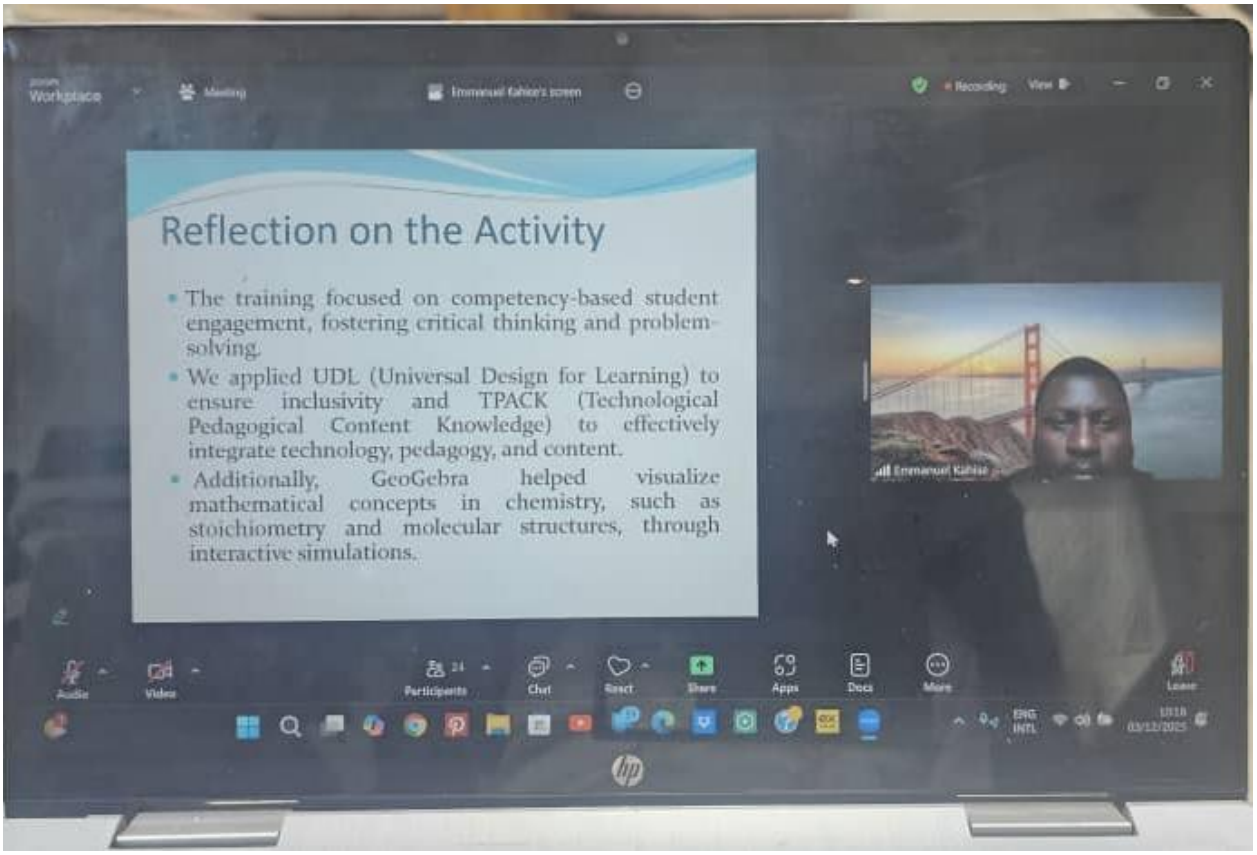
This dissemination event is also in media with the title, "*OUT hosts Dissemination and Certificate Award Workshop on Competency-Based Digital Skills Training for STEM Teachers for Iringa District Council" and the link below*

| https://www.diramakini.co.tz/2025/12/out-hosts-dissemination-and-certificate.html






Workplace
NOLICE KAVIKULE
Edephonce Ntuka
LINUS SONGORO
Shadrack Mbogela
Albert Ishengoma
ASIFIWE MWAMAKULA
Emmanuel Kahise
Anna David
Zacharia Zacharia Luambano
SITTA PETER NDAMAYAPE
oladi nosa
Paul David
Mussa Mnyeti
LYDIA KAYANDA
Witness Msavi
silasi kipako
Maurine Muro
Ezekia Jasti Dabba
JUHUDI NYEMBA
Augusto tweve
Augusto tweve
Christopher mk...
Christopher mkepule
Furaha Makunga
Saganga Kapaya
Audio
Video
Participants
Chat
React
Share
Host tools
Apps
Docs
More
End


Workplace
Meeting
Emmanuel Kahise's screen
Recording
View
Reflection on the Activity
The training focused on competency-based student engagement, fostering critical thinking and problem-solving.
We applied UDL (Universal Design for Learning) to ensure inclusivity and TPACK (Technological Pedagogical Content Knowledge) to effectively integrate technology, pedagogy, and content.
Additionally, GeoGebra helped visualize mathematical concepts in chemistry, such as stoichiometry and molecular structures, through interactive simulations.
Emmanuel Kahise
Audio
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Participants
Chat
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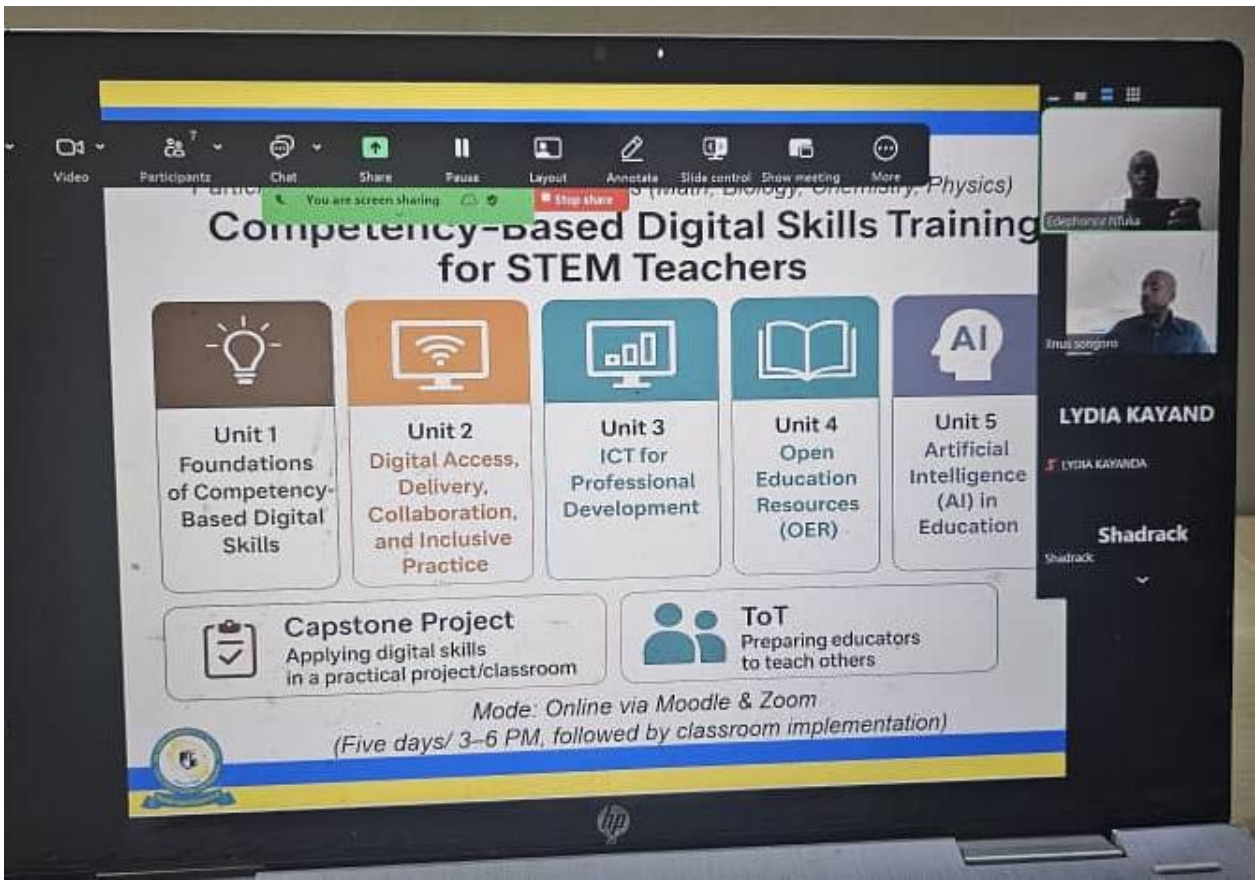

Video
Participants
Chat
Share
Pause
Layout
Annotate
Slide control
Show meeting
More
You are screen sharing
Stop share
Competency-Based Digital Skills Training
for STEM Teachers
Unit 1
Foundations of Competency-Based Digital Skills
Unit 2
Digital Access, Delivery, Collaboration, and Inclusive Practice
Unit 3
ICT for Professional Development
Unit 4
Open Education Resources (OER)
Unit 5
Artificial Intelligence (AI) in Education
AI
Capstone Project
Applying digital skills in a practical project/classroom
ToT
Preparing educators to teach others
Mode: Online via Moodle & Zoom
(Five days/ 3–6 PM, followed by classroom implementation)
LYDIA KAYAND
Shadrack


Workplace
Meeting
Recording...
View
THE OPEN UNIVERSITY OF TANZANIA
Certificate of Completion
Awarded to
Lydia Anthony Kayanda
For your successful completion of a Competency-Based Digital Skills Course under Connected Learning for Secondary Schools STEM Teacher Capacity Building (CL4STEM) – Impact Grant Project in Tanzania, from October 15th, 2025 to November 7th, 2025
GPE KIX
LYDIA KAYANDA
Audio
Video
Participants
Chat
React
Share
Host tools

Annex B: Training Module Brochure

This annex contains the official brochure used to introduce the Competency-Based Digital Skills Training for STEM Teachers to participating schools and teachers. The brochure outlines the purpose of the training, target participants, structure of the five units, Training of Trainers approach, and the classroom capstone requirement. It was used for teacher orientation and stakeholder communication before training delivery *(Sample, continue up to Unit 5 & ToT).*

Competency-Based Digital Skills Training for STEM Teachers

CL4STEM Complementary Module

Organized by **The Open University of Tanzania (OUT)** and Offered to **Iringa DC**

Module Purpose and Units

This 5-unit module equips STEM teachers with practical digital skills to design, deliver, and assess learning effectively, moving beyond basic digital literacy to competency-based pedagogy. It integrates digital tools, Communities of Practice (CoPs), Technological Pedagogical and Content Knowledge (TPACK), and Universal Design for Learning (UDL) while building on earlier Connected Learning for STEM (CL4STEM) capacity-building efforts and aligning with the Tanzania National Digital Education Strategy and associated Guidelines. The module also introduces AI as a transformative tool for teaching and learning. The module covers five units: Foundations of Competency-Based Digital Skills; Digital Access, Delivery, Collaboration, and Inclusive Practice; ICT for Professional Development; Open Education Resources (OERs); AI in Education; and concludes with Training of Trainers (ToT).

Learning Outcomes

By the end of this module, participants will be able to:

- Differentiate and demonstrate digital literacy and competency-based digital skills
- Apply digital pedagogy principles, TPACK & UDL in digitally enabled STEM teaching and Learning
- Use digital tools for access, delivery, collaboration, and the inclusive practice with UDL
- Create and share Open Educational Resources (OER) and embed them into interactive STEM content
- Strengthen digital professional growth through TPACK, UDL, reflective teaching, MOOCs and CoPs
- Integrate AI tools responsibly into STEM lessons in alignment with the National AI Guidelines
- Demonstrate classroom-tested use of at least two combined digital skills/tools in a capstone project
- Mentor colleagues and cascade competency-based digital skills through Training of Trainers (ToT)

Training Outline

Unit 1: Foundations of Competency-Based Digital Skills

- Basics of Competency-Based Digital Skills in Tanzania
- Digital literacy vs. competency-based digital pedagogy
- Introduction to the TPACK and UDL for STEM teaching and learning
- Word processing, Spreadsheets, and Presentation applications in teaching and learning
- Searching, evaluating, and managing STEM resources
- Safe and secure use of digital tools and data protection

🔹 Tools: MS Word, MS Excel, MS PowerPoint, Google Search/Scholar, Moodle, MP4, Interactive simulation tool (PhET/GeoGebra), OER Commons, Google Security (2FA) & Grammarly AI Checker

🔸 Case study: Teacher designs a STEM lesson using PhET - literacy vs. competency-based approaches

✦ Practical exercise: Design a competency-based STEM lesson with TPACK and UDL approaches

❓ Quiz: Questions of different formats from this 1st Unit

📝 Output: Mini-lesson plan using one resource and a guiding question

Annex C: Teachers' Content Validation Schedule

This annex presents the schedule and structure used during the teachers' validation session. It includes dates, session objectives, validation focus areas, and attendance records. The validation process ensured that the module content was practical, clear, and suitable for STEM classroom application before full deployment.

Content Validation Timetable

Competency-Based Digital Skills for STEM Teachers

A Validation of the CL4STEM Complementary Module for Iringa DC STEM Teachers

Purpose: Review & validate module content in Outline & Moodle by STEM Teachers

Date: Monday, 13th October 2025; **Mode:** Online (Moodle + Zoom)

Time/Duration: 3:00 pm – 06:00 pm EAT

Zoom Link:https://us02web.zoom.us/j/83093706336; ***Meeting ID:*** *830 9370 6336*

Time	Activity	Lead Person(s)
03:00 - 3:15	Welcome/Introduction/Brief Opening Remarks Initiative/Module/ Validation Overview	DEO/DEO Representative Project Lead & Core Team
03:15 - 3:25	Unit 1 Presentation: Foundations of Competency-Based Digital Skills	ICT Expert/Core Team
03:25 - 3:42	Comment Session (Unit 1)	STEM Teachers (Validators)
03:42 - 3:52	Unit 2 Presentation: Digital Access, Delivery, Collaboration, and Inclusive Practice	ICT Expert/Core Team
03:52 -04:09	Comment Session (Unit 2)	STEM Teachers (Validators)
04:09 - 04:19	Unit 3 Presentation: ICT for Professional Development	ICT Expert/Core Team
04:19 - 04:36	Comment Session (Unit 3)	STEM Teachers (Validators)
04:36 - 04:46	Unit 4 Presentation: Open Educational Resources (OER)	ICT Expert/Core Team
04:46 - 05:03	Comment Session (Unit 4)	STEM Teachers (Validators)
05:03 - 05:13	Unit 5 Presentation: Artificial Intelligence (AI) in Education	ICT Expert/Core Team
05:13 - 05:30	Comment Session (Unit 5)	STEM Teachers (Validators)
05:30 - 05:40	Training of Trainers (ToT) and Capstone Project for classroom application/implement.	ICT Expert/Core Team
05:40 - 05:55	General comments on cross-cutting feedback & improvement consolidation	STEM Teachers (Validators) & Moderator
05:55 - 06:00	Closing Reflections and Official Closing	Validators' representative & Project Lead

Supported by the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX), a Joint Endeavour with the International Development Research Centre, Canada (IDRC).

Annex D: Educators' Validation Schedule

This annex documents the validation session conducted with teacher educators and subject experts from OUT. It outlines the programme agenda, participant roles, and areas reviewed, including content accuracy, alignment with national policies, pedagogical soundness, and tool appropriateness. Feedback from this process informed the final revisions to the module.

Content Validation Timetable

Competency-Based Digital Skills for STEM Teachers

A Validation of the CL4STEM Complementary Module for Iringa DC STEM Teachers

Purpose: Review & validate module content in Outline & Moodle by OUT STEM educators

Date: Monday, 13th October 2025; **Mode:** Online (Moodle + Zoom)

Time/Duration: 9:00 AM – 12:00 Noon EAT

Zoom Link: https://us02web.zoom.us/j/82666110749; ***Meeting ID:*** *826 6611 0749*

Time	Activity	Lead Person(s)
09:00 - 9:15	Welcome & Initiative/Module/ Validation Overview	Project Lead & Core Team
09:15 - 9:25	Unit 1 Presentation: Foundations of Competency-Based Digital Skills	ICT Expert/Core Team
09:25 - 9:42	Comment Session (Unit 1)	STEM Educators (Validators)
09:42 - 9:52	Unit 2 Presentation: Digital Access, Delivery, Collaboration, and Inclusive Practice	ICT Expert/Core Team
09:52 -10:09	Comment Session (Unit 2)	Validators/STEM Educators
10:09 - 10:19	Unit 3 Presentation: ICT for Professional Development	ICT Expert/Core Team
10:19 - 10:36	Comment Session (Unit 3)	Validators/STEM Educators
10:36 - 10:46	Unit 4 Presentation: Open Educational Resources (OER)	ICT Expert/Core Team
10:46 - 11:03	Comment Session (Unit 4)	Validators/STEM Educators
11:03 - 11:13	Unit 5 Presentation: Artificial Intelligence (AI) in Education	ICT Expert/Core Team
11:13 - 11:30	Comment Session (Unit 5)	Validators/STEM Educators
11:30 - 11:40	Training of Trainers (ToT) and Capstone Project for classroom application	ICT Expert/Core Team
11:40 - 11:55	General comments on cross-cutting feedback & improvement consolidation	Validators/STEM Educators & Moderator
11:55 - 12:00	Closing Reflections and Official Closing	Validators' representative & Project Lead

Supported by the Global Partnership for Education Knowledge and Innovation Exchange (GPE-KIX), a Joint Endeavour with the International Development Research Centre, Canada (IDRC).

Annex E: Training Timetable and Daily Agenda

This annex provides the full training timetable covering Moodle-based learning activities and Zoom live sessions. It includes session dates, time allocations, unit focus, and facilitation responsibilities. The timetable illustrates how the online delivery model was structured to fit teachers' schedules while maintaining consistent engagement.

Training Timetable (Online via Moodle & Zoom)
Competency-Based Digital Skills for STEM Teachers
A Training of the CL4STEM Complementary Module for Iringa DC STEM Teachers

Dates: Wednesday, 15th - Tuesday, 21st October 2025

Duration: 3:00 - 6:00 PM (3 hours daily); **Participants:** 30 STEM Teachers from Iringa DC
Facilitators: OUT Project leader, ICT Experts, and Educators
Organizers: The Open University of Tanzania (OUT) and Iringa District Council (Iringa DC)
Zoom Link:https://us02web.zoom.us/j/83093706336; ***Meeting ID:*** *830 9370 6336*

Day 1: Wednesday, 15th October 2025 – Opening session & Unit 1

Time	Session	Lead Person(s)
3:00 – 3:30	Welcome, Participants/Initiative Introductions, Opening remarks, and online group picture	Project Leader, DVC–ARC (OUT), DEO (Iringa DC), MoEST/PO-RALG Rep.
3:30 – 4:30	Presentation on Unit 1 & associated activities: Foundations of Competency-Based Digital Skills	ICT Expert and relevant educator (s)
4:30 – 5:30	Case Study, Practical Exercise & Quiz	ICT Expert & Participants
5:30 – 5:50	Q&A and Daily Reflections	Facilitators & Participants
5:50 – 6:00	Wrap-up of the Day	Lead facilitator

Day 2: Thursday, 16th October 2025 – Unit 2

Time	Session	Lead Person(s)
3:00 – 3:10	Recap of Day 1 (Physics Representative)	Selected Participant
3:10 – 4:30	Presentation on Unit 2 & associated activities: Digital Access, Delivery, Collaboration, and Inclusive Practice	ICT Expert
4:30 – 5:30	Case Study, Practical Exercise & Quiz	ICT Expert & Participants
5:30 – 5:50	Q&A and Daily Reflections	Facilitators & Participants
5:50 – 6:00	Wrap-up of the Day	Lead facilitator

Day 3: Friday, 17th October 2025 – Unit 3

Time	Session	Lead Person(s)
3:00 – 3:10	Recap of Day 2 (Chemistry Representative)	Selected Participant
3:10 – 4:30	Presentation on Unit 3 & associated activities: ICT for Professional Development	ICT Expert
4:30 – 5:30	Case Study, Practical Exercise, and Quiz	ICT Expert & Participants
5:30 – 5:50	Q&A and Daily Reflections	Facilitators & Participants
5:50 – 6:00	Wrap-up of the Day	Lead facilitator

Competency-based

Day 4: Monday, 20th October 2025 – Unit 4

Time	Session	Lead Person(s)
3:00 – 3:10	Recap of Day 3 (Biology Representative)	Selected Participant
3:10 – 4:30	Presentation on Unit 4 & associated activities: Open Educational Resources (OER)	ICT Expert
4:30 – 5:30	Case Study, Practical Exercise, and Quiz	ICT Expert & Participants
5:30 – 5:50	Q&A and Daily Reflections	Facilitators & Participants
5:50 – 6:00	Wrap-up of the Day	Lead facilitator

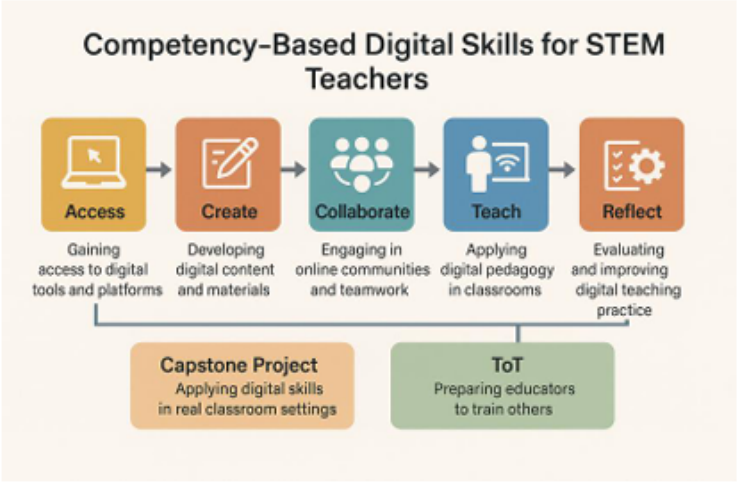
Day 5: Tuesday, 21st October 2025 – Unit 5, ToT & Capstone Project

Time	Session	Lead Person(s)
3:00 – 3:10	Recap of Day 4 (Mathematics Representative)	Selected Participant
3:10 – 4:00	Presentation on Unit 5& associated activities: AI in Education	ICT Expert
4:00 – 4:45	Case Study, Practical Exercise & Quiz	ICT Expert & Participants
4:45 – 5:20	Training of Trainers (ToT) & *Capstone Project Development to be Implemented in the Classroom	ICT Expert & Other facilitators
5:20 – 5:45	Q&A and Daily Reflections (Unit 5 & ToT)	Facilitators & Participants
5:45 – 5:50	Participant Reflections (Teachers' Representative)	Selected Participant
5:50 – 6:00	Official Closing Remarks	Iringa DEO - Academic

**Capstone Project Development & Implementation in the Classroom* - Each teacher will develop one (application of ICT in T/L that fits context) over these five days as he/she covers units and then implement it in the classroom in the remaining days of the week after training.

Competency-Based Digital Skills for STEM Teachers

Expectations In a Nutshell



Annex F: Dissemination and Certificates Award Workshop Schedule

This annex contains the official programme schedule for the Dissemination and Certificates Award Workshop for the Competency-Based Digital Skills Training for STEM Teachers in Iringa District Council. The schedule outlines the timing of activities, session flow, and responsible persons for the online workshop conducted via Zoom on Wed, 3 Dec 2025, from 09:00 to 12:00 hrs.

United Nations Educational, Scientific and Cultural Organization

UNESCO Chair on Teacher Education and Curriculum Open University of Tanzania Dar es Salaam, Tanzania

Connected Learning for STEM (CL4STEM)

Connected Learning for Secondary Schools STEM Teacher's Capacity Building (CL4STEM)

Competency-Based Digital Skills Training for STEM Teachers - Iringa DC

Dissemination and Certificates Award Workshop

Wednesday, 3rd December 2025

Zoom Link: https://us02web.zoom.us/j/88160996153; **Meeting ID: 881 6099 6153**

WORKSHOP SCHEDULE: 9.00 AM -12:.00 MIDDAY

PROGRAMME SCHEDULE		
Time (hours)	**Event/Activity**	**Responsible Person(s)**
0855-0900	Participants Registration *(Ensure your login reads your name)*	ALL/Secretariat
0900-0905	General introduction of event & participants (Teachers, HoSs, and the Gov., OUT & Council officials present)	Prof P. Ikwaba, Project team member
0905-0915	Welcome address by the OUT Act. DVC-ARC	Prof K. Saganga
0915-0930	Overview of the CL4STEM Complementary Module: Competency-Based Digital Skills for STEM Teachers	Dr E.Nfuka, Project leader
0930-0950	Teachers' Capacity Building presentation on covered content, activities applied in classrooms, lessons learnt, challenges & strategies for scaling it up in classes, schools & Council with respect to your Subject (CHEM, BIOL, MATHS, PHYS) – Subject Teachers representative.	Mr E. Kahise - Chemistry
0950-1010		Ms K. Lydia - Biology
1010-1030		Mr D. Paul - Maths
1030-1050		Mr L. Songoro - Physics
1050-1100	The overall reflection of Teachers' Capacity Building made with a Reflection from the heads of schools' view	Mr O. Nosa, Heads of Schools representative
1100-1115	Iringa DC District Education Officer (DEO) remarks on the ending project and scaling plans in the Council	Ms A. Nkwera, DEO
1115-1130	Brief remarks by the GPE/KIX Focal Point in Tanzania, Iringa REO, and PO-RALG representatives	GPE/KIX Focal Point, Iringa REO & PO-RALG
1130-1140	Closing Remarks by the Representative of the Ministry of Education, Science and Technology in this Project	Mr. M. Mnyeti, MoEST
1140-1155	Award of Certificates to Teachers - digitally	Mr. Mnyeti, Prof Saganga, Ms Nkwera, Mr Anosta
1155-1200	Vote of Thanks/Group Photo	L. Songoro, Teachers' rep

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GPE KIX KNOWLEDGE INNOVATION EXCHANGE

TISS Centre of Excellence in Teacher Education

Annex G: Teacher Evaluation Tool (Google Form)

This annex contains the full teacher evaluation instrument used at the end of the training. It includes all survey sections, question items, and response formats covering course experience, skills gained, confidence, ToT readiness, delivery preferences, and monitoring options. The tool supports transparency and potential reuse in future training rounds (https://forms.gle/Z6b17qJE7oHf4Daw8)

SURVEY

Title:
Competency-Based Digital Skills Training for STEM Teachers Evaluation

SECTION A: Consent
Description:
Thank you for participating in this training. Your feedback will help improve future rounds and guide scaling-up across the council. Your responses are confidential.

Question (Required):
Do you agree to participate in this evaluation?
• Yes
• No

SECTION B: Course Experience (1–5 Rating)
Linear scale: 1 = Very Low, 5 = Very High

1. Clarity and relevance of the training content
2. Usefulness of Moodle materials and activities
3. Helpfulness of Zoom live sessions
4. Ease of accessing training materials
5. Relevance of digital tools demonstrated
6. Classroom applicability of what you learned
7. Support received from facilitators
8. Overall satisfaction with the training

SECTION C: Skills and Competencies Gained (1–5 Rating)

1. Confidence in using digital tools in STEM teaching
2. Ability to design competency-based digital activities
3. Ability to apply TPACK and UDL
4. Ability to create/adapt OER
5. Ability to use AI responsibly
6. Ability to collaborate digitally
7. Readiness to mentor peers (ToT)

SECTION D: Capstone project (2 to 3 Digital tools) Implementation in Class

1. Did you implement your capstone project in class?
   • Yes
   • No

- ToT
- Capstone implementation

4. Are you willing to train other teachers using the ToT model?
   - Yes
   - No

5. What support will you need to train your peers?
   (Checkboxes – one or more)
   - Training materials
   - Digital devices and connectivity
   - Time from school leadership
   - Mentorship from OUT/DEO
   - Support from TRC coordinators
   - Additional ToT preparation
   - Incentives/recognition
   - Others

6. How can the council integrate this training into routine CPD?
   (Checkboxes – one or more)
   - Include in annual CPD plans
   - Embed in school-based training days
   - Offer through TRCs each term
   - Link to performance appraisals
   - Include in new teacher induction
   - Align with digital education strategy

7. What role can TRC coordinators play in supporting scale-up?
   (Checkboxes – one or more)
   - Coordinating training logistics
   - Hosting cluster sessions
   - Monitoring school activities
   - Providing technical support
   - Facilitating Communities of Practice
   - Collecting feedback
   - Supporting ToT teachers

SECTION F: Additional Comments

1. What was the most valuable part of the course? *(Paragraph)*
2. What should be improved and how in future rounds? *(Paragraph)*
3. Any final suggestions? *(Paragraph)*

2. Which digital tools did you use in preparing content/assessment and delivering in class? *(Checkboxes)*
   • PhET
   • GeoGebra
   • BioDigital Human
   • Kahoot or Quizizz
   • Otter.ai or Transkriptor for transcribing
   • Moodle or Zoom
   • Office tools (Word, Excel, PPT)
   • Google search
   • OER Platforms
   • AI Tools (ChatGPT, Copilot, NoteBookLM)
   • Grammarly AI Checker,
   • Video/Screen recording
   • Others (Short answer)
3. What worked well in the lesson? *(Paragraph)*
4. What challenges did you face, and mitigation suggestions? *(Paragraph)*
5. What change did you observe in yourself and the learners? *(Paragraph)*

SECTION E: Scaling-Up

1. What delivery mode would work best for scaling up in your entire council? *(Checkboxes – one or more)*
   • Online (Moodle + Zoom)
   • Blended (Online + face-to-face)
   • Face-to-face workshops
   • School-based sessions
   • Cluster-based sessions
2. What monitoring approach should the council use during scale-up? *(Checkboxes – one or more)*
   • Monthly school reports
   • Classroom observation visits
   • Moodle digital submissions
   • WhatsApp/CoP progress tracking
   • Quarterly cluster review meetings
   • End-of-term evaluations
3. Which parts of this module are essential for future scale-up rounds? *(Checkboxes – one or more or all)*
   • Competency-Based Digital Skills (Basics)
   • Digital Access, Delivery & Collaboration
   • ICT for Professional Development
   • OER
   • AI in Education

Annex I: Capstone Lesson Sample

This annex presents a classroom capstone sample from any of the subjects involved (Biology, Chemistry, Physics, or Mathematics). The annex demonstrates how competency-based digital skills were applied in real classroom settings & serves as a reference for future training &scale-up.

Physics Group Work – TPACK approach

STEM LESSON PLAN: Projectile Motion / Mwendo wa Mrundiko

Subject: Physics / Integrated Science

Topic: Projectile Motion

Class Level: O-Level (Form II or III)

Duration: 80 minutes (Double Period)

Language of Instruction: English & Kiswahili

Teaching Framework: TPACK (Technological, Pedagogical, and Content Knowledge)

1. Learning Objectives / Malengo ya Somo

- Define projectile motion and identify examples in daily life. / Kueleza maana ya mwendo wa mrundiko na kutoa mifano ya kila siku.
- Describe the horizontal and vertical components of projectile motion. / Kueleza sehemu za usawa na wima za mwendo wa mrundiko.
- Use technology (simulation or video) to visualize the path of a projectile. / Kutumia teknolojia kuona njia ya mrundiko.
- Calculate basic parameters such as time of flight, range, and maximum height. / Kuhesabu muda wa kuruka, umbali na kimo cha juu zaidi.
- Design and perform a simple experiment or simulation demonstrating projectile motion. / Kufanya jaribio rahisi la kuonyesha mwendo wa mrundiko.
- Communicate findings in both English and Kiswahili. / Kuwasilisha matokeo kwa Kiingereza na Kiswahili.

2. TPACK Framework Integration

TPACK Element	Application in Lesson
Content Knowledge (CK)	Understanding of projectile motion, horizontal & vertical components, and relevant equations.
Pedagogical Knowledge (PK)	Inquiry-based, collaborative, and experiment-driven learning.
Technological Knowledge (TK)	Use of PhET Simulation – 'Projectile Motion', videos, and data recording tools.
TPACK Integration	Students use simulations and digital tools to visualize and analyze projectile motion while applying physics and math concepts collaboratively.

3. Teaching and Learning Activities / Shughuli za Kujifunza

A. Introduction / Utangulizi

Teacher: Show video of football being kicked or stone thrown. Ask: 'What do these have in common?' / 'Ni kitu gani kinachofanana?' Introduce 'Projectile Motion (Mwendo wa Mrundiko)'.

Students: Observe and share examples such as throwing a ball or shooting an arrow.

B. Exploration / Utafiti

Teacher: Guide students to use PhET Simulation – 'Projectile Motion' and adjust angle, velocity, and height.

Students: Work in pairs using computers or tablets to record results in bilingual tables.

C. Explanation / Ufafanuzi

Teacher: Explain components of projectile motion with formulas; translate into Kiswahili for clarity.

Students: Copy examples, ask questions in English or Kiswahili.

D. Elaboration / Ufafanuzi Zaidi

Teacher: Assist students to perform a mini-experiment using a ball rolled off a table to observe projectile path.

Students: Measure distance and height, compare with simulation results, and present findings.

E. Evaluation / Tathmini

Teacher: Give a short bilingual quiz and assess presentations using rubric below.

Rubric / Kigezo cha Upimaji

Aspect / Kipengele	Excellent (3)	Good (2)	Needs Improvement (1)
Concept Understanding / Uelewa wa Dhana	Clear & accurate	Mostly correct	Incomplete
Technology Use / Matumizi ya Teknolojia	Effective	Adequate	Minimal
Collaboration / Ushirikiano	Very good teamwork	Some teamwork	Poor teamwork

Communication / Mawasiliano	Clear bilingual explanation	Partial translation	Limited clarity

4. Teaching Aids / Vifaa vya Kufundishia

• Digital: PhET Simulation (Projectile Motion), calculator, projector

• Physical: Small balls, ruler, stopwatch, meter rule

• Materials: Bilingual vocabulary cards, printed worksheets, chart paper

5. Multilingual & Inclusive Strategies / Mikakati ya Lugha Nyingi

• Introduce key terms in English and Kiswahili.
• Provide bilingual handouts and visuals.
• Allow code-switching for better understanding.
• Use peer translation and mixed-language group work.

6. Assessment Summary / Muhtasari wa Upimaji

Skill / Ujuzi	Assessment Type / Aina ya Upimaji	Focus / Lengo
Science Knowledge	Quiz, oral questioning	Understanding projectile concepts
Technology Use	Simulation activity	Application of digital tools
Engineering	Experiment / Model design	Accuracy & creativity
Mathematics	Calculations	Correct formula use
Communication	Presentation	Clear bilingual delivery

7. Extension Activity / Kazi ya Nyumbani

Investigate and record an example of projectile motion in sports (football, basketball, or javelin) and explain in both English and Kiswahili.
Chunguza na andika mfano wa mwendo wa mrundiko katika michezo kama mpira wa miguu, mpira wa kikapu au mikuki, kisha eleza kwa Kiingereza na Kiswahili.