A Model to Improve the Effectiveness of Secondary Trainers in Cascaded Teacher Professional Development Programmes

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by

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Approval Sheet

This thesis report entitled "A Model to Improve the Effectiveness of Secondary Trainers in Cascaded Teacher Professional Development Programs", by Lucian Vumilia Ngeze, is approved for the degree of Doctor of Philosophy.

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Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I declare that I have properly and accurately acknowledged all sources used in the production of this report. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

Teacher Professional Development (TPD) involves activities that develop teacher's skills, knowledge, expertise and other characteristics. TPD is achieved in many ways depending on the context and nature of the professional development activity involved. Several models have been employed in achieving career progression via TPD. Cascade is one of the models used in large-scale training of teachers. It involves phases of training teachers where the trained teachers have to train other teachers at lower levels.

Cascade is widely deployed in the design, development and implementation of teacher professional programmes in many developing countries, including Tanzania. Cascade model is used mostly when: 1) a large number of teachers are to be trained within a short period of time; 2) the same teachers have to be trained to train other teachers; and 3) funding is limited and there is a need for a cost-effective approach to teacher training. On the other hand, implementation of cascaded teacher training is hindered by inadequate preparation of trainers (such as reliance on content knowledge, with no focus on training skills). This results in decreased confidence to train other teachers, leading to content dilution and misinterpretation of some terms.

To improve implementation of cascaded teacher training programmes, we developed Attain-Align-Integrate-Teach-Train (A2IT2) model. A2IT2 is a 5-phased model that develops a school teacher into a trainer who can cascade a training program effectively. A2IT2 is based on A2I model (Warriem et al., 2014) as used in the development of teacher training programs on technology integration in teaching and learning. Through A2IT2 model, the selected school teachers go through a number of content workshops that equip them with content knowledge and training practice, as well as skills workshops that equip the teachers with important training and facilitation skills and techniques for adult learners.

A2IT2 model was deployed in four content workshops using Design Based Implementation Research (DBIR) Methodology. Two DBIR cycles with two iterations each were used to refine the model. The selected participants transitioned across different roles from being learners to becoming teacher trainers to cascade the training.

From this research work: i) the developed teacher trainers improved confidence to train other teachers as the trainers, as revealed during their solo training sessions; ii) participants (teachers) perceived confidence to use technology in teaching and learning; and iii) teachers integrated technology tools in the developed lesson plans.

Keywords: Cascade model of teacher training, teacher trainer development, knowledge transfer, A2IT2 model, train the trainer, secondary trainer.

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List of Abbreviations

A2I	Attain-Align-Integrate
A2IT2	Attain-Align-Integrate-Teach-Train
CBC	Competence-based Curriculum
CK	Content Knowledge
CoT	Co-trainer
CfW	Confirmatory Workshop
CPD	Continuous Professional Development
CW	Content Workshops
DBIR	Design Based Implementation Research
DBR	Design Based Research
EQUIP	Education Quality Improvement Program
GESCI	Global E-school and communities Initiative
GRR	Gradual Release of Responsibility
IIT	Indian Institute of Technology
ICT	Information Communication and Technology
KOICA	Korea International Cooperation Agency
LA	Learning Assistant
MoEST	Ministry of Education Science and Technology
MOOC	Massive Open Online Course

MT	Master Trainer
PO-RALG	Presidents Office Regional Administration and Local Government
RA	Research Assistant
RQs	Research Questions
RT	Resource Trainer
SW	Skills Workshop
TA	Teaching Assistants
TEQIP	Technical Education Quality Improvement Program
TIE	Tanzania Institute of Education
TK	Technology Knowledge
TTC	Teacher Training College
TPD	Teacher Professional Development
UCSAF	Universal Communication Service Access Fund
UNOPS	United Nations Office of Project Services
URT	United Republic of Tanzania

Definition of Key Terms in this Thesis

Cascade Model: This is one of the commonly deployed models in teacher professional development. It is deployed when the need is to train a large number of teachers within a short period of time.

Teacher: This a professional teacher who teaches at primary and/or secondary school level.2eds

Primary Trainer: This is the expert trainer who is knowledgeable in the training content and whose task is to train the first level of teachers who after training become secondary trainers.

Master Trainer (MT): This is similar to Primary Trainer. It is the first level of trainer in the cascade model.

Secondary Trainer: The trained participant whose task is to plan and conduct a teacher training session with teachers in a cascaded program.

Learner (L): This is a participant (teacher) in the content workshop who participates for the first time. He/she learns the workshop content for the first time.

Learning Assistant (LA): This is a participant of the previous content workshop who joins another new content workshop with another role to help new participants in their learning process. LA helps new participants by guiding them during collaborative activities and clarifies some portions of the workshop content. His/her participation is about 10-15% of the content workshop.

Co-trainer (CoT): This is a selected LA who has undergone a skills workshop and who has trained with the master trainer for approximately 35-40% of the content workshop.

Trainer (T): This is a co-trainer who has taken a full content workshop with other teachers in a different context. This trainer plans, conducts and evaluates the training with minimal support from the master trainer.

Student: This research used microteaching to enhance technology integration practices. During microteaching sessions one teacher conducted a microteaching session while the rest of the participants participated as “students”.

Technology Integration: This is the meaningful use of technology resources to improve learning and achieve intended learning goals. In this research, technology resources can be computers, mobile devices (eg. Smartphones, tablets, digital cameras), application software (eg. Microsoft PowerPoint, Microsoft Word) and the Internet.

Technological and Pedagogical Knowledge (TPK): This is the knowledge of how technology resources can be used meaningfully in teaching and learning.

Chapter One

Introduction

1.1 Background

Teacher professional development (TPD) includes all activities and actions that are implemented to enhance knowledge, skills and attitudes of teachers to improve their teaching and learning practices (Guskey, 2000). Hunzicker (2011) defines TPD as any supportive, job-related, instructionally focused, collaborative and on-going activity that advances in-service teachers to improve students' performance. These TPD activities occur in different forms such as workshops and seminars (Kirkpatrick et al., 2019), participation in educational conferences and short courses (Carlson & Gadio, 2002), participation in professional development networks (Wood, 2007) and mentoring and coaching (Onchwari & Keengwe, 2008).

Different models are used to train school teachers on different aspects of their professional development. The award-bearing model and Deficit Model (Kennedy, 2005), Action Research Model (Bullough & Gitlin, 1995), Community of Practice (Wenger, 1998), A2I model (Warriem et al., 2014) and Cascade model (Hayes, 2000) are examples of teacher training models. Successful implementation of each model depends on the amount of planning done before and the objectives to be achieved.

Cascade model of TPD is one of the models commonly deployed in low- and mid-income countries for professional development of teachers (Perry & Bevins, 2019). In Tanzania, this model has been used by teachers in different teacher professional development programs (Mosha, 2012). While cascade model implementation has a number of advantages such as training a large number of teachers in a short time and being cost effective, there exist a number of challenges. Most common challenges that occur in cascade-based teacher training programs in Tanzania are design-related and trainer-related (Gelander et al., 2017). Design-related challenges include focus on delivery of too much content with little or no time to reflect (Desimone, 2011).

The goal of cascaded training programs is to train a large number of participants within a short time possible (Hayes, 2000). It is expected that at the end of the first level training participants will be able to go and train other teachers on the same content as the training is closed. Success of the training at lower levels depends on how participants from the first level training are prepared as trainers, the nature of the content and context where it will be delivered.

Developing a teacher trainer is an important stage when the training has to be cascaded and knowledge be shared at different levels. Competent teacher trainers ensure that participants of a training program do not only have content knowledge but they have skills that will make the training much easier in the new context. Since not all participants at the first level of a cascaded training become trainers, it is important to have a mechanism to develop trainers among the training participants.

This research work aims to improve the efficiency of cascaded teacher training programs in Tanzania, focusing on developing teacher trainers. The selected teachers undergo a number of content and skills workshops that impart them with important skills that are relevant to plan, conduct and evaluate a teacher training program. As teacher trainers are developed, teacher training confidence increases, dilution of training content decreases and feedback from master trainers to the secondary trainers is strengthened.

1.2 Motivation

Between 2011 and 2014, the Government of Tanzania through the Ministry of Education and Vocational Training implemented a project named National Programme on ICT for Secondary School Teachers. The goal of this programme was to integrate the effective use of ICT in delivery of secondary school education in order to transform the country into a knowledge society. MoEST (2010) highlighted the needs analysis that was conducted and the considerations during training content development. This programme was designed to train teachers from 4536 schools in the country.

Training of teachers deployed cascade model. A National Facilitation (NF) team was formed to train Master Trainers (MTs) from 23 nucleus schools. I was one of the NFs. At the end of the

training, the MTs were assessed and those who qualified were certified to train teachers at the secondary school level. Three national ICT centres were identified where teachers from different regions had to gather and be trained for a period ranging from 7 to 14 days. Teachers from different domains, with different backgrounds, were invited at the national centres to be trained. The trained teachers were now called Master Trainers and were required to go back to their schools and train their fellow teachers.

As the programme was going on, we collected data from the MTs to understand the challenges they faced as they trained school teachers. Even though there were some challenges in the design and implementation of the programme, some MTs reported that they did not engage their participants effectively during the workshops. MTs did not get enough support from the master trainers to be able to conduct their training sessions. This was partly due to lack of confidence to take up the sessions, as they missed facilitation skills, activity design skills and adult learning principles while implementing the training. In this way, the programme was not successful as it was expected.

This scenario motivated me to look into a great detail on how effectiveness of master trainers in cascaded teacher professional development programmes can be improved. In this research, a closer look into the challenges associated with the implementation of cascaded teacher training programmes was done. Details of these factors are discussed in Chapter Two.

1.3 Objectives of the Research

Main Objective

To improve the delivery of cascaded teacher professional development programs on ICT integration in schools in Tanzania.

Specific Objectives

This research aimed to achieve the following specific objectives:

1. To analyse the challenges associated with the implementation of cascaded teacher professional development programs in Tanzania;

2. To develop a model that will be used during design, development and implementation of cascaded teacher training programs on ICT integration in Tanzania;
3. To implement the model through teacher training workshops; and
4. To develop teacher trainers that can improve training of teachers in cascaded teacher training programs in Tanzania.

1.4 Significance of the Study

Teacher training programs in Tanzania are faced with different challenges, spanning from the design to implementation and finally to the transfer of knowledge and skills. This research focuses on challenges related to the trainers required for cascading teacher training programs. By addressing this challenge in the teacher training programs, this study will have a potential to inform the teacher professional development planners and developers about the best approaches to implement cascaded teacher training projects. If implemented well, the developed model will produce teacher trainers who are competent to propagate the training to other teachers with improved efficiency.

1.5 Scope of the Research

To improve the efficiency of cascaded teacher training programs in Tanzania, a number of challenges need to be addressed. These challenges range from program design, development, and implementation to final evaluation after the program is fully implemented. Effective completion of teacher training programs depends, among other factors, on knowledge, skills and competencies the teacher trainer has. This research focused on challenges related to the trainers of the cascaded teacher training programmes. It aimed at developing a teacher to become a teacher trainer.

Throughout the analysis, solution design, implementation and evaluation of A2IT2 model, this research work focused on training in-service primary and secondary school teachers. This is because some schools are equipped with some ICT infrastructure that can enable implementation of different workshops back in their schools through knowledge sharing and transfer of training.

The solution to the persistent problem of teacher training in cascaded programmes in Tanzania was done using workshops. Design of the workshops focused on developing school teachers to become teacher trainers in a cascade training environment. The developed teacher trainers became secondary trainers or local trainers in cascaded TPD programmes. The goal was not to train master trainers as these were already knowledgeable on workshop implementation.

As the training of different groups of school teachers, the focus was on the domain of technology integration. Common technology tools that teachers can quickly use in their teaching and learning practices were selected from the needs analysis. Educational technology tools including mentimeter, padlet and PowerPoint presentation promote 21st century teaching and learning practices. At the end, participants were required to create PowerPoint presentations to be used when conducting microteaching and co-training sessions.

1.6 Problem Statement

Cascade model is the most commonly used school teacher training model in Tanzania (Kitta, 2004). It involves training a number of teachers for a number of days on the training content. The trained school teachers then become trainers of other school teachers on the same content at lower levels. However, analysis of some school teacher training programs such as those reported by Matimbwa and Juma (2019) and Gelander et al., (2017) that deployed cascade model in Tanzania revealed that secondary trainers (trained teachers) have a challenge in cascading the training to lower levels. This is attributed to a number of factors such as poor program design that involved too much content to be covered within a limited time period as well as poor teacher's intrinsic motivation to concentrate on the training goals to achieve the desired outcomes. Teachers looked for motivation from payment they received from participating in the teacher training sessions. Some participants from the training sessions were selected to become school-based in-service education and training (INSET) coordinators, with a task to train other teachers at the school level. Training other teachers became difficult to some selected school-based INSET coordinators who were not self-motivated to work on all the activities during the training conducted away from their schools.

Cascaded teacher training programs that focus on content delivery alone still face the same challenges of not achieving the intended objectives of the training. It is important that teachers are developed as trainers who can scale the training to reach the goals.

This research focuses on improving the effectiveness of secondary trainers in cascaded TPD programmes. This is achieved through a number of workshops that aim at developing content knowledge and the skills that are important to conduct teacher training sessions effectively.

1.7 Solution Outline

To address the challenges of teacher trainers in cascaded teacher professional development programmes that are conducted in Tanzania, a model to cater for the design and implementation of such cascaded teacher training programs in Tanzania was developed. The Attain-Align-Integrate-Teach-Train (A2IT2) model was developed to cater for the teacher training design, development and implementation of cascaded training programmes. A2IT2 model was developed from both content workshops (CWs) and skills workshops (SWs) conducted both on face-to-face, blended and online modes. These teacher training workshops started from December 2018 to March 2021.

The first step was to conduct needs analysis to gather requirements of teachers. Suggested topics from the needs analysis were categorised and finalized. Content workshop (CW) using the Attain-Align-Integrate (A2I) model (Warriem et al., 2014) was designed. At the end of this first iteration, it was found that some participants were not able to integrate technology tools into their lesson plans. During the second iteration, microteaching sessions were added for which participants operationalized their technology-enhanced lesson plans. This meant that a microteaching (T) phase was added to A2I model to become A2IT. The microteaching phase ensured teachers make practice of integrating technology when teaching their own subjects. Reflections from the second iteration (CW2) suggested a need to engage the selected learning assistants into more training practices. For the third iteration, a co-training session was introduced in the design and implementation of CW3, leading to the development of A2IT2 model. During the co-training session, the learning assistants took short training sessions with new participants. Reflections from the third iteration showed a need to engage the co-trainers

into sessions that they could apply the skills from the skills workshops to build confidence for solo teacher training. Two content workshops, CW4a and b were conducted by the developed teacher trainers at different times, places and with different participants. Through different iterations, the master trainer gradually released responsibilities to the developing teacher trainers till when they became full teacher trainers. This finally led to the A2IT2 model. A Confirmatory Workshop (CfW) was designed using A2IT2 model and implemented to confirm the working of A2IT2 model to cascade a teacher training session.

The workshops were conducted in face-to-face (F2F), blended and full online modes. Three regions were selected for the face-to-face workshops with teachers. The face-to-face workshops were conducted in public schools to make it easier for teachers to join. Pamba Secondary School (in Mwanza region) was considered to represent teachers from the northern regions of Tanzania and Dodoma Secondary School (in Dodoma region) was selected to represent teachers from the central regions of Tanzania. Participants from three schools – Kola Hill Secondary School, Forest Hill Secondary School and Morogoro Secondary School (all in Morogoro region) – represented teachers from eastern regions of Tanzania. This setting of locations attracted teachers from adjacent regions to participate during the content workshops. Table 1.1 gives details of different workshops completed during the research work.

Table 1. 1: Overview of Content and Skills Workshops Involved in the Development of the Solution

	Iteration 1	**Iteration 2**	**Iteration 3**		**Iteration 4**			**Confirmation**
Workshop	CW1	CW2	SW1	CW3	SW2	CW4a	CW4b	CfW
Goal	Training teachers on ICT integration	Integration of technology in lesson plans	Imparting skills and attributes of a teacher trainer	Co-training a short session	Planning, conducting and evaluating workshops	First co-trainer taking a full solo training session	Second co-trainer taking a full solo training session	Evaluating a workshop conducted by a CW4 participant
Dates	December 11-15, 2018	June 28-30, 2019	December 18-19, 2019	January 14-17, 2020	August 24-26, 2020	August 29-31, 2020	March 29-31, 2021	November 6-7, 2020
Days	4	3	7 (online) 2 (F2F)	4	3	3	3	3
Participants	19	26	11	35	4	20	22	21
Mode	F2F	F2F	Blended	F2F	Online	F2F	F2F	F2F
Model	A2I	A2IT	-	A2IT2	-	A2IT2	A2IT2	A2IT2
Teacher as	Learner	Teaching Assistant	-	Co-trainer	-	Trainer	Trainer	-
Location	Kola Hill Secondary School, Morogoro	Dodoma Secondary School, Dodoma	Moodle + Kola Hill Sec School, Morogoro	Pamba Secondary School, Mwanza	Via Google Meet	Forest Hill Secondary School, Morogoro	Morogoro Secondary School, Morogoro	Kola Hill Secondary School, Morogoro

A2IT2 model created a level of trainers who appear to increase their level of experiences and expertise at different levels as they take roles in different teacher training programmes. Figure 1.1 shows the change in roles and responsibilities of the master trainer and the developing teacher trainers in this research.

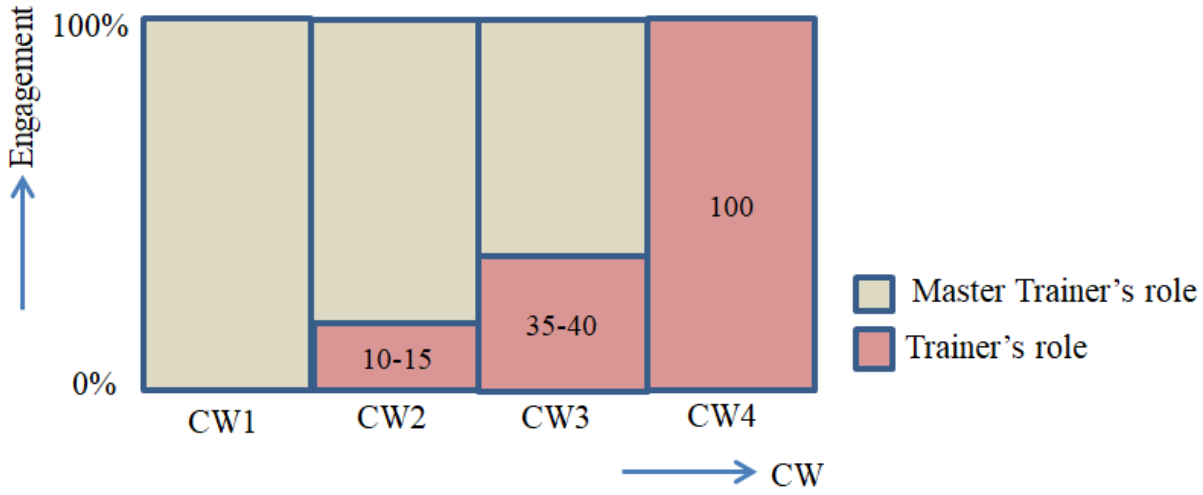

Figure 1. 1: The changing roles of teachers across different workshops

As the teacher's role change from 0% (participating as a learner in the workshop) to 100% (as a full trainer), the names change at each of the content workshops. The terminology as the teachers develop from one level to the next are explained on page xvii to ensure that the flow is clear.

1.8 Contribution of the Thesis

The principal contributions of this thesis are highlighted:

i) *A2IT2 Model that develops teachers into teacher trainers*. The model helps to train teachers to become teacher trainers who are well versed in training school teachers on effective technology integration in teaching and learning.

ii) *Teacher trainers*: As A2IT2 model unfolds through different phases, a teacher trainer evolves through a number of phases with a shift in expertise at each phase.

iii) *Trained teachers*: Through a number of content and skills workshops, teachers have been equipped with knowledge and skills on areas including creating technology-enhanced lesson plans, and integrating technology into teaching and learning.

iv) *Sustainability* of cascaded TPD programmes in the country as competent teacher trainers are developed during the workshop sessions.

1.9 Structure of the Thesis

This thesis is organized in nine chapters. Chapter One introduces the problem and how it was solved; Chapter Two contains a review of the relevant literature and seminal work connected to the research work; Chapter Three discusses the phases of the Design Based Research (DBIR) methodology as used to complete this research work; Chapters Four and Five discuss the two DBIR cycles in detail (the chapters explain about the iterations per each cycle and the studies conducted under each iteration); Chapter Six discusses A2IT2 Model and gives details about its components; Chapter Seven details the implementation of A2IT2 Model through different content and skills workshops, phases of A2IT2 Model and design principles; Chapter Eight discusses the findings, claims and implications of this research; and Chapter Nine details the contribution of this Thesis, gives recommendations to different users of the model and suggests future directions for extending this research work.

Chapter Two

Literature Review

In this chapter, a review of current literature on TPD models with focus on cascade model is detailed. The review aimed at describing the cascade model with a focus on its benefits and implementation challenges in the teacher training domain.

In completing the review, different recent sources have been used. Most of the sources have been those published from 2010 to 2022. Literature for the years before 2010 was reviewed to ensure that no relevant seminal research work is omitted. The list of research in this work was found from different sources such as journals, theses/dissertations and books. Most of the articles came from journals related to Teacher Education, Teaching, Training and Professional Development published by Taylor and Francis, Sage Publications and Elsevier. The reviewed theses/dissertations and books involved those that reported research in the areas such as TPD, Design Based Research (DBR) and teacher training. While searching for literature, different keywords were used such as teacher professional development, cascade model, primary trainer, secondary trainer, transfer of training and train the trainer. Others include benefits of cascade model, challenges of cascade model, microteaching and shift of expertise.

This Chapter is organized into three sections. Section 2.1 discusses the teacher education and the education system in Tanzania; section 2.2 discusses the meaning of TPD; section 2.3 discusses different Teacher Professional Development models; section 2.4 focuses on cascade model of TPD (benefits, challenges and proposed solutions); section 2.5 presents workshop design and development models; section 2.6 highlights trainer skills and attitudes; section 2.7 presents previous related work on trainer development; and the last section outlines the need for this research in the context of Tanzania.

2.1 Teacher Education and Education System in Tanzania

In Tanzania, teachers' colleges and universities are responsible for teacher education. Universities provide teacher education at different levels. They provide diploma, undergraduate and postgraduate degree programmes related to education. Teachers' colleges, on the other hand, provide non-degree pre-service teacher education including certificate and diploma programmes (MoEST, 2014). Primary school teachers are those who have undergone two years at a teacher training college. To teach at the secondary school level, teachers need to have completed a diploma in education. Teachers who have at least a bachelor degree qualify to teach at any level of the school system, administrative work and in teacher colleges (Malmberg & Hansen, 1996).

Tanzania Institute of Education prepares and approves the curriculum for teacher education while the National Examinations Council of Tanzania sets examinations for teachers (Hardman et al., 2012). The National Curriculum Framework for Basic and Teacher Education states the structure of the different levels of education (MoEST, 2019). Formal education in Tanzania starts at the age of 4. It follows a 2+7+4+2+3+ structure that starts with the pre-primary education for 2 years. Primary education takes 7 years that start from Standards 1-7. This is followed by 4 years of ordinary level secondary education (Forms 1-4). The next level is advanced level secondary education that takes place for 2 years (Forms 5 and 6). The last level consists of 3 or more years depending on the nature of the programme in vocational, technical and higher education.

2.2 Teacher Professional Development

Teacher professional development (TPD) is defined to involve activities that develop knowledge, skills, and expertise of teachers (OECD, 2009). Avalos (2011) defines TPD to be about teachers learning, learning how to learn and transforming their knowledge into practices to improve students' learning. In the same line, Hunzicker (2011) has defined professional development as any activity that is supportive, job-related, instructionally focused, collaborative and on-going that engages teachers to improve students' understanding (Darling-Hammond et al., 2017b).

Teacher professional development is one of the important elements in the reform of education systems in many countries. Through TPD activities, teachers improve their teaching practices

which in turn impacts student learning outcomes (Darling-Hammond et al., 2017a). A number of studies have stated features of effectively designed TPD programmes. Focus on the subject content and how students learn; involvement of active learning strategies; relevance to their day to day activities; and a design that is reflective during practice are some of the characteristics of effective TPDs (Darling-Hammond et al., 2017b; Desimone, 2011; Villegas-Reimers, 2003). The same authors insisted that TPD be designed to provide feedback to the participants and create activities that encourage them to reflect on their learning. Professional development of teachers is a long-term activity that consists of acquiring experiences over a period of time with follow-up and guided support (Villegas-Reimers, 2003).

TPD activities can be either formal or informal (OECD, 2009). Formal TPD occurs in the form of workshops and seminars, participation in educational conferences and short courses, and completion of a qualification programme such as a diploma or degree programme. Others include observational visits to schools, participating in professional development network and enhancing collaboration activities within schools. On the other hand, informal TPD involves activities such as mentoring and coaching, collaborative planning and teaching, sharing of good practices, and informal dialogues on how to improve teaching and reading professional literature. Research has shown that TPD programs improve teachers in different ways.

Professional development of teachers involves activities that are designed to change the existing beliefs, attitude and perceptions (Guskey, 2010). In his model for teacher change, Guskey (2010) concludes that TPD programs have three common goals: Initiating change in classroom teaching practices; change in student learning outcomes; and change teachers' attitudes and beliefs.

2.3 Teacher Professional Development Models

Section 2.2 gave a closer look into the general aspects of TPD and how it was implemented in Tanzania. Section 2.3 focuses on the different TPD models. TPD is achieved in many ways depending on the context and nature of the type of professional development activity involved. Several models have been employed in achieving career progression in teachers. These models have evolved over time, some accounting for the advancement in technology.

While the traditional TPD models lacked an element of collaboration by nature, in this digital era, professional development should strive to be participatory while sharing resources and ideas. Different models have been used for professional development of teachers, depending on the purpose.

The following are some of the models that are commonly used in implementing TPD programmes, depending on the nature of the activity to be completed:

i) Training Model

This model of TPD supports a skills-based, technocratic view of teaching whereby TPD provides teachers with the opportunity to update their skills in order to be able to demonstrate their competences. An expert plans, designs and develops the training programme or course. Once the programme/course is ready, the expert delivers it to the teachers. In many cases, this training model is appreciated as an effective way of introducing new knowledge. The quality of the training content is controlled by the expert.

ii) Communities of Practice

Wenger (1998) coined the concept of Communities of Practice (CoP) as a way to learn through social participation. CoPs are formed by people who engage in learning together certain matters connected to their profession. In this model, participation means being an active participant in the practice of social communities and constructing activities in relation to these communities. CoPs can be created everywhere in groups of professionals who come together for a common purpose. Three features are dominant in CoP: domain, community and practice. In this case, teachers (from the same domain) come together for a purpose of learning by engaging in joint activities and discussions, and information sharing.

iii) The Award-bearing Model

This model relies on or emphasizes the completion of award-bearing programmes of study – usually validated by colleges or universities. This is done so as to ensure quality of the programme. The main challenge of this model is that it does not put emphasis on the classroom practice (Kennedy, 2005).

iv) The Deficit Model

This model is designed specifically to address a perceived deficit in teacher performance. It aims at filling in the gaps whenever teachers cannot complete or work on certain identified skill set (Kennedy, 2005). The model attempts to remedy perceived weaknesses in individual teacher performance. This model is suitable for individuals whose performance needs to rise higher.

v) The Coaching/Mentoring Model

This model stresses on one-to-one relationships between two teachers. Coaching is more skills based and mentoring involves an element of 'counseling and professional friendship'. Mentorship is the mentoring of novice teachers by the experienced teacher (Hellsten et al., 2009). The mentoring model can support a transmission view of professional development. Teachers are initiated into the status quo by their more experienced colleagues or a transformative view where the relationship provides a supportive, but challenging forum for both intellectual and affective interrogation of practice where the quality of interpersonal relationships is crucial. This model is reliable.

vi) The Action Research Model

This model attempts to redefine teacher professional development by encouraging reflective inquiry within school communities that promote dialogic examinations of practice. The model focuses on reflectivity as an essential element of teaching and teacher development (Bullough & Gitlin, 1995; Norman & Reiman, 1996). Action research, as the study of a social situation, involves the participants themselves as researchers, with a view to improving the quality of action within it. It is meant for teachers to reflect on the teaching practices aiming at improving teaching efficiency. Some limitations of action research include: difficulty in publishing the findings and replicating the study or predicting outcomes scientifically.

vii) A2I Model

Attain-Align-Integrate (A2I) model guides in the design, development and implementation of teacher training programs that involve constructive alignment for the integration of ICT in teaching and learning of engineering courses (Warriem et al., 2014). The model involves three phases: firstly, the Attain (A) Phase which focuses on introducing workshop participants to learner-centred teaching; secondly, the Align (I) Phase which focuses on the alignment between learning objectives, instructional strategies and assessment strategies; and

lastly, the Integration (I) Phase in which technology integration is achieved in the lesson plans and technology tools are embedded in the training program.

viii) Cascade Model

This is a model to train large numbers of teachers gathered at central venues. It involves phases of training teachers where the trained teachers have to propagate knowledge to participants at lower levels (Kennedy, 2005). At the top, there are primary trainers who are responsible for training the first group of teachers. These teachers once trained become secondary trainers. They have to go to lower levels and be able to train other teachers. This model involves teachers, and therefore, the same people are used as trainers. In this way, many teachers can be trained at once, hence reducing the cost of training. It focuses mainly on imparting knowledge to the teachers.

Hayes (2000) hinted on the factors to be considered for conducting successful cascaded training. He insisted that: the method of conducting the training must be experiential and reflective rather than transmissive; the training must be open to reinterpretation; rigid adherence to prescribed ways of working should not be expected; expertise must be diffused through the system as widely as possible, not concentrated at the top; a cross-section of stakeholders must be involved in the preparation of training materials; and decentralization of responsibilities within the cascade structure is desirable.

A summary of the most commonly used TPD models is given in Table 2.1.

Table 2. 1: Comparison of Different TPD Models

No	TPD Model	Benefits	Challenges
1	Training Model (Kelly & Williamson, 2002)	• Delivered to the teacher by an expert • All training topics come from the expert • The training model is acknowledged as an effective means of introducing new knowledge • High degree of central control for quality assurance	• Participant is in passive role (recipient of knowledge) • Most commonly delivered off-site
2	Community of Practice (Wenger, 1998)	• Access to new knowledge • Fosters trust and sense of common purpose • Encourages skill development of individuals and schools	• Low levels of one to one interactions between members
3	The Award-Bearing Model (Kennedy, 2005)	• The award obtained is a mark of quality assurance of the programme	• Does not put more emphasis on the classroom practice
4	Deficit Model (Rhodes & Beneicke, 2003)	• The model attempts to remedy perceived weaknesses in individual teacher performance • Suitable for individuals with low performance	• Depends on organizational and management support • Commitment is key to success

5	Coaching/mentoring Model (Rhodes & Beneicke, 2003)	• It involves creating an element of 'counseling and professional friendship' • A more experienced teacher mentors a less experienced teacher • It is reliable	• One to one teacher training • Few participants can be mentored
6	Action Research Model (Bradbury, 2015).	• Evaluates own practices for self-improvement • Encourages reflection in the communities of teachers • Participants are part of the research process	• Difficulty in publishing the findings • Difficulty in replicating the study
7	A2I model (Warriem et al., 2014)	• Based on three phases: Attain, Align and Integrate • Designs short-term training programmes for teachers and educators • Focuses on constructive alignment in ICT	• Focuses on engineering education
8	Cascade Model (Hayes, 2000)	• Many teachers can be trained at once • It is cost effective as it uses local participants • Focuses on imparting knowledge to the teachers	• Dilution of the training content • Knowledge passed is skill-based; not application

While the traditional TPD models lacked an element of collaboration by nature, in this digital era, professional career development should strive to be participatory while sharing resources and ideas. One of the most commonly applied models in TPD is the cascade model. It involves phases of training teachers where the trained teachers have to propagate knowledge to participants at lower levels. The details of cascade model are given in Section 2.4.

2.4 Cascade Model of Teacher Professional Development

Cascade model of training involves training of teachers at different levels. At the top level, you have a number of trainers who are selected based on the already set criteria to meet the training demands. These are called primary trainers or master trainers or lead trainers (Armour & Makopoulou, 2012). The first level involves participants selected from a pool of teachers, normally from different schools. These selected teachers are then trained by the primary trainers based on the content to be covered. This training may be for several days depending on the needs at that particular time. The trained teachers are called 'multipliers', secondary trainers or local tutors (Armour & Makopoulou, 2012). These are also called local trainers (Mormina & Pinder, 2018), lead trainers (Wei et al., 2017), or professional development facilitators (Lange & Meaney, 2013). The secondary trainers then go to lower levels and train other teachers on the same content they have been trained on.

The cascade model is used widely in training large number of participants in different sectors. The first reported case of cascading training is reported by (Jacobs & Russ-Eft, 2001) for implementing a job instruction training program of the Training Within Industry (TWI) during World War II. After that, cascade model was used in other disciplines to train participants in different professional development activities including in education (Bett, 2016; Karalis, 2016). This model is applied in public health (Yarber et al., 2015a), nutrition training (McClelland et al., 2002), and general health care (Assemi et al., 2007; Stratos et al., 2006). Figure 2.1 shows a pictorial implementation of a cascaded training of teachers for one level of training.

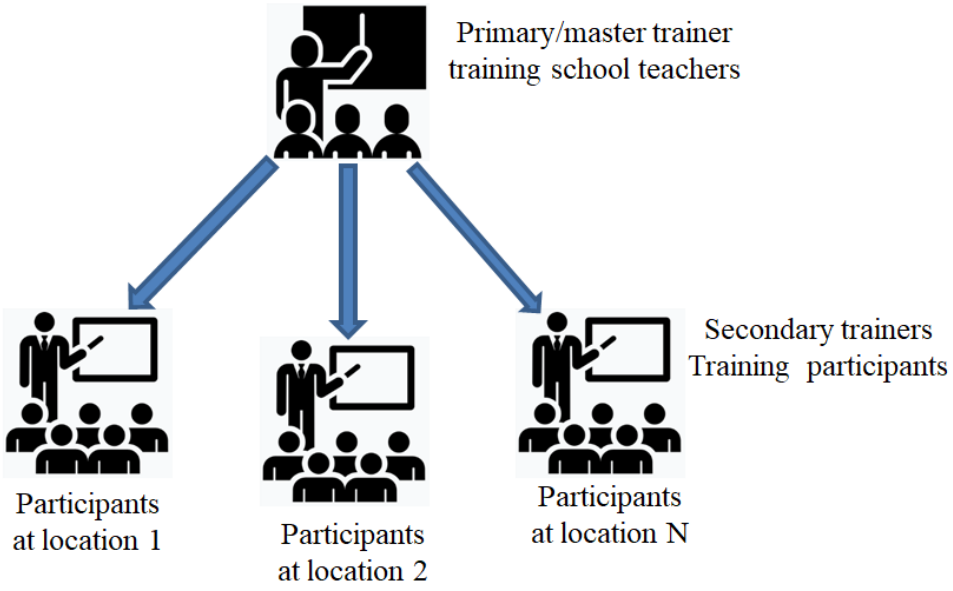

Figure 2. 1: A one level cascade model structure

This model is also referred to as Train of Trainer (ToT), Train the Trainer (TtT) model, pyramidal training, triadic training, and helper model (Suhrheinrich, 2015a). In this research, the name cascade model is maintained.

2.4.1 Benefits of Cascaded TPD Programmes

Cascade model of TPD is one of the models commonly deployed in low- and mid-income countries for professional development of teachers (Perry & Bevins, 2019). This model is used in many countries as a way to reach many teachers and educators within a short time. It is preferred in most cases over other TPD models because of different benefits.

The model develops teachers to become trainers at different levels. Implementation of the programme becomes simplified as the trainers are familiar with the context of the training (Brion & Cordeiro, 2018; Kennedy, 2005). Local trainers have access to networks of teachers in their schools and friends, and this makes them best to understand issues that might affect effectiveness of the training. This paves a way to exploit local experts to generate and share knowledge.

The use of local trainers makes cascade model cost-effective as it removes the need of using expatriates from other countries as trainers (Dichaba & Mokhele, 2012; Orfaly et al., 2005). Since teacher training programmes at different levels are school-based, participants do not

need to travel to other schools. This reduces the cost of running the entire training program. On the other hand, cascade model is preferred over other models in developing countries that have fewer resources to conduct training to a large number of teachers. This reduces the cost of the training and hence many teachers can be reached in a small duration of time (Fiering, 2014).

Cascaded TPD programmes take place in stages during implementation. This makes it easy to monitor progress at different stages to improve the next stages (Dichaba & Mokhele, 2012). The different levels of the cascade model are designed in most cases in such a way that teachers are trained within a short period of time (Hayes, 2000; Suzuki, 2011; Yarber et al., 2015a). Short time of training helps to produce the required number of teachers and reach the objectives.

2.4.2 Cases of Cascaded TPD in Tanzania and their Challenges

Mosha (2012) reported a study conducted in four districts of Tanzania: Kisarawe, Kinondoni, Moshi Municipality and Moshi Rural. The study aimed to determine the extent to which the skills- or competency-based ethos of the competency based curriculum detailed in the books and other learning resources were used to teach grade 4 to 7 pupils. Purposive sampling was deployed to select two high performing schools and two low performing schools in each district. Documentary review; focus group discussion with subject teachers, district education officers and district school inspectors; and classroom observations were data collection methods.

A result from Mosha (2012) showed that implementation of competence-based curriculum (CBC) in the classroom was not achieved as most teachers were still teaching using old teaching methods. Most teachers had not changed from the content-based teaching to competency-based teaching. It was found out that teachers were not able to set up learning activities that were student-centred and appropriate to the learning objectives intended.

While factors such as limited funds and lack of frequent follow-up and feedback were mentioned for poor implementation of competency-based curriculum in schools, poor choice of trainers was another factor. From this study, Mosha (2012) revealed that the trainers of the competence-based curriculum implementation did not have the abilities to train other teachers as they had not been fully developed as trainers to train other teachers.

Muyungu (2015) explored pre-service student teachers training and perceived needs to practice inclusive education. The study also investigated the strategies and techniques that are used to train teachers toward inclusive education in Tanzania. The conceptual framework reflects factors that might influence the implementation of inclusive education in teacher education, not only from teacher education but also from the society at large. It also guides the levels on which student teachers seem to be essential for them to practice inclusive education from the society at large to the classroom level.

The study by Muyungu (2015), among other objectives, aimed to investigate pre-service student teachers' perceived needs in order to practice inclusive education. It used a qualitative approach with 8 participants (6 pre-service student teachers and 2 teacher trainers). The student teachers were on their third year of their college education, being trained on how to handle diverse and inclusive classes of students. They were asked on how their understanding of inclusive education helped them in lesson planning, preparation of teaching aids and management of inclusive and diverse classes.

Results showed that most of the student teachers perceived that their training on inclusive education was insufficient and stated that they needed further training. They did not gain sufficient competence and knowledge on inclusive education practices from their trainers. This made them feel unprepared to apply what they had been trained into the real classroom with diverse students. This resulted from poor training sessions on inclusive and diverse education that did not include important areas relevant to the student teachers (Mayungu, 2015).

Kanyonga et al., (2019) reported the implementation of competence-based curriculum in three technical colleges in Arusha city in Tanzania. The study deployed a cascade model where 24 trainers were involved from three technical colleges found in Arusha. Among the participants were college principals, heads of departments or sections, lecturers, instructors and technicians as trainers.

Results from the cascaded training by Kanyonga et al, (2019) showed that the participants of the training did not meet expectations of the colleagues who did not attend the training. Some of the trainers did not conduct the training to their colleagues but only shared diluted information to their colleagues. The researcher reported of one training session that was

conducted in Dodoma where only one person (the principal of the college) attended. Upon returning to the college, the principal summarized the competence-based training by highlighting the key take-away that the most important part of the training was to make students more competent in practical sessions.

EQUIP-T was a project that aimed at improving the performance of teachers with a focus on strengthening early grade teaching of Kiswahili (reading and writing) and developing effective and gender-responsive pedagogy (Gelander et al., 2017). The project took place between 2015 and 2017 in seven regions of Tanzania. This project implemented a continuous professional development programme from the district level targeting INSET Coordinators (a senior teacher from each school), including the Ward Education Coordinators (WECs) and teachers.

Analysis of EQUIP-T showed that the project brought about positive change in teaching and learning based on lesson observations. Participants of the programme stated that the project empowered them with pedagogical skills and different participatory methods that made it easy to help the pupils in learning. On the other hand, the project reported that teachers used more teaching aids during class sessions, but pupils were not regularly engaged in reading activities.

One of the challenges of EQUIP-T project that were reported by the INSET coordinators and head teachers at the end of the district-level training sessions was too much content within a short time period. This meant that the trainers trained them at a high pace to cover the content, which made it difficult for the coordinators to train teachers during the school-based training. As expected, participants of such cascaded training programs had to train other teachers back in their schools.

African Digital School Initiative (ADSI) project in collaboration with the Ministry of Education, Science and Technology trained 400 school heads and 400 STEM teachers from 40 schools in Tanzania within the period from 2016-2019 (Matimbwa & Juma, 2019). Report of the ADSI programme showed that even though the programme implementation was a success, there were some challenges during implementation. One of the implementation challenges of the ADSI project is that teacher trainers (who are Teachers Training College lecturers) did not have enough knowledge and skills to train other teachers who would then

conduct school-based teacher training programmes. Another challenge was on training design where training was scheduled for a short period of time while so much was to be covered.

The Information and Communication Technology Programme for secondary school teachers in Tanzania was a project that was launched in 2011 and was proposed to end by 2016 (MoEST, 2010). This programme aimed to integrate the effective use of ICT in delivery of secondary school education in order to transform the country into a knowledge society. The cascade model of TPD was deployed in training secondary school teachers. Training was planned in three cycles: Basics to ICT, computers and applications; Computer Hardware, Computer Software, ICT Devices and Networking; and Use of ICT in teaching and learning. The programme did not complete all the cycles as only two cycles were covered. Teachers who were trained at nuclear schools were expected to train teachers in their schools and 5 more adjacent schools. While some teachers managed to train teachers, others were not able to do that. Evaluation was done to some participants to reflect on their experiences of cascading training to other teachers. In this regard, an online survey with eight open-ended questions was shared to the participants to collect their experiences during the cascaded teacher training sessions (See **Appendix O**).

Analysis of the participant responses from the programme by MoEST (2010) revealed some difficulties and challenges the secondary trainers encountered when they were required to start cascading the training. They reported that some concepts were not clearly understood due to the shortage of time that caused difficulties when passing through the handout. Another respondent reported that not enough time to be familiar with the course contents, and no follow up was made to ensure that training was happening. One of the participants responded that he faced challenges in understanding some technical words used in the training manual. This implied that there was a challenge in the methods used for training these teachers. Again, the teacher trainers did not have enough content knowledge and skills to train these teachers in schools. This calls for the research to develop teacher trainers who can help in sustaining cascaded TPD programmes in Tanzania.

2.4.3 General Challenges of Cascaded TPD Programmes Elsewhere

While the cascade model of TPD has proven to be cost effective as it uses existing teachers as trainers and its ability to reach many teachers within a short time, there are several challenges

associated with its implementation. A number of scholars have hinted out that there is misinterpretation of crucial information as the training cascades to lower levels (Engelbrecht et al., 2007; Jansen, 2003; Suzuki, 2011). Cascaded TPD needs trainers who are confident to train other teachers at different levels. Studies have reported that trainers lack confidence as they conduct training sessions to others (Bax, 2002; Engelbrecht et al., 2007). One example is the study by Dichaba (2013) which highlights that lack of confidence from the trainers frequently made them use their mother tongue language to communicate instead of using the standard language of training. Dichaba & Mokhele (2012) observe that there is dilution of critical information and less is understood as the training moves down to lower levels. On the other hand, trainers modified the content of the training or replaced new resources to make their training much easier (Dichaba & Mokhele, 2012; Hayes, 2000; Suzuki, 2011). This hinders the success of the cascade model of training.

In another study by (McDevitt, 1998), it was seen that the training followed a top-down approach and that it lacked feedback mechanisms from the lower levels to the higher level. This can result partly because the distance between the higher levels and the lower levels is large. On the part of the training, the participants keep changing as the training moves down, which imply that secondary trainers need to have skills to manage the training content. While designing the training programme for cascade training for teachers, the curriculum was developed by few individuals at the top level (Jansen, 2003) which became a challenge while implementing it at lower levels.

Dichaba (2013) found out that the reasons to the failure of cascade model of teacher training to be the longer periods that take place between the cascades of the first level to the next lower levels; the quality of presentations being made by the secondary trainers at the lower levels; and the way the content is being delivered to the teachers at lower levels. Secondary trainers need to master the content of the training so that they can be able to implement it effectively. Since training others needs time to make preparations, it is good that trainers get relieved of some responsibilities so that they can focus well on creating resources and activities for the training.

Some cascaded TPD programmes are designed in such a way that the experts are made to concentrate at just the top level of the training cycles (Dichaba, 2013; Mathekga, 2006). When the experts remain at the top of the cascade model, the cascade model of training

becomes transmissive in nature, making it a one way process without feedback at all levels. Hooker (2008) showed that workshops which train teachers based on cascade model aim at helping secondary trainers to learn new tools and techniques as users. They do not put emphasis on the instructional practices to build competence they need to train others.

Another common challenge to the cascade model of professional development of teachers is the dependency of expatriates from other countries to plan design, develop and implement such activities. A number of cascaded TPD programmes in developing countries have been conducted relying on the external expatriates. For example, a large scale cascaded science teacher professional development programme in Ghana depended on the experts from the United Kingdom (UK) during design and implementation (Perry & Bevins, 2019). Again, a three-layer cascade system for multigrade teacher training in Nepal was developed and implemented in corporation with foreigners and Nepalese advisors (Suzuki, 2011). Dependency on expatriates on such teacher training programmes may hinder the growth of internal facilitators and trainers.

Even though many of the challenges of implementing cascade model in teacher training are based on contextual factors, little or less research has focused on the development of teacher trainers or facilitators of teacher training programmes. Even though Brion and Cordeiro (2018) focused on building capacity for educational leaders in developing countries in Africa, Perry and Bevins (2019) focused on developing teachers as teacher trainers. These two empirical studies focused on trainer development through stages under the supervision of external experts from foreign countries. There is a need to develop capacity of local teacher trainers who can cascade teacher training programs while minimizing the existing challenges of cascade model implementation. The importance of investing on developing teacher trainers is highlighted by Karalis (2016) as the researcher points out that there is a lack in trainers of trainers in many cascade programmes. Competent trained teacher trainers not only can they cascade the training sessions effectively, but they can also help teachers improve their classroom teaching skills.

This research focuses on developing a school teacher to become a teacher trainer through a defined set of activities across different phases of the selected methodology. The research develops the teacher trainer by 1) learning more about the content of the workshop and applying it in different workshops; and 2) equipping them with relevant training skills to

effectively deliver the workshop to other teachers. This leads to development of a model that outlines the phases detailing about the design of the workshop content, nature of activities, the roles of the facilitator and the participants, mastery level and the skills developed per phase. Implementation of the model in turn reduces dependency on expatriates in planning, developing and implementation of such training programmes.

2.4.4 Related Solutions to the Challenges of Cascaded TPD Programmes

Cascade model as one of the models that is widely used in education, is prone to a number of challenges. The challenges that occur during implementations of different models of TPD can be minimized using different strategies. Empirical researchers have suggested a number of solutions to these challenges.

Hayes (2000) suggested some key criteria that cascaded TPD programme designers need to consider. The author insists that, 1) the method of conducting the training must be experiential and reflective rather than transmissive; 2) the training must be open to reinterpretation; rigid adherence to prescribed ways of working should not be expected; 3) expertise must be diffused through the system as widely as possible, not concentrated at the top; 4) a cross-section of stakeholders must be involved in the preparation of training materials; and 5) decentralization of responsibilities within the cascade structure desirable. These criteria help to improve trainer confidence and lack of feedback between the different levels and between the trainers.

On the issue of diluting the workshop content, some writers have suggested to use local mentors during the training to provide mentorship and guidance during and beyond the training session (Lange, 2016; Turner et al., 2017a). Professional learning communities can help in improving mentorship and communication among trainers and mentors.

Other researchers have focused on enhancing different skills that are required by trainers especially in cascaded training sessions. Bax (2002) insists on building confidence of trainers by improving their presentation skills and adaptation skills to cope with the changing circumstances in the training context. Bantwini (2009) insists on the analysis skills to determine the contextual factors and teachers needs as basis for designing programmes that are sustainable. A number of crucial factors for the implementation of cascade model have

been suggested from the experiences of cascade training sessions in Greece. Karalis (2016) points out the 1) design of the training program should originate from the needs of final participants; 2) there should be careful selection of the experts and first phase trainers; 3) as the program continues there should be a continuous monitoring process to determine efficiency; and 4) training content should be well-prepared and rich.

2.5 Workshop Design and Development Models

TPD involves engaging adult learners through a number of strategies such as workshops or seminars. The workshops for teachers are designed based on a number of principles and models. Some of the workshop design models include the following.

Sork (2000) Workshop Planning Model involves a number of elements. The elements include: 1) Analyse and Plan Context and Client System, 2) Justify and Focus Training, 3) Clarify Intended Objectives, 4) Formulate Instructional Plan, 5) Formulate Administrative Plan, and 6) Develop Summative Evaluation Plan. In this model, the six elements are all connected to the core of Formative Evaluation. This implies that a constant revision of the plan takes place to ensure quality of the planned workshop.

Kolb's Model of experiential learning (Kolb, 1984) is another model that can be applied to workshop development. The model focuses on three aspects of the workshop: understanding workshop participants; development of the workshop design to address the topics for the identified participants; and facilitating the workshop in an active learning way. Understanding participants unveils the different learning styles. These learning styles are helpful in developing learning activities that can be used to promote the intended skills. This in turn helps to identify the facilitation skills needed during the workshop. Kolb's Experiential Learning Cycle consists of 4 phases: Concrete Experience; Reflective Observation; Abstract Conceptualization; and Active Experimentation. Table 2.2 presents the workshop design models.

Table 2. 2: Workshop Design Models

Workshop Design and Development Model	Number of phases	Unique features	Limitation

Sork's Workshop Planning Model	6	It covers different aspects of designing an effective workshop	It focuses on general workshop planning It does not account for technical aspect of the workshop explicitly The model does not give details of how the workshop content have to be designed for each phase
Kolb's Model	4	Focuses on individual learning styles, learning activities and facilitation skills	Does not open up what is done during the workshop design. Does not speak on what is to be done at the workshop module level.
A2I Model	3	• At the end of each phase there is a specific output expected from the participants • The design of the workshop content ensures that learning activities and assessment strategies are aligned to the learning objectives. • It involves throughout the workshop phases	Does not hint on workshop evaluation strategies.

A2I model was chosen for the workshop design and development because it focuses on designing the workshop module by ensuring there is an alignment between instructional strategies to the learning objectives and assessment strategies to the learning objectives (Warriem et al., 2014). In A2I model implementation, there is a shift in responsibilities of participants across the different phases. During Attain phase, the participant is an active learner. With Align Phase, the participant now becomes a teacher who has to perform some microteaching session. Finally, during Integrate Phase, some participants become teachers whereas others remain as learners when creating activities for a lesson plan. One example is the workshop designed for faculty members to develop and apply simulations in their teaching and learning. The faculty members were trained to use a general purpose electronic simulator, SEQUEL, in teaching electronics lessons (Mavinkurve & Patil, 2016).

2.6 Analysis of Trainer Skills and Attitudes

Teacher professional development aims at improving teacher practice, skills and beliefs. Hew and Brush (2007) insisted on professional development that focuses on upgrading knowledge and skills of the participants. Different researchers identified a number of skills and attributes that are relevant for trainers. Table 2.3 presents the skills and attributes that effective trainers possess.

Table 2. 3: Relevant Trainer skills from Literature

Category	Skills/Attributes
Important trainer skills	Pedagogical knowledge of the area, Rich experience, Self-regulation of emotions, facilitation skills (Grewal et al., 2006) Effective communication skills, Effective Presentation Skills (Leach, 1996) Questioning skills (Galbraith, 1998) Listening skills (Stolovich, 1999) Providing feedback (Wlodkowski, 1978)
Attributes of an effective trainer	Confident, enthusiastic (Leach, 1996) Open-minded, Approachable (Thompson, 2001)
Attributes of a teacher trainer	Pedagogical Content Knowledge (Turner et al., 2017a) Rich experience (Perez et al., 2012) Good understanding of participants (Kelly, 2009). Self-regulation of emotions (Grewal et al., 2006)

The identified skills are relevant for effective teacher trainers. I developing trainers, it is important to include a set of skills from Table 2.2 to ensure that cascading the training takes place to the extent expected.

2.7 Previous Related Works to Trainer Development

There have been few empirical studies that aim at developing trainers or facilitators of training sessions. The available empirical studies focused on transforming a teacher or an educator to becoming a trainer through a number of stages and activities. Brion and Cordeiro (2018) conducted a study that utilized cascade model to build capacity for educational leaders in Ghana and then in Burkina Faso, Liberia, Rwanda and Ethiopia. This 3-day cascade model design aimed at developing few (2-3) trainers while facilitating the sessions so that they can facilitate a training of 30-40 participants per session. The applicants first became observers who attended a full training session, observing all the actions, participating actively and taking some notes. Later on, they became co-facilitators in training sessions. During the first co-facilitation session, they took about a third of the training content and for the second time they took half to two thirds of the content. After that, they became full trainers who took 100% of the content. The main facilitators of the workshops were from the US and provided the general and individualized feedback during debriefing sessions at the end of each day or end of the training.

Another example is from Ghana where Perry and Bevins (2019) have highlighted a project to improve teaching of science in Ghana. It involved a selected team of Ghanaian co-trainers who first worked with the facilitation team from the UK to run the project. The co-trainers started as observers during the different sessions of the training program. The next shift was to jointly plan a training session and deliver it together with the UK facilitator. In the end, the co-trainer planned and delivered the 2-3 days training sessions alone with little guidance from the UK facilitator. This experience was then shared among all co-trainers as they became facilitators of their own full training sessions. This was a programme led by facilitators from the UK. In these two related works, development of local trainers depends on the mentorship and facilitation role played by the external/foreign consultant. This is a similar case when school teachers have to be trained by university professors or college instructors (Dichaba & Mokhele, 2012) for the same job that can be done by similar teachers if well trained.

Other trainer development efforts have been reported in Cameroon by Lange (2016). The researcher described the cascade model that was deployed to train secondary trainers (referred to as multipliers) who eventually conducted school-based teacher training programmes on the content. Criteria to select these multipliers from a pool of school teachers included commitment to train others and qualification as a teacher. There were 77 multipliers

who were trained to cascade the training. Training of multipliers was conducted by the programme advisors. This training focused on building competence on the selected modules including: general pedagogy, means of educational measurements, research methodology, computer science and learner-centred didactics. At the end of the training, the multipliers reached about 770 teachers through school-based local training and conducted 2-3 times in a year on an average of 2 days per session.

In the works by other researchers (Bett, 2016; Dichaba, 2013; Krainer, 2015; Suzuki, 2011) on the implementation of cascade model in education, the focus is more on the training of trainees by master trainers. The master trainers were developed more on engaging in content knowledge than on the effective delivery of the training program. In another study, Bax (2002) interviewed two of the previous cascade trainers focusing on two questions: i) the most important aspects of running a successful cascade session and ii) advice to novice trainers on what to focus on. The trainers stressed on building and exhibiting confidence in front of the trainees and maintaining it across sessions. As trainers, flexibility and adaptation to the situation of the training becomes important during the training sessions. This helps to balance the social and cultural dimensions that make teacher training sessions a success even though these factors are all based on personal attributes of the trainer.

2.8 Teacher Professional Development in Tanzania

Teacher professional development is one of the success factors for different reforms in the education systems of any country. Teachers need to improve their knowledge, skills and competences to be able to cope with the new and innovative teaching methodologies. In Tanzania, a small number of teachers get an opportunity to participate in professional training programmes each year (Komba & Mwakabenga, 2019). Many teachers spend a number of years without participating in any professional programmes.

There exist challenges that hinder effective implementation of TPDs in Tanzania, namely: low teachers' intrinsic motivation towards their professional development, timing of the professional development programmes in times when teachers are engaged with other duties, and poor or less management support to teachers (Anangisye, 2011). Moreover, Komba & Mwakabenga (2019) identified challenges such as lack of a policy on TPD that states the

implementation plan; insufficient budget to reach all teachers for training programmes; and missing component in teacher training colleges to prepare pre-service teachers for their own professional development.

2.8.1 Government Efforts on Professional Development of Teachers in Tanzania

Some of the recommendations to the Ministry of Education, Science and Technology are to plan regular capacity building training sessions for teachers to improve their competence-based teaching practices (Kinyota, 2020). Poor implementation of inquiry-based science teaching in secondary schools in Iringa, Tanzania, was attributed to the insufficient teacher training. Mkimbili and Ødegaard (2020) recommend more opportunities for focused training programs to prepare school teachers in conducting practical and investigative teaching. It is true to say that the quality of TPD opportunities in Tanzania varies from one teacher to the next. The foregoing discussion therefore sheds light on the importance of regular teacher professional development to improve teaching and learning and performance of students.

In 2020, the Government developed a National Framework for Continuous Professional Development for Practicing Teachers (MoEST, 2020). The goal was to ensure there is improvement in learning outcomes through a coordinated and institutionalized national Teacher Continuous Professional Development (TCPD). The framework highlighted different levels of formal TPD that take place at lower levels. For example, at the district level, the Local Government Authorities (led by the District Education Officer) identifies TPD requirements, determines the number of schools to participate in the TPD programme and finally schedules and executes the TPD session to teachers. At the school level, communities of learning have been insisted to be embraced and practiced. Even though the guideline states that TCPD is mandatory for all teachers and a possibility of a wide range of TCPD opportunities will be available through different approaches, real implementation might take time to be realized. This is because the same teacher selection criteria and methods to join a teacher training workshop are followed. This practice leaves many teachers, especially those in the semi-urban and rural areas, out of the teacher training plan.

2.8.2 Common Forms of Teacher Professional Development in Tanzania

While different forms of TPD are used at different levels and by different TPD organizers in the country, workshops and seminars are the most common forms of TPD in Tanzania (Chilumika, 2013; Komba & Nkumbi, 2008). The challenge with these forms is that they have a large content to be covered within a short time period. This limits time for participants to reflect on the content especially when the content is too large compared to the available training time. Workshops and seminars are still useful forms of TPD especially when they are used within particular models such as cascade (Namamba & Rao, 2017). Workshops or seminars designed to be implemented in a cascade fashion have a purpose of multiplying the impact to engage more teachers.

Other forms of professional development have been mentioned to promote professional growth of teachers especially when it is difficult for trainers to follow-up all the training participants. Kafyulilo (2013) hinted out on the use of collaborative methods such as community of practice (CoP), teacher design team, lesson study and professional learning community.

2.9 ICT Integration in Schools in Tanzania

The Ministry of Education, Science and Technology developed a policy to guide the integration of ICT in Basic Education (MoEST, 2007). The policy covers pre-primary, primary, secondary, teacher education, non-formal and adult education. The policy evolved from the overall objectives of education policies, and relevant national development policies, including the Tanzania National ICT Policy of 2003.

In order to implement the policy, the department of secondary education in the Ministry of Education, Science and Technology put in place strategies that will enable secondary school teachers to be equipped with knowledge and skills of integrating ICT in teaching and learning, administration and management. This was expected to empower teachers, students, educators, managers and leaders to use ICT judiciously and effectively for expanding learning opportunities and ensuring Education quality and relevance. The Government envisaged that ICT integration in teaching and learning could facilitate effective provision of education and improve access to many. This led to a need for establishing in-service teacher

training programmes which would provide teachers with opportunities to upgrade themselves while continuing with the teaching profession.

For the past decade, the Tanzanian government and other stakeholders had invested in creating an enabling environment to help in the integration of technology in teaching and learning. This started with a drive to create computer labs in schools that are equipped with enabling infrastructure such as electricity.

There have been initiatives and programmes such as the National ICT Programme for Secondary School Teachers (2011-2016), Tanzania Beyond Tomorrow project, and e-school project, all of which have provided ICT training to teachers in many ways.

Other stakeholders in the education sector such as Universal Communications Service Access Fund (UCSAF), African Digital School Initiative (ADSI), Global e-School and Communities Initiative (GESCI), World Bank and the British Council have also extended ICT training programmes to school teachers with the intention of building capacity in the use of technology in teaching and learning. In this line, a number of projects on teacher training at both primary and secondary levels have been completed. One such example is the Educational Quality Improvement Programme (EQUIP-T) project. This project trained over 2000 for the period between 2015-2017 (Gelander et al., 2017).

The expectation when such training sessions are conducted is that after the training, participating teachers go back to their schools and share the experiences with other teachers. Lack of confidence among the trainers, less training content knowledge and poor mentorship from the master trainers are some factors that contribute to this scenario. The missing part when all these training programmes are in place is training evaluation and follow-up.

2.10 The Need for this Research in the Context of Tanzania

School teachers improve their teaching and learning practices when they attend continuous professional development (CPD) programmes whether school-based or away from their contexts. In recent years, the governments of Tanzania through the Ministry of Education, Science and Technology and other stakeholders have invested efforts to train teachers on ICT integration and other domains. The goal of such teacher training programmes is to equip

teachers with knowledge of ICT tools and techniques to integrate technology in teaching and learning activities in their schools. Others focus on improving school administrative functions using ICT.

To conduct such ICT teacher training programmes to reach many teachers, the government and stakeholders design the training programmes deploying a cascade model. With this model, school teachers with different backgrounds are brought at a training centre and trained by primary trainers (usually experts in ICT) on the planned ICT modules for a number of days. After the training, it is assumed that participants become secondary trainers and they go back to theirs schools with objectives to cascade the same training content to teachers in their schools and those adjacent. The assumption that every participant from the workshop is a trainer is not in such cases. Therefore, it is important to develop selected teachers to ensure that they have the abilities to cascade teacher training programs. This research focuses on improving effectiveness of school teacher trainers in cascaded teacher training programs.

Chapter Three

Research Methodology

This chapter highlights the methodology that was taken to achieve the objectives of this research study. It starts by giving an overview of the Educational Design Research in Section 3.1 and then looks into the choice of the appropriate research methodology in Section 3.2. Section 3.3 presents Design-based Implementation Research as the chosen methodology for this research. The design, development and implementation of the different research studies are presented in Section 3.4. Finally, Section 3.5 outlines the different ethical considerations for this research.

3.1 Introduction to Educational Design Research

Educational Design Research (EDR) is a research methodology that is used to generate interventions in the education domain. EDR is an extension of the standard Design Research (DR) that focuses on creating interventions in the education domain (McKenney & Reeves, 2018). Recently, Easterday et al. (2018) defined educational design research as a methodology conducted by researchers in the education domain to design, develop and implement practical interventions and produce theoretical design models. All this is achieved in a design process involving understanding, defining, conceiving, and building, testing, and presenting the solution iteratively through empirical studies. Several researchers have identified features of EDR as a suitable methodology to produce intervention for education challenges. Cobb et al. (2003) and van den Akker (1999) have stated that, EDR is:

- *Interventionist*: The research designs an intervention to problems in real settings;
- *Iterative:* The final stable intervention goes through a number of iterations for any of the phases of analysis, design and development, testing and refinement;
- *Process oriented:* The focus of the methodology is on understanding and improving interventions to educational problems;

- *Utility oriented:* The merit of a design is measured, in part, by its practicality for users in real contexts; and
- *Theory oriented*: The design is based on existing theories, and field testing of the design contributes to theory building at different levels (local theory, mid-range theory and high-level theory).

EDR is implemented in many research activities because of many reasons. Several researchers have mentioned the motives for conducting EDR (Van den Akker et al., 2006). Three of the motives mentioned state that, EDR aims at:

i) Generating theories that are grounded empirically by combining studies that focus on the process of learning and the means aiding the process of learning.
ii) Advancing design practices that yield solutions to different educational problems.
iii) Making educational research more relevant to the policy makers and practitioners.

To achieve research goals, EDR involves collaboration with a number of actors in the field of education that is directly connected to the problem being solved. The collaborative efforts start right from the problem identification stage till the implementation and refinement stages. As the project continues, it goes through a number of multiple iterations of investigation, designing and development, testing and refinement. One large study might involve a number of sub-studies, each of which aims at achieving the main goal.

The iterative nature of EDR is important to generate a successive approximation of the developed intervention. Iterations are important in creating desired interventions while generating theories that can be impactful. Iterations involve activities that help to learn more about the effectiveness of the design to meet stakeholders' needs and research goals (Lewis et al., 2020). Through iterations, the refinements are done at different phases of the intervention deployment. This helps to reduce any uncertainties that can happen in the course of reaching the end of the project. Iterations involve building and testing of the intervention which in turn helps in understanding more about the context, what to change in the design and how to achieve stakeholders' goals (Peters et al., 2013).

EDR consists of different approaches focusing on solving challenges related to practices or producing theories and artifacts to improve effectiveness in teaching and learning. It involves

different cycles that are iterative in nature to improve the effectiveness of the intervention (Plomp, 2013). EDR focuses on producing interventions that solve many challenges in the education sector. Akker et al. (2006) have stated the types of interventions from an EDR study. An intervention can be educational products such as learning materials that support learning. It can also be a process that includes strategies, tactics or sequences that support the process of teaching and learning. On the other hand, an intervention can be a program that combines products and services to reach an intended educational purpose. Such programs can be a seminar series, a learning unit and a course or a teacher professional development program. Finally, EDR can produce an intervention that can be in a form of a policy to help in guiding the decision making process to educational administrators. A policy can be used to solve challenges related to areas such as curriculum, evaluation and assessment.

Design research encompasses other forms of designs that can be applied in education and other fields such as Evaluation Research (Powell, 2006), which focuses on evaluating existing educational interventions and finding their effectiveness in improving teaching and learning; Community-based Participatory Research, where the researcher collaborates with partners in the target community to conduct joint research to drive some changes based on the topic being investigated (Coughlin et al., 2017); Design-based Research (DBR), which creates a model for designing and testing of educational innovations in different learning contexts such as classrooms and laboratories; Implementation Research (Peters et al., 2013), which focuses on studying about the implementation of educational innovations in learning settings; and Design-based Implementation Research (DBIR), which focuses on solving common problems of practice that involve multiple stakeholders.

3.2 Choice of the Research Methodology

Education Design Research appears in many designs that are geared to providing solutions to educational problems. Each design has special features that make it suitable in solving such challenges. Table 3.1 shows the most common forms of DBR and the focus area to solve challenges in education.

Table 3. 1: Different Design-based Research Methodologies and their Focus

Design	Details	Focus
Design-Based Research (Plomp & Nieveen, 2007)	• Development of interventions and design principles with flexibility to explore and validate theories related to learning in the operating context of the intervention (Anderson & Shattuck, 2012a) • The teaching-learning problem is open, substantial and daunting • No how-to guidelines for addressing the problem are available	Focuses more on classroom practice
Developmental Research (van den Akker, 1999)	• Product or program development • The effectiveness of the proposed intervention is unknown before hand • This requires evolutionary (interactive, cyclic, spiral) approaches with some research activities to feed the process due to reforms in teacher training	Focuses more on designing, developing and evaluating instructional programmes, processes and products
Design and Development Research [DDR] (Wang & Hannafin, 2005)	• Development of effective interventions to solve educational problems generating contextually sensitive design principles and theories • More like Development Research	Method that aims at improving a product or program
Action Research (Lodico et al., 2010)	• This is used to enhancing current practice of teaching or student learning • It is carried out by teachers or other educational officers to identify and correct problems of local concern. • The process is cyclic in nature	To improve the current practice in an educational setting
Design-based Implementation	• It solves persistent problems of practice through collaborative and iterative designs	Focuses beyond the classroom level to

Research (Fishman et al., 2013)	• It builds capacity of teachers to sustain the change • Implementation and scaling up of interventions and generating design principles	implement educational interventions across local settings

DBIR methodology brings together researchers, practitioners and other stakeholders who are directly concerned with the problem to analyse, design and develop a solution. Stakeholders' contribution continues through the different phases and iterations of the intervention. The collaboratively designed educational intervention is effective, sustainable and scalable. This research deploys DBIR as its methodology. Details about DBIR features and implementation are in the next section.

3.3 Design-based Implementation Research

DBIR uses design-based research approaches and methods to study and refine implementation and diffusion of innovations in education (Penuel et al., 2011). This methodology focuses on differentiating educational researchers based on the nature of interventions developed and to be implemented. In this aspect, DBIR differentiates educational researchers as those who design interventions to solve educational challenges and the researchers who study the diffusion of the developed interventions in the education system. It is a methodology that involves design at various stages of the solution development. Research activities that use the DBIR approach have four important characteristics (Fishman et al., 2013). These are:

i) Multiple stakeholders collaborate to identify persistent problems of practice in education and develop the solution together.
ii) The design of the solution is iterative and collaborative in nature.
iii) A concern with developing theory and knowledge related to classroom learning and implementation through systematic inquiry.
iv) A concern with developing capacity for sustaining changes in systems.

3.3.1 Suitability of DBIR in this Research Work

DBIR involves interventions that go beyond the settings of a classroom (Penuel et al., 2011). It focuses on implementation of innovations across different local contexts. The power to bring together researchers and practitioners from different disciplines makes it a unique methodology for this research work. The four principles of DBIR have been mapped to the real situation that happens in teacher training programs in the context of Tanzania. Table 3.2 presents the mapping of DBIR features to the teacher training practices in Tanzania.

Table 3. 2: Mapping of the Four DBIR Principles to the Research Work

No	DBIR Feature	Mapping to Practice in Tanzania
I	Persistent problem of practice	Most of the teacher training programs in Tanzania deploy cascade model. The assumption is that training teachers on content is enough to be termed as teacher trainers.
II	Collaborative solution design and iterative implementation of the intervention	The problem analysis, design and development and implementation stages involved both the researcher and practitioners (school teachers, head of schools and district educational officers). Iteration of the intervention involved school teachers.
III	Developing theory and knowledge related to classroom learning	Two components from this research: i. A model to develop teacher trainers for cascading teacher training programs ii. Knowledge and skills to integrate technology tools in teaching and learning.
IV	Developing capacity for	Capacity building of teachers in two ways: i. Training of school teachers to become teacher

	sustaining the change	trainers who can cascade the training programme. ii. Capacitating teachers on the effective use of integration of technology in teaching and learning

DBIR methodology was selected for this research work because it tries to solve a persistent problem of improving teacher performance through professional development. Implementation of this problem involves multiple stakeholders such as teachers, school management, education officers at district and regional levels and the researchers. To solve this problem, a set of activities need to be executed including developing a solution to the problem and training teachers on how to implement the solution.

3.3.2 DBIR Phases in this Research Work

DBIR methodology consists of defined phases that drive the research to solve the educational challenge in hand. It starts with analysis of the practical problems of practice. In this case, the persistent problem of practice was found to be the inefficiency of cascaded ICT training for secondary school teachers in Tanzania. The researcher shared experiences of his participation in national projects on teacher professional development conducted in the form of workshops. This was mapped to the findings from literature review to complete the problem analysis phase. The different phases of this research based on DBIR according to Reeves (2006) are shown in Figure 3.1.

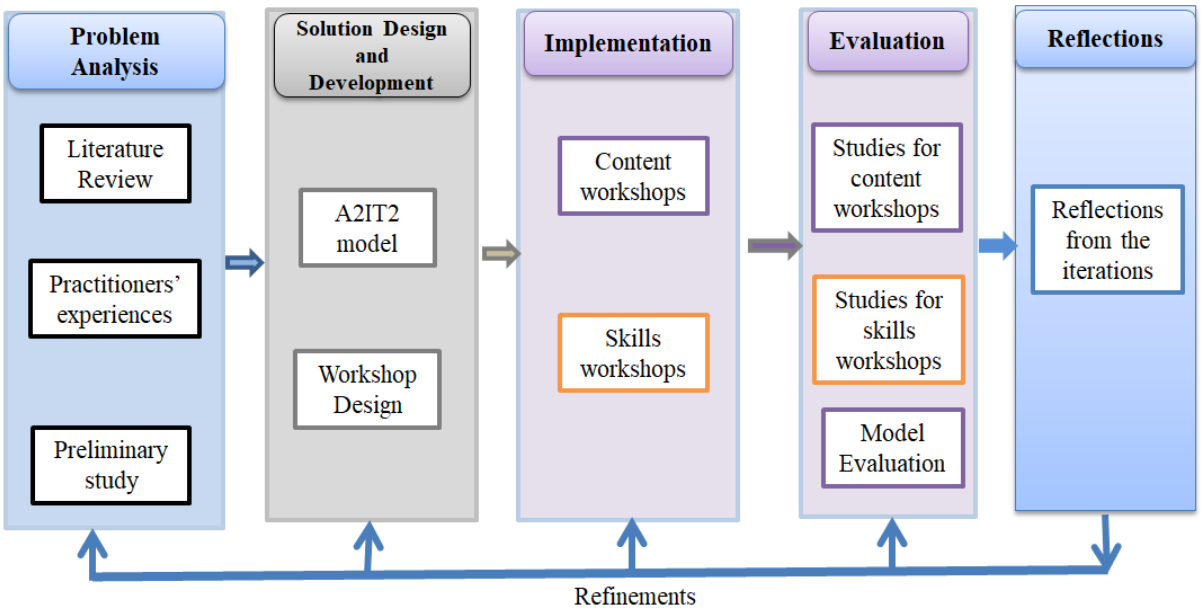

Figure 3. 1: Broad Phases of DBIR Methodology and connection to this research

Problem Analysis Phase: This involves analysis of the persistent problem of practice and the context in which the problem occurs. It involved a collaborative meeting with teachers who participated in previous cascaded training programmes and TPD programme designers. This phase gave a review of key points to consider when designing a solution to cascaded training programmes in Tanzania. Again, a review of literature was conducted to identify the challenges of cascaded teacher training programmes. This was reflected on the training of teachers on technology integration in teaching and learning.

Solution Design and Development Phase: During this phase, the solution to the persistent problem of inefficient cascaded ICT training for school teachers was designed. The design included selecting the appropriate form of professional development – workshop; conducting needs analysis from teachers to collect details of the topics they would need to learn more; analyzing the results and sequencing the topics; and setting up objectives for the first workshop. In addition, this stage also involves taking into consideration the existing design principles. In developing this solution, Constructive Alignment (Biggs, 1999), Microteaching (Allen & Eve, 1968), Peer Instruction (Mazur, 1999) have been deployed. A2I model (Warriem et al., 2014) was used as the theoretical basis to the design of the solution. The development involved creating workshop contents, individual and group activities for each suggested topic.

Implementation Phase: This involves implementation of the proposed solution in the desired context. A number of content workshops (CW1-CW4) and skills workshops (SW1 and SW2) are conducted with the beneficiaries (teachers) at different times based on the objectives and research questions for each workshop.

Evaluation Phase: During this phase, studies to collect data are conducted. For each CW and SW, a number of research questions are answered, data collected, analysed and findings are stated. Data are collected during the workshops and are collected using different data collection instruments to meet the desired objectives of the study.

Reflection Phase: As data analysis is completed, the research questions are answered. Findings from data, observations from the sessions and experiences inform the researcher the necessary refinement needed to the current iteration to improve the next iteration. Depending

on the findings, refinement can be done on any of the previous phases and to any of the components of each phase.

The five phases of DBIR constitute one iteration which involves completion of all the five phases including the refinements suggested. The next iteration starts where the first iteration ends. Figure 3.2 shows one complete iteration.

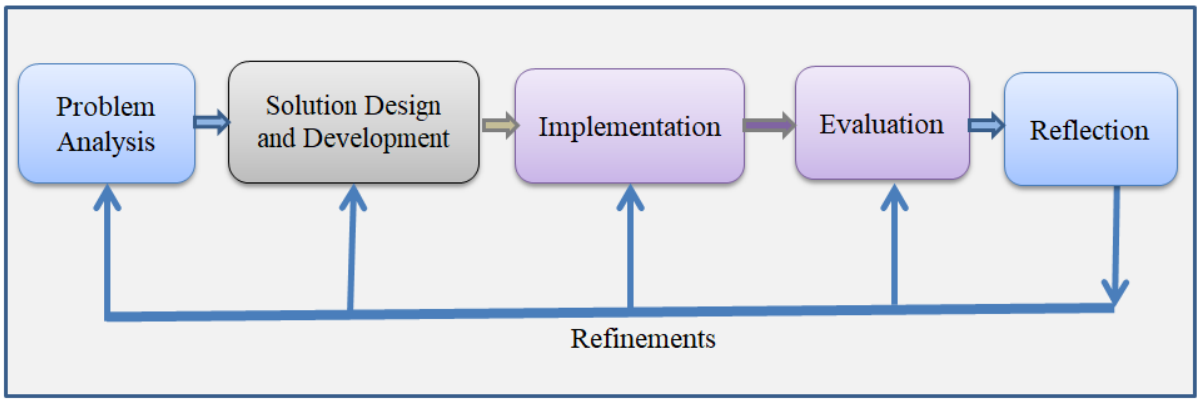

Figure 3. 2: The phases that constitute one complete iteration

3.3.3 DBIR Cycles in this Thesis

This research involved two cycles of DBIR to generate the refinements needed to evolve the model. Cycle 1 focused on analyzing the teacher training challenges from literature, practitioners' experiences and conducting a preliminary study. Implementation involved content workshops that were evaluated to generate the refinements to be made for each iteration.

DBIR Cycle 1

This cycle focused on the following goals: (i) to identify the challenges associated with the implementation cascade model of teacher professional development in Tanzania; (ii) to develop and implement a solution to the selected challenges identified in (i); (iii) to determine teachers' intention to transfer knowledge and skills in schools and the challenges associated with transfer; and iv) to reflect on design improvements to the developed intervention.

The broad research questions for Cycle 1 included:

i) What are the challenges associated with the implementation of cascaded TPD programmes?

ii) How confident are school teachers in integrating ICT in teaching and learning?
iii) In what ways do school teachers plan to transfer knowledge from the training?
iv) What are improvements to increase effectiveness of the developed Intervention?

DBIR Cycle 1 consisted of two iterations (Iterations 1 and 2) having two studies, Studies 1 and 2. Iteration 1 consisted of literature reviews on TPD models combined with practitioners' experiences and a preliminary study. A2I model (detailed in Chapter Four) was the basis of Study 1 implemented by content workshop, CW1. A2I model has been used in a number of studies related to training design on technology integration in teaching and learning (Mavinkurve & Patil, 2016; Murthy et al., 2017).

Reflections from Iteration 1 led to the refinement of A2I model to A2IT after adding another phase on microteaching. This was implemented during the content workshop, CW2, and evaluated by Study 2. Figure 3.3 depicts the two different cycles of DBIR implementation in this research.

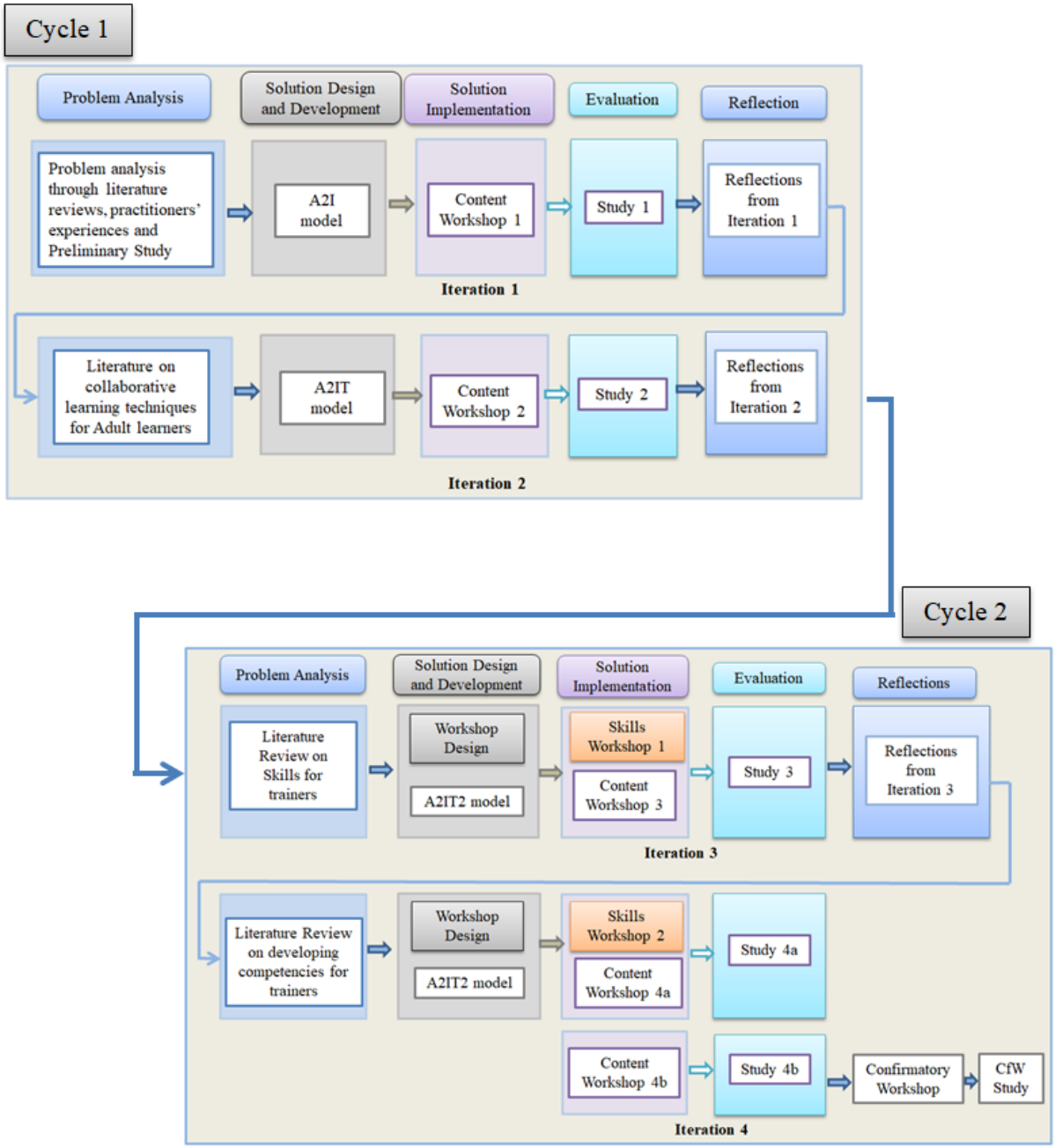

Figure 3. 3: The two DBIR cycles and components per cycle

DBIR Cycle 2

The goals of DBIR Cycle 2 were as follows:

i) To refine the developed model based on the reflections from iteration 1;

ii) To impart important teacher training skills to the selected previous workshop participants;

iii) To evaluate the developing teacher trainers through micro-training and full training sessions; and
iv) To evaluate the developed model across different teacher training sessions.

Cycle 2 involved four broad research questions to achieve the stated goals as follows:

i) What competencies do experienced trainers possess?
ii) What are considerations for designing a teacher training workshop?
iii) What is the experience of teacher trainers after a co-training session?
iv) What improvements are necessary for transfer of knowledge?

Each of these broad research questions was then broken into specific research questions that were answered from the skills workshops (SWs) and the content workshops (CW3 and 4).

This Cycle consisted of two iterations: Iterations 3 and 4. Iteration 3 involved a skills workshop (SW1) with three research questions and Study 3 to respond to three other specific research questions. On the other hand, Iteration 4 consisted of another skills workshop (SW2) with one specific research question and Study 4 with two research questions. To confirm the results of Study 4a, a similar study (Study 4b) with the same setup, same research questions and same data collection methods was repeated by another teacher trainer.

3.4 Design and Implementation of Research Studies

This research work involved a number of studies (Study 1 through 4b for all content workshops and two for the skills workshops, SW1 and SW2) as depicted in Figure 3.3. This section describes the design and implementation of the different workshops.

3.4.1 Research Questions

This research set out to answer several research questions per each study that finally led to the development of the model. These studies and their research questions are shown in Tables 3.3 to 3.6.

Table 3. 3: Research Questions for Study 1 and their Relevance

Research Questions for Study 1	Relevance to this Research
What are the teachers' learnings from the workshop?	• To evaluate how much participants have gained as learners • To analyze the level of technology integration by teachers during the Integrate phase
What are the teachers' confidence levels to use technology tools in their teaching and learning?	To analyze the level of technology integration by teachers during the Integrate phase
How do trained teachers perceive transfer of knowledge from A2I model based workshop into their contexts?	To find teachers who have made concrete application of knowledge from the first content workshop to join the second content workshop as Learning Assistants
What are the factors that hinder effective teacher training on ICT in schools?	To determine factors that might hinder transfer of training in schools by trained teachers

Table 3. 4: Research Questions for Study 2 and their Relevance

Research Questions for Study 2	Relevance to this Research
How well do teachers align technology to the learning objectives during a microteaching session?	To determine how technology is aligned into the lesson plan and how it is realized during microteaching sessions
How confident are teachers in technology tools in their teaching practices and sharing with other teachers?	To analyze the progress in technology integration by teachers during the Integrate phase
How do teachers perceive the role of a microteaching session in teacher training?	To highlight the role of peer feedback during a microteaching session
What modifications to the model would make effective transfer of workshop content to other teachers?	To find design considerations are needed to help LA in managing a small training session

Table 3. 5: Research Questions for Study 3 and their Relevance

Research Questions for Study 3	Relevance to this Research
What are the perceptions of participants on the session taken by a co-trainer?	To determine missing skills for co-trainers to take on their individual solo sessions. The skills will be implemented in the second skills workshop
What are co-trainers' lessons from the sessions they took?	Self-reflections from co-trainers during the Co-train phase.
What modifications do co-trainers need to improve their training sessions?	To refine the final Train phase as co-trainers will be equipped with the relevant skills

Table 3. 6: Research Questions for Study 4a and b and their Relevance

Research Questions for Studies 4a and b	Relevance to this Research
To what extent do A2IT2-based workshop participants integrate technology tools during a training programme conducted by a co-trainer?	Evaluating the effectiveness of the full session taken by the co-trainer during the Train phase
How confident are teachers in using technology tools in their practices and sharing with other teachers?	Evaluating teachers' competences in using technology tools
What are the features of an effective teacher trainer for an effective teacher training session?	Refining additional features a full trainer possesses after conducting a full solo training session
What are the reflections of the developed trainer from their solo teacher training?	Self-reflections of the trainers help to improve the Train phase

3.4.2 Sampling of Participants of Research Studies

Throughout this research, a goal was to develop school teachers to become teacher trainers. This was through a number of ICT-based content workshops that introduced teachers to effective integration of technology in teaching and learning.

Purposive sampling was deployed to invite participants to the different types set of content workshops. In this case, school (primary and secondary) teachers were the main participants in all content workshops. Invitation to the workshops required school teachers to have their own computers or laptops and to come from schools that have some minimum ICT infrastructure, including at least a projector and at least 5 working computers in a computer laboratory.

These teachers (participants) had varying range of teaching experiences from 1 year to teachers with more than 20 years of teaching experiences. The participants had 21 to 60 years of age.

3.4.3 Data Collection Instruments and Methods

To collect data from different studies, a number of data collection tools were deployed. Some of these tools were created by the researcher; others were adapted; while some were adopted to achieve the goals of this research. The instruments used in this research work are described in this section.

Checklists for Participants Details

This tool was used by the Learning Assistants when analyzing demographic details of the workshop participants mainly to capture the situations and contexts in their own schools. The analysis was done as Activity 1 during the first Skills Workshop. This tool was developed by the researcher. It is given as **Appendix G**.

Checklists for Evaluation of Effective Peer Instruction Questions

Learning Assistants used this tool during the first Skills Workshop to evaluate the given set of questions and determine whether they were effective peer Instruction (PI) questions. The

analysis was done as Activity 1 during the first Skills Workshop. This tool was developed by the researcher. It is given as **Appendix H**.

Interview Protocols

For each of the workshops, semi-structured interviews were conducted to capture different aspects of the training and how participants reacted to the sessions. The questions for each workshop depended on the research questions and the nature of the activities when the teacher transitioned across different stages to become a teacher trainer. The questions were developed by the researcher to give responses to the different research questions.

Microteaching Assessment Rubric

This tool was developed by the researcher for assessing microteaching sessions during group presentations. It captured information about the group, topic selected, class setting and total participants. This tool consisted of six (6) dimensions with three (3) levels of achievement to scale the dimensions. The six dimensions included statement of learning objectives, learning activity design, student-centred approaches, and assessment of skills, technology integration and inclusion of real-life examples. The three levels of achievement (scale) include Not Observed (0), Approaching Expectations (1) and Meeting Expectations (2). Based on the six dimensions, evaluation was done following the scale. This tool is attached as **Appendix D**.

Classroom Observation Protocol

This was developed by the researcher to collect observations during a microteaching session. It consisted of three parts to record observations. Part 1 captured background details such as observation date, observation start time, observation end time, and length of observations. It also captured teacher's name, class, topic, subject and technology tool integrated in the lesson.

Part 2 of this tool captured the structure of the lesson based on what the observer saw and thought. It also captured the level of interaction between the teacher and the students (the rest of the workshop participants) and interaction among the students. Other sections collected data on technology integrated in the lesson and level of use of other available resources.

Part 3 captured the overall reflections on the lesson such as teaching approach used, ability of students to complete activities, student response to technology integration and any difficulty the teacher faced when integrating technology in the lesson. This tool is given as **Appendix B**.

Training Evaluation Form

To evaluate content and skills workshops, some items from the Kirkpatrick Blended Evaluation Plan Form Samples[1] were adapted. Only some items that were relevant were selected to be used along with other items from the researcher. The final tool was used to evaluate training workshops. Design of the tool depended on the research questions to be achieved for the particular workshop.

Google Forms

Based on the possession of smartphones by participants, Google form was used to collect data at different times. During the first skills workshop (blended) and the second skills workshop (full online), Google forms were used to collect data from participants. This was the case for other instances such as collecting demographic data of participants before joining the workshop sessions.

Video Camera

Videos are data collected to capture events that happen when teacher training sessions take place. For the face to face workshops, video camera was used to record specific sections of the sessions that would be analysed to gather detailed information on the sessions taking place. For example, microteaching sessions (described more in Iterations 2, 3 and 4) were recorded to ensure that the sessions and how teachers orchestrate the session can be analysed later with greater details.

[1] https://www.uslegalforms.com/jsfiller-desk15/?requestHash=e3eb790f1d0508df66225d9203886e8f6b32156ea7a4752ff90621cec1305821&ref=https://www.uslegalforms.com&projectId=1012159428&loader=tips&replace_gtm=false&et=as#3a5e066caee343c4a37d2337bb5f33c1

3.4.4 Data Analysis

Design based implementation research (DBIR) methodology involves both qualitative and quantitative data collection tools. This implies that both qualitative and quantitative data analysis techniques were performed to analyse the data collected from this research.

Qualitative data were collected using four main methods: Observation, one-to-one semi-structured interviews, focus group interviews with 2-3 participants per session and online surveys. Observational data were collected using an observation protocol during microteaching sessions to evaluate sessions being taken up by participants as they taught a small session from the lesson plan they had developed. Interview protocols were used when interviewing participants. Demographic data at the beginning of the workshops and their learning experiences at the end of the workshops were collected using Google forms.

The collected data were analysed using thematic analysis (Braun & Clarke, 2006). Thematic analysis involves six steps: i) Familiarizing with data through immersion into the data by repeated reading; ii) Generating initial codes from the initial set of ideas generated from re-reading the data; iii) Sorting the different codes into potential themes; iv) Reviewing and refinement of the themes to ensure there is coherence between them; v) Naming and defining the themes to determine relations to the research questions and to themselves; and vi) Final analysis and writing up the research publication.

Quantitative data involved data in the form of numbers and frequencies mainly from participants' demographic details. In this case, frequency analysis was mainly used to generate results in the form of graphs and tables. The results depended on the nature of data that were collected and what was to be extracted from the data as results.

3.5 Ethical Considerations

Regardless of the type of research being undertaken, it is important to observe ethics to ensure that proper conduct is observed. This applies to all participants in the studies and the institutions they come from on the one hand and the researchers and their own institutions they come from, on the other hand. Ethical issues also apply to participants of the research studies in order to ensure confidentiality (Lodico et al., 2010).

The Indian Institute of Technology Bombay, through its Institutional Review Board (IRB), based on the review of the submitted details and research instruments, granted permission to conduct research studies in Tanzania for the duration of my studies. See **Appendix I**. On the other hand, the Morogoro Regional Education Officer (REO) granted permission to conduct research workshops with teachers in Morogoro region. The permission was granted after a brief session to understand the objectives of the workshops and the benefit of the workshops to the region. **Appendix J** is the permission granted to conduct research.

For participating teachers in the workshops, informed consent was obtained at the beginning of each face-to-face workshop. The informed consent form consisted of items that participants had to agree to ensure confidentiality (See **Appendix K**). For online forms, participants towards the end of the form were required to respond to a separate question that asked them if they agreed to use the data for research. For data storage, all data collected were stored on separate personal portable drive. This practice ensured data were not shared across networks and hence maintaining confidentiality.

In Chapter Four, a description of DBIR Cycle 1 is given. Details of all the studies, iterations and reflections, and implementations are discussed.

Chapter Four

DBIR Cycle 1

This Chapter focuses on the different components of DBIR Cycle 1. The overview of each iteration is given in Section 4.1. Moreover, sections 4.2 and 4.3 give a detailed depth of Cycle 1 focusing on Iterations 1 and 2 respectively. Each iteration consists of a research study to achieve a set of research questions. At the end of each iteration, reflections are stated that lead to refinement of the developing cascaded teacher training model.

4.1 Iterations in DBIR Cycles

The iterative nature of design-based research is important to generate a successive approximation of the developed intervention. Iterations are important in creating desired interventions while generating theories that can be impactful. Iterations involve activities that help to learn more about the effectiveness of the design to meet stakeholders' needs and research goals (Lewis et al., 2020). Through iterations, the refinements are done at different phases of the intervention deployment. This helps to reduce any uncertainties that can happen in the course of reaching the end of the project. Iterations involve building and testing of the intervention which in turn helps in understanding more about the context, what to change in the design and how to achieve stakeholders' goals (Peters et al., 2013).

This research involved four iterations to refine the developed model for improving efficiency of cascaded TPD programmes. This topic focuses on two iterations that make up the DBIR Cycle 1. Figure 4.1 shows the two iterations of DBIR Cycle 1.

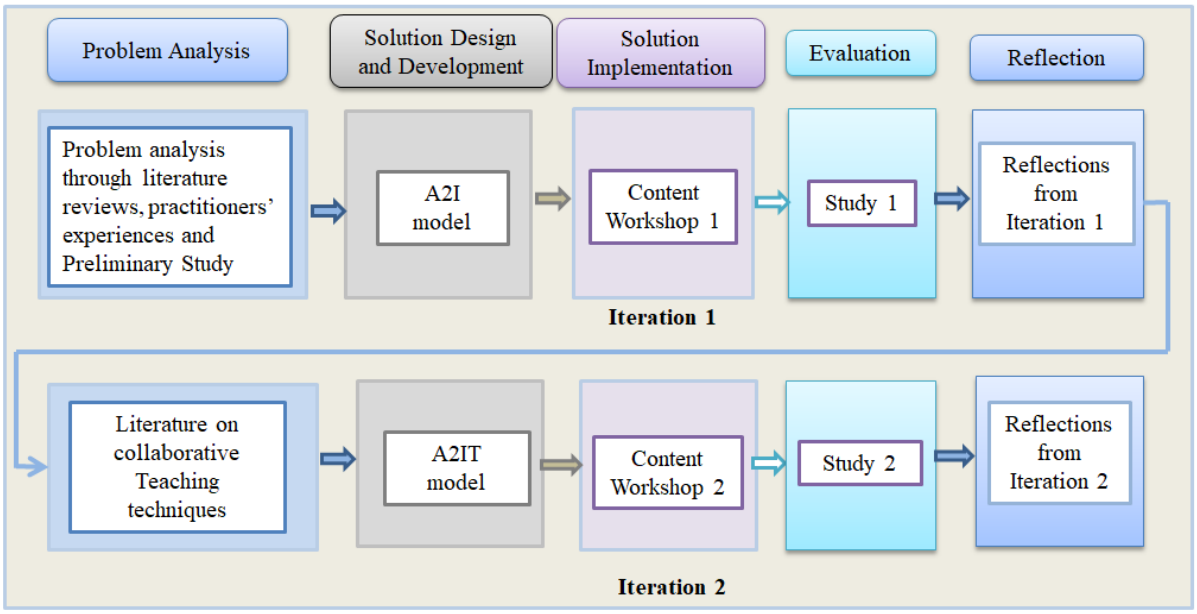

Figure 4. 1: The two iterations of DBIR Cycle 1

4.2 Cycle 1 - Iteration 1

Iteration 1 was conducted as the first workshop that involved the first group of teachers. It aimed at training teachers on the selected topics to improve their technological and pedagogical knowledge (TPK) and confidence in using the selected technology tools. This iteration involved a number of phases as described in the following sections:

4.2.1 Problem Analysis

i) The Persistent Problem of Practice

Tanzania, like any other developing nations, is embarking on upgrading school teachers in terms of knowledge and skills at different educational levels. This is due to the rapid economic, social and technological advancement. The Education and Training Policy (ETP) 2014 put it clear that the government shall ensure increased application of science and technology in the provision of education and training at all levels (MoEST, 2014). While some teacher training programmes are designed in such a way that they are implemented in a cascaded fashion, other programmes have cascaded design implied. Participants in each of the workshops are expected to share experiences with other teachers in their schools and adjacent schools.

In 2010, the Government of Tanzania initiated a programme to train school teachers on how to use ICT in teaching and learning (MoEST, 2010). This programme was named "National ICT Programme for Secondary School Teachers". To make this in-service secondary school teachers training effective, the cascade model was employed. In Phase 1, the National Facilitation (NF) team trained teachers [named master trainers (MTs)] in twenty three nuclear schools. The Master Trainers were assessed; those who qualified were certified to train other teachers at the secondary schools.

Level 1 of this cascade model aimed to train teachers from 21 schools, Level 2 from 126 schools, Level 3 teachers from 756 schools and finally at Level 4, teachers from 4536 schools. Each training session consisted of 5 days, with seven hours of intensive training. The MTs at the top level (1st level) produced other MTs at lower levels who conducted the training of teachers. After the training, participants went back to their schools as trainers who are equipped to train their colleagues. Data about their experiences with teacher training were collected using the tool **Appendix O**. When asked about their readiness to train others, participants expressed difficulties as they prepared to train their colleagues. The following are some of the excerpts from the responses of three teachers, T1, T2 and T3:

T1: *"...Some concepts were not clearly understood due to the shortage of time that caused difficulties when passing through the handout..."*

T2: *"It was hard to understand some technical words..."*

T3: *"... No enough time to be familiar with the course contents, and no follow up was made..."*

From the three teachers, apart from the program design-related issues, it is evident that their trainers trained them on important skills that are important to transfer the training into the school context. It is therefore important to choose a research design that can develop teachers through phases to become teacher trainers. The design selected aimed to improve the practice of cascaded training programmes in Tanzania.

ii) Literature Review on TPD

To analyse the persistent problem of practice in cascaded teacher training programmes in Tanzania, a review of literature review on TPD models was performed. This helped us in

understanding the details of different models and how they are implemented. A closer look was given to learning more about cases of implementation of cascaded teacher training programmes more in the African region. Through these cases, benefits of cascaded teacher trainings and the associated challenges were identified.

Though literatures review, a number of suggestions on how to improve delivery of such training programmes were suggested. These were as a result of lessons from conducting such cascaded teacher training programs in their contexts. Details of the literature review on TPD are found in Sections 2.2 and 2.3. Of these, the A2I forms the basis of our work which is described in Section 4.2.3.

iii) Practitioners' Experiences

Apart from conducting literature review to know about the problem, collaborative meetings among researchers and practitioners in that natural context are important (Herrington et al., 2007a).

The researcher drew on the experiences in facilitating teacher training programs in different national TPD programmes. One of the experiences shared came from the participation as a facilitator in the previous cascaded teacher training programme that took place between 2011 and 2016. This cascaded training was a national program for secondary school teachers on ICT integration. It was planned to be cascaded in three cycles: Cycle 1 focused on basics of ICT, computer applications and the Internet; Cycle 2 involved topics on multimedia, hardware and software installation and maintenance, and safety of ICT devices; and finally, Cycle 3 focused on the use of ICT in teaching and learning. Only two cycles (Cycles 1 and 2) out of the planned three cycles were completed.

In a collaborative meeting with some participants of the above national programme, a number of issues were raised on the planning, designing, and implementation of the same. A number of those issues were related to why they were not able to effectively train other teachers in their schools are presented in this case.

As participants shared their experiences with one of the trainers in this programme, it was noted that there are issues that need to be addressed together. One of the issues was how to

improve training programs that involve teachers as trainers. This research focuses on developing a teacher to become a teacher trainer.

4.2.2 Study for Establishing the Problem

This was conducted as part of this research project which took place between January and May, 2018, focusing on trying to find preliminary answers to two research questions.

Research Goal: To study the characteristics of primary and secondary trainers in cascaded teacher training programs.

Research Questions

This study aimed at responding to these two research questions:

RQ1.1: What is expected of teachers selected as secondary trainers in cascaded TPD?

RQ1.2: What kind of support do secondary trainers need from primary trainers?

A qualitative study was carried out with details as follows: The research study consisted of two samples: one sample consisted of four (4) secondary trainers, who were graduate students in the Department of Educational Technology at IIT Bombay. This sample provided responses to RQ 1.1. The second sample included two primary trainers who are professors in the same department. This sample provided responses to RQ 1.2. The two groups of trainers trained a group of 38 participants, who were novice instructors from technical education institutions in India. The novice instructors participated in the Technical Education Quality Improvement Programme (TEQIP) workshop for a duration of four weeks. The workshop took place from January 23 to February 20, 2018 at the Indian Institute of Technology Bombay (IIT Bombay), in Mumbai, India.

Procedure

The first part of the workshop was conducted by the two primary trainers. Based on the arrangement, secondary trainers participated as observers. In all sessions that were taken by primary trainers on the first week of the workshop, the secondary trainers participated as teaching assistants (TA). The secondary trainers then took sessions each with a topic to train the participants. In completing this study, it was assumed that: The TEQIP training was in the

form of a cascade since it involved primary and secondary trainers; participants of the TEQIP workshop had similar profiles since they were all novices in the teaching process; and Secondary trainers were considered as school teachers who were required to go and train others.

Data Collection and Analysis

At the end of the workshop duration, structured interviews with the two primary trainers were conducted. The interview protocol consisted of a set of four questions about factors that were considered to select the secondary trainers; how to make sessions effective; and other general comments. Finally, secondary trainers were interviewed, one by one based on the set of questions that were prepared connected to their experiences as trainers. Validity and reliability of the interview questions were established through expert validation, where two experts in the field of teacher professional development went through the interview questions and shared their refinements. The interview protocol was refined and administered to the teachers.

During data analysis, interview data were subjected to the six steps of thematic analysis by (Braun & Clarke, 2006). Having transcribed the data, familiarization was done by reading and re-reading the data actively. Initial codes were then generated including their extracts. From codes, searching for themes was done. This involved sorting different codes and grouping them into themes. The generated themes were reviewed to combine or break them down into other codes. Final themes were defined, refined and named to identify what each theme tells about. An expert in TPD coded the interview transcripts in relation to the research questions following the same approach to generate another set of themes. The generated themes were compared with the previous themes to reach an agreement of the themes from the transcripts. This stage was done to ensure reliability of the themes. The final themes are shown in the result section.

Results and Discussion

Result 1: Characteristics of Secondary Trainers

Data revealed that secondary trainers in cascade training sessions had content knowledge about the topics of the training. On the other hand, they had attended a number of workshops

with related topics to the planned workshop content. Before taking up their training sessions, they had participated in a number of sessions taken up by the primary trainer and engaged in learning. It is expected that secondary trainers have content adaptation skills to customize the content for the audience; skills to design and implement activities that engage participants; and time management for each of the sessions. This implies that, selection of appropriate secondary trainers is important in order to successfully conduct effective cascaded TPD programmes. This is in line with the list of specific skills that workshop participants need to be asked as part of the planning stage as given by Sufi and colleagues (Sufi et al., 2018).

Secondary trainers develop through the following stages: Being in a learner stage and taking the role of a teaching assistant. During the learning stage, the secondary trainer attends sessions taken by the primary trainer, takes some notes and reflects on the sessions. A teaching assistant participates in the sessions by a primary trainer, assists in answering questions from the participants, records the different activities that happen during the session and makes a reflection at the end of the sessions. Figure 4.2 shows the transitions and activities to be completed at each stage.

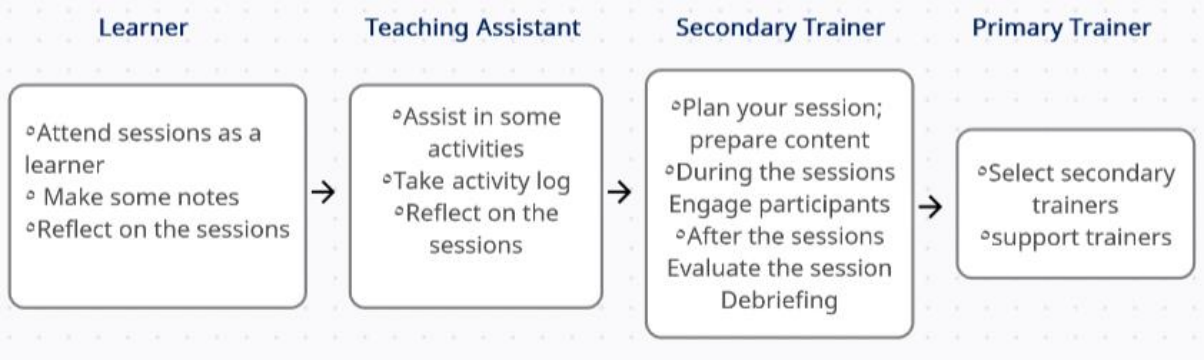

Figure 4. 2: The transition from learner to secondary trainer and beyond

Result 2: Role of Primary Trainer to Secondary Trainers

As a response to RQ1.2, primary trainers are important during the design, development and implementation of a cascaded teacher training programme. One of their roles during planning and designing is the selection of participants who join the training programme. Their presence in the training room during the sessions or their availability to guide secondary trainers when they face some challenges is one support. At the end of the day's session or at

the end of the workshop, primary trainers are important to give feedback to secondary trainers as they debrief about the sessions.

At the end of the problem analysis phase, design and development of the intervention followed. The next section gives details of how the intervention was developed.

4.2.3 Solution Design and Development

Evaluation of the preliminary workshop for establishing the problem, data from literature review and the shared experiences from the previous participants of cascaded workshops led to ideas to extend the A2I model to train school teachers. A2I model is a research work by Warriem, Murthy and Iyer (2014) and uses three phases of Attain, Align and Integrate for teacher training using constructive alignment for use of ICT in engineering education. The model was applied to train teachers in the school context by setting up activities that engage them to achieve the stated objectives.

Activities were designed to fit into the different phases of the A2I model to ensure that the desired goal is achieved. Table 4.1 shows the different phases and the focus, coverage, nature of activities and the roles of those involved in the study.

Table 4. 1: Phases of A2I Model as Applied to this Research

	Attain	**Align**	**Integrate**
Focus	Introduce participants to student-centred teaching and learning	Align Instructional activities to Learning Objectives Align Assessment Strategies to Learning Objectives	Developing a Technology-integrated lesson plan
Coverage	• Introduction to ICT in teaching and learning • Constructive Alignment • 21st Century	• Introduction to educational technology tools • Technology Integration in the Lesson Plan	Aligning technology integration instances in a lesson plan to the learning objectives

	Teaching		
Nature of activities	*Individual* • Identifying smart learning objectives • Creating smart learning objectives	*Individual activities*: e.g. Create a PI question from the subject you teach *Group activities*: e.g. develop a lesson plan	*Group activities*: e.g. integrate technology in a lesson plan to achieve intended learning objectives
Trainer's Role	Instructor	Facilitator	Facilitator
New Participant's role	Active learner	Individual practices and group practices	Work collaboratively to align technology at strategic points of the lesson plan to achieve the learning objectives
TA's Role	Learners of the content	-Previous participants help new participants in group activities	-Previous participants help new participants lead group activities
Mastery Level	General knowledge of ICT in education, 21st century teaching and learning	Application of knowledge in working on activities	Mastery of content and technology
Mode of delivery	Lecture, discussions, brainstorming	Exploration, Discussions, Presentations, feedback	Discussions, Presentations, Feedback
Achievement	Components of a well-designed technology-integrated lesson plan	Constructively aligned Lesson Plan	Technology-enhanced Lesson plan (Appendix M)
Skills Developed	No	Creating smart learning objectives	Designing a Technology-enhanced Lesson plan

During the Attain phase, participants were given individual activities on identifying valid learning objectives and creating SMART learning objectives. For the Align phase, a number of individual and group activities were introduced. Individual activities involved activities such as creating peer instruction (PI) questions; whereas for group activities, participants developed lesson plans. Technology integration was implemented in the developed lesson plan during the Integrate phase. Details of the topics and the roles of participants are explained in the next section in Table 4.2.

4.2.4 Solution Implementation: Content Workshop 1 (CW1)

This was carried out from December 11-15, 2018 at Kola Hill secondary school in Morogoro region. It consisted of school teachers as participants. It involved 5-6 hours of workshop per day on the selected topics. The training involved individual and group activities that were completed by participants during the session and others as homework.

Research Goals: CW1 was set to achieve the following goals:

i) To introduce teachers to technology integration in teaching and learning; and
ii) To select teachers to engage as learning assistants in the next workshops.

Workshop Design

The workshop was designed based on the needs analysis gathered from teachers. An online survey was shared among teachers with a question "Which topic(s) would you like to learn to help in ICT integration?" 74 teachers responded with varied number of topics. The topics were then categorised to produce a list of six topics. For each topic learning objectives, instructional goals and assessment methods were clearly specified as shown in Table 4.2.

To ensure teachers were able to train other teachers effectively, activities based on the three phases of A2I were created per each topic. Table 4.2 shows the initial orchestration activities that were implemented during each topic.

Table 4. 2: Topics and Activities Completed by the Researcher and Teachers

Topic	What the researcher did	What teachers did
Internet Search	• Ask teachers to download documents - PDF document - Word document • Ask teachers to download images /illustration from the internet • Give feedback on group activities • Summarize different pedagogical strategies used in the lesson	• Teachers to stick on one of the subjects they teach • To use the examples from the selected subject. • Download documents (2 PDF documents, 2 Word documents, 2 images) related to the content of the selected subject. • Teachers to present the downloaded documents in each case to others groups • Other groups to give feedback on the content displayed • Instructor to comment on the presentation from each group • Ask teachers to highlight different pedagogical strategies used in the lesson. • Ask them to specify learning activities where each has been used
YouTube in Teaching and Learning	• Introduce the use of visualization (videos, animation) in teaching and learning • Ask teachers to download two videos from YouTube • Ask teachers to download animations from YouTube • Demonstrative how to use videos and animations in teaching and learning	• Download two short videos (up to 7mins) relevant to one of the topics they teach from the selected subjects • Prepare a lesson plan on how to integrate the selected videos and animation in teaching his/her topic • Group presentation of the lesson plans developed • Receive feedback from other groups

	• Give feedback and comments on different presentations by each group • Summarize the different pedagogical strategies used in the lesson	• Instruction to give general comments on the activity • Ask teachers to highlight/summarize the different pedagogical strategies used
Mentimeter in Teaching and Learning	• Introduce mentimeter to the participants • Demonstrate how to create PI question based on multiple choice question (MCQ) and present responses from students • All participants to respond to the PI question that will be presented • Demonstrate how to create a quiz using mentimeter • All participants to act as students and respond to the quiz • Summarize the different pedagogical strategies used in the lesson	• Create a PI MCQ based on the topic from the course • Let other groups act as students and vote • Give suggestions of when to use mentimeter in teaching their topics • Each group to create a 2 question quiz based on what they teach • One group to act as the teaching group while the other group will attempt the quiz (Student group) • Each group to receive feedback from both groups and instructors • Teachers to discuss the pedagogical strategies used at different points
Padlet in Teaching and Learning	• Introduce padlet to the participants • Create a topic to demonstrate how padlet works • Ask all groups of participants to respond to the topic/thread on the padlet • Share general comments on observation from padlet activity presentations	• Each group to create a padlet topic/question and let other groups respond to that question/topic -Topic/question should be from the subject selected -Give comments as anonymous • Each group to give/suggest when to use padlet in teaching the

	• Summarize different pedagogical strategies used in the lesson	selected topics. • Teachers to highlight the pedagogical strategies and point where applied
MS Power Point	• Instruct them to create 5 slides of what they have learnt in the previous lesson • Demonstrate how to upload objects (Videos, animations, Images) to PowerPoint • Ask questions: When is it appropriate to use PowerPoint? • Give general comments on the presentation by groups • Summarize different pedagogical strategies used in the lesson	• Group presentation of the 5 summary slides among what they have learned over the previous topics • Upload the images, objects and animations at an appropriate location of the slides and give appropriate content. • Each group to present their PowerPoint slides to other groups • Receive feedback from other groups • To suggest when to use power point in their teaching and learning. • To summarize different pedagogical strategies used in this lesson

4.2.5 Evaluation of Iteration 1 through Study 1

Study 1 was planned to consist of a number of research questions that were to be researched for. Using the same participants, the study was completed and evaluated as follows.

Sample and Sampling Technique

A total of 19 in-service school teachers (17 teaching in secondary schools and 2 in primary schools) participated in the training for 4 days at Kola Hill secondary school in Morogoro region, from 11-15, December 2018. Purposive sampling was deployed to invite participants to the study. An invitation was shared within teacher networks to invite those who had their own laptops and those whose schools had computer labs. This was made so in order to ensure that teachers could practice what they learned after the workshop. These teachers came from 12 secondary schools and 2 primary schools located in 5 regions: Morogoro, Dodoma, Kilimanjaro, Ruvuma and Mwanza. They were invited by the researcher through email invitations to 10 teachers, who had participated in the Massive Open Online Course (MOOC) offered by IIT Bombay. Majority of the participants taught ICT, History, English, Geography and Mathematics. Majority of the teachers (58.8%) were aged between 31 to 40 years with 4 to 10 years of experience (41.2%). Only 5 teachers had prior experience of training teachers, while out of all the six topics, majority of the participants had a very good knowledge of the topic on "Internet Searching for educational Content".

Research Questions

This study involved four research questions, namely:

i) What are the teachers' learnings from the workshop?
ii) What are the teachers' confidence levels to use technology tools in their teaching and learning?
iii) How do trained teachers perceive transfer of knowledge from A2I model based workshop into their contexts?
iv) What are the factors that hinder transfer of teacher training in schools?

Data Collection Process

Data from the study were collected using workshop entry and exit feedback surveys, questionnaires and two focus group discussions. The workshop entry and exit survey had one demographic question together with questions related to the availability of technology infrastructure in schools. One question consisted of all the topics to be covered during the workshop and determined to find out the level of understanding of the topics before the workshop (pre-test) and after the workshop (post-test). The question had 5 scales from none (1) to very high (5). The questionnaire consisted of only four open-ended questions, basically requiring teachers to describe how they would integrate the educational technology tools into their different topics they would be teaching the next semester (January to May, 2019). Three interview sessions, each consisting of one teacher, were conducted to discuss the effectiveness of the workshop and how teachers were prepared to go and apply the skills in their teaching sessions at the same time to be able to train other teachers. The same interview protocol was used in all the three interviews for the purpose of triangulating the data.

Data Analysis

Data for the first and second research questions were analysed based on the six steps of thematic analysis given by Braun and Clarke (2006) to generate themes from the open responses from teachers. Analysis involved the researcher and one research assistant who was familiar with data analysis. Transcription of the audio was done to convert the audio file into text. Re-reading of the data was done to ensure that the researcher and the research assistant were familiar with data. Codes in each case were finally developed, categorized, refined and renamed. These produced themes that were finally compared between the two results from the researcher and research assistants. This was done to ensure reliability of the themes generated. The same analysis technique was used to analyse the responses from participants for research question four. The themes obtained are as shown in Table 4.4.

For the third research question, frequency analysis was deployed to analyse the responses of participants to the open question on how they could transfer the knowledge they gained from the workshop. Results are shown in Figure 4.4.

Results and Discussion

Result 1: Teachers' Learnings from the Workshop

Results from the analysis of open-ended questions at the end of the workshop revealed a number of learnings that teachers had gained. Apart from gaining ability to use some technology tools such as PowerPoint presentation design and searching for teaching resources from YouTube, teachers thought on how to use technology tools to help students with special needs. Table 4.3 gives the details of the themes generated and sample quotes from the teachers.

Table 4. 3: Learnings from the Workshop

Theme	**Examples of Quotes from the Participants**
Use of PowerPoint	"I have become more fluent and interested in using ICT integration than I used to be before the workshop. Some advancement has been attained in using PowerPoint and internet for teaching".
Use of different technology tools	"Before I joined the workshop, I was unaware of some tools like filtering YouTube materials, Google forms and making a proper PPT for teaching. Recently, I can do them and make it useful in teaching"
Searching for Internet Resources	"I am able to download teaching and learning resources from different websites as well as preparing teaching and learning activities such as preparing in PowerPoint presentations"
Implementing Inclusion in the class	"I am now able to create digital storytelling, a tool which makes students active and love the lesson. It also improves the performance for students as well as understanding the lesson. Digital storytelling is the best way that helps to make video that comprises multiple interest of learning because it helps even students with special needs. With a video, you will be able to fulfill needs for students with disabilities and the normal ones at the same time. For example, those with hearing problems can watch and read the subtitles; those with eye disability can listen; etc."

Table 4.3 gives the responses of the teachers after the workshop. It is interesting to note that, teachers thought of different ideas that can be implemented using ICT. One example is on the use of digital storytelling to fulfill the needs of special students in the classroom.

Result 2: Perceived confidence to use technology tools in teaching and learning

A big number of teachers who participated in the workshop had never participated in any training before. Three teachers were randomly selected to participate in the interview to answer a set of questions. This semi-structured interview consisted of 6 questions. One question from the interview asked the interviewees: "How will you use the knowledge from this workshop?" The teachers responded differently on how each was planning to use the knowledge. One teacher said:

> *"....instead of using formal methodologies of asking students if they have understood and they just provide a call answer that "Yes, we have understood", I can now use Mentimeter so that each student can give feedback if the lesson was well understood or not*".

This teacher appreciated the contribution technology can offer in the classroom. Using technology, teachers can be able to engage students in activities, thus making them retain what they are taught.

Another response from the interviewee was:

> *"Initially, I was able to prepare a PowerPoint presentation, but it was not a very well enriched presentation. Now, I am able to put even animation, including video clips within the presentation*".

This showed that teachers had gained knowledge on some tools and were ready to change their ways of teaching to incorporate technology for achieving the intended learning goals.

Result 3: Teachers' perception of transfer of knowledge from A2I model-based workshop into their contexts

Participants of the workshop were asked about the ways in which they had been able to use knowledge from the workshop into their own school settings. There are many ways they transferred their learning. Figure 4.3 depicts a summary of their responses from their submissions.

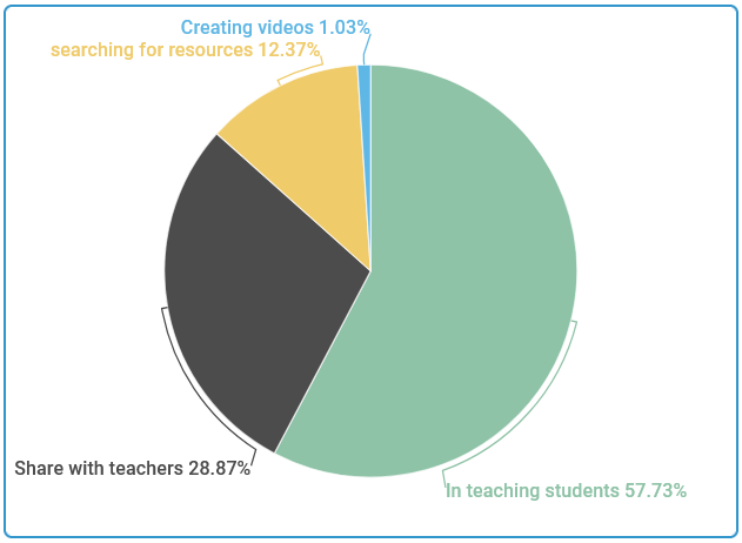

Figure 4. 3: Participants' perception for knowledge transfer in schools

From Figure 4.3, over half of the participants (57.73%) transferred knowledge more into their teaching and learning. This was evident in the response of one participant, who responded:

> "*I have used it; it was like knowledge of obtaining materials from internet, preparing good learning and teaching materials using PowerPoint in a good way. Also, I have applied mentimeter and padlet in getting feedback*".

As they returned back to their schools, participants (teachers) shared their experiences with fellow teachers to improve their teaching with technology. One of the participating teachers said, "*I became a good example in using ICT to teach mathematics and English*". This inspired other teachers on the power of technology in the teaching and learning of all subjects.

Result 4: Challenges to the transfer of teacher training in schools

Thematic analysis of the feedback survey from 15 teachers who responded evolved different factors that were suggested by teachers as factors that may hinder effective training in ICT. Table 4.4 shows the challenges that they may face as they go to train other teachers back in their schools.

Table 4. 4: Emerging Themes on the Challenges

Theme	Description
Inadequate enabling	Poor access to electricity, computers and Internet

infrastructure	connection
Lack of motivation to participate	Some teachers are not willing to stay after work hours, need payment to participate in workshop
Altitude to change	Some teachers think that this is another work load on teaching, not ready to learn about ICT
Time limitation	Busy teaching schedule, fixed school timetable, work related duties

The challenges given in Table 4.4 are both internal and external to the participants. Motivation is key to ensure transfer happens. Planning for transfer is important before the workshop starts. Kemerer (1991) hints out on three strategies that can promote transfer: structuring expectations, improving skills and establishing rewards. The three factors can help in minimizing the challenges found out by teachers.

4.2.6 Reflections from Iteration 1

From Study 1, all the teachers participated as learners in the workshop. They followed up the sessions and participated in activities as required by the master trainer. Some observations were collected as follows:

Observation 1: Evaluation of their submitted lesson plans showed that some participants were not able to effectively integrate ICT in their lesson plan. In some lesson plans, it was not clear on why a technology was used and how it achieved the learning objective. Learning objectives, learning activities with technology integration, and assessment were misaligned.

Inference: This indicates that the design of the next iteration would need to include components that would help participants in ensuring effective integration of technology in their lesson plans. Presentation of the developed lesson plans and feedback from peers and master trainer were key design considerations for the next iteration. Feedback from presentations would help in improving alignments of the different components of the developed lesson plan.

Observation 2: Evaluation of workshop feedback form found out that participants requested for more practice with more questions to be added; inclusion of simple and known examples

in the presentations; and individual assignments to help in practicing what they learnt during the workshop.

Inference: This means that Iteration 2 need to add more activities to engage the participants and more questions when using the technology tools (mentimeter and padlet).

Again, the following two points were noted:

i) *Readiness for professional development opportunities:* Participants were ready to use the available opportunities that aimed to enhance their teaching and learning practices. This is evident from the 19 participants who joined the session after seeing invitations shared in different teacher networks about the scheduled ICT workshop. One participant made it clear that:

> "*My way of teaching has changed since I have acquired new ways of teaching and integrating technology and different ways of getting feedback from students such as mentimeter and padlet, and the way of preparing learning and teaching materials from internet*".

This meant that participants were willing to change their teaching practices.

ii) *Sharing with other teachers:* While some participants managed to share the experiences with other teachers, others did not manage to do so. There are many reasons associated with this as highlighted by participants. Some of the challenges they shared include :

a) Scarcity of ICT infrastructure: Some schools have computer labs with few computers, Internet connection to some schools, and a technician to repair the ICT devices in the lab.
b) Administrative support: In few schools, the administration does not encourage teachers to learn and use the available ICT infrastructure to improve their teaching and learning practices.
c) Time factor: Due to the teaching schedules of teachers in schools, trained teachers do not get enough time to be able to share with other teachers. It is important to see how best scheduling can be done locally to allow sharing of the gained knowledge.

Inference 1: The three points were challenges that were outside the scope of the research and hence added as options for future research work. For the next study, participants from schools which had the enabling environment for ICT integration were selected.

Inference 2: To ensure that teachers can have a solid content knowledge, the most active and those motivated to learn more about how ICT need to be selected and encouraged to join the next workshop.

4.3 Cycle 1 - Iteration 2

Iteration 2 was implemented from the two inferences emanating from the reflection in Iteration 1. Two goals were set during Iteration 2:

i) To develop and engage participants as learning assistants; and
ii) To introduce collaborative teaching strategies to improve technology integration in teaching and learning.

4.3.1 Refinement of A2I Model – Extending it to A2IT

The reflections from Iteration 1 implied that some refinements needed to be done to A2I. In this case, two modifications were suggested on A2I model as shown in Table 4.5.

Table 4. 5: Refinement of A2I Model Leading to A2IT

Refinement Needed	How it is implemented
To develop learning assistants	Selection of participants from Study 1 to join Study 2
To improve integration of ICT in the lesson plan	Introduction of microteaching sessions

Selection of Study 1 Participants to join Study 2 as Learning Assistants

The cascade model aims at engaging some or all participants as trainers. This means the master trainer and secondary trainers need to have some desired skills to train others. Mormina and Pinder (2018) hinted on some criteria they used to select both types of trainers

for implementing their intervention. Selecting secondary trainers involved features such as enthusiasm to train, communication skills, competence and commitment. In our case, some participants who completed Study 1 were selected to join Study 2 to ensure that they had enough content knowledge that that was important to transfer training into other contexts. Some participants did not complete Study 1 requirements because of different reasons such insufficient infrastructure in schools (lack of computers, Internet and electricity); some teachers in schools were rigid to accept a non-paid workshop; and large classrooms with many students. To join the next workshop, a number of selection criteria were followed:

i) Those who had participated in Study 1;
ii) Those who had managed to use the knowledge from CW1 into their contexts;
iii) Intrinsic motivation for participating in CW2 (focusing on interest in learning, application of knowledge); and
iv) Knowledge of ICT tools in teaching and learning (knowledge of some computer applications).

From the total participants of CW1, 11 teachers met the criteria and were selected to participate in the next workshop, CW2, as learning assistants (LAs).

Strategies for Holistic Development of a Teacher

Evaluation of the implementation of A2I model in CW1 showed that some participants were not able to clearly integrate technology tools not only in the developed lesson plans but also during presentations. The following reasons were identified:

i) Missed alignment of technology affordances to achieving the intended learning objectives;
ii) Challenges in setting up a learning activity that involves technology, e.g. improper setting up of a word cloud question on Mentimeter; and
iii) Missed chance of peer learning and collaboration from the rest of the workshop participants, that is, participants from other groups.

Different collaborative teaching strategies were studied to identify the optimal strategy to apply that could engage teachers in integrating technology in their lesson plans while at the

same time receive feedback to improve their presentations. Three suitable strategies are co-teaching, lesson study and microteaching. The details for each strategy are given as follows:

i) Co-teaching

Co-teaching is one strategy that was analysed for suitability in teaching and learning. Bell (2007) defines co-teaching as a strategy that involves two or more teachers to deliver instructions to a diverse group of students. It is also called team teaching. While one of the teachers is a general education teacher and a subject matter expert, the other teacher (s) can be special education teacher (s) depending on the setting. Teaching takes place in different approaches: one teacher, one assistant; station teaching; parallel teaching; alternative teaching and team teaching. One of the challenges of implementing co-teaching is that it takes time for coordination of all the activities for a lesson (Chitiyo, 2017). The same content and teaching are done in one session. Since co-teaching involved teaching the entire lesson within the same lesson time, it was not adopted for this purpose.

ii) Lesson Study

Lesson Study (LS) is an approach in which teachers work together to plan, develop and conduct a lesson; while one teacher collects evidence on students' learning (Lewis, 2009). LS involves setting goals from students' needs; developing lesson plans; teaching phase by one team member while others observe and collect data; and debriefing from the results of the data collected.

Even though lesson study has advantages such as professional development of teachers and the peer-learning (Espinosa et al., 2018), implementation of lesson study has some challenges. Some of the challenges include more time is required when planning a lesson, and the need for more than one teacher to teach a lesson (Kanellopoulou & Darra, 2019). The challenges of time to complete activities become a hindrance to the use of lesson study to improve technology integration in teaching and learning.

iii) Microteaching

Microteaching is a teaching technique that allows teachers to apply well defined teaching skills to a well-designed lesson in a short time compared to the normal lesson duration (Allen, 1967). This technique uses a small group of students who have an opportunity to observe the

session as it is being conducted. This technique allows for diagnostic evaluation of their knowledge shared by their colleagues, supervisors and participating students.

In this research, microteaching was adopted and implemented by grouping participants into 4-5 teachers per group. The group consisted of teachers from the same domain or those sharing teaching subjects. Each group worked on the lesson as follows:

Teachers from the same domain work collaboratively on an ICT integration activity. They select a 20-minute topic to work on. They create a technology-enhanced lesson plan **(Appendix M)** showing all the components from A2I phases (LO, IS, activities, AS) using a sample lesson plan template shown in **Appendix A**. They operationalize Step 2 in a PowerPoint presentation in which one of the group members conducts a microteaching lesson for 15-20 minutes while the rest of the participants become "students". The group receives feedback from the Master Trainer and participants.

The inclusion of the microteaching session led to the addition of another phase to the A2I model. The new phase is Teach (T) Phase and involves microteaching sessions for participants of the workshop. This was implemented in different workshops and evaluated according to the different research questions that were set.

Teach Phase in the A2I Model

In this case, the Teach Phase was added, focusing on allowing participants to implement and teach a technology-enhanced topic to other participants. Table 4.6 shows the addition of the Teach phase to the A2I model. The new model is now A2IT.

Table 4. 6: A2IT Model - Teach Phase Added

	Attain	**Align**	**Integrate**	**Teach**
Goal	Introduce participants to the idea of student-centeredness	Align strategies with student learning goals while using tech	Technology integration design through constructive alignment of IS, LO and AS	Teach a technology integrated topic to participants
Coverage	Introduce the 4	Increased depth	Depth is the largest	Depth is on

	components: IS, LO, AS and tech	in coverage of contents		technology tool
Nature	Instructor-driven	Participant driven for mastery (individual)	Participant-driven (Collaborative)	Teacher - Driven
Participant	Active learner	Practices individually	Works on a collaborative activity to integrate technology in a lesson they teach	Collaborative planning, design and teaching

4.3.2 A2IT Implementation through CW2

Instructional Goal: Each participant will be able to integrate ICT in his/her lesson plan and teach a 15-20 minutes lesson.

Research Goal: To engage learning assistants in managing activities during a workshop session taken by the master trainer.

CW2 Details

Even though teachers had perceived that they were confortable in using the tools, the aim was to improve their pedagogical knowledge to train so that they could train teachers effectively. The workshop was conducted in June 2019 at two different training schools. The first was held at Kola Hill Secondary School, in Morogoro, from June 11-14, 2019. The second workshop took place at Dodoma Secondary School in Dodoma region, from June 28-30, 2019.

During preparation for this study, ways to minimize the challenges of implementation of teacher training sessions in schools were sought. Workshop participants were encouraged to meet the following conditions:

i) To come from a school with a functional computer laboratory for practice after the workshop; and

ii) Upon receiving the letter of invitation, they were encouraged to come with a letter of notification from the Head of School. In case when the participant was the Head of school, he/she was required to show motivation and commitment to propagate the change.

4.3.3 Evaluation of A2IT through Study 2

Research Questions

The following were the research questions in this study:

i) How well are teachers aligning technology to the learning objectives during microteaching?
ii) How confident are teachers in technology tools in their teaching practices and sharing with other teachers?
iii) How do teachers perceive the role of a microteaching session in teacher training?
iv) What modifications to the model would make effective transfer of workshop content to other teachers?

Sample and Sampling Techniques

There were a total of 26 school teachers from Morogoro and Dodoma regions. The training was conducted at Dodoma Secondary School, in Dodoma region. Again, purposive sampling was deployed to invite participants to the study (an invitation into different teachers' networks). One of the conditions to join was that each participant should have a laptop and his/her school should have a computer lab. This was made so in order to ensure that teachers could practice what they learned after the workshop. They came from a total of 20 different adjacent schools, majority of them teaching ICT, English, Geography, Kiswahili, Maths, and History. Majority of the teachers had 6-15 years of teaching experience, with an age range of 21-40 years.

From CW1, another purposive sampling was performed to select 11 participants to join this workshop, CW2. The 11 participants had to meet specific criteria as detailed in Section 4.3.1. This made a total of 37 participants in CW2.

Training Plan

CW2 was conducted for 3 days, each day consisting of 6 sessions each of one hour of training. Table 4.7 shows the topics and the day in which the topic was covered.

Table 4. 7: Schedule of the Training Sessions during CW2

Day	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
Day 1	Introduction to ICT in Teaching and Learning	Introduction to ICT in Teaching and Learning & L	Introduction to Padlet	Creating Padlet questions	Padlet integration in teaching and learning	Padlet integration in teaching and learning
Day 2	Introduction to Mentimeter	Creating questions in Mentimeter	Mentimeter in teaching and learning	Mentimeter in teaching and learning	Integration and Presentation	Integration and Presentation
Day 3	Effective PowerPoint Presentation	Effective PowerPoint Presentation	Effective PowerPoint Presentation	Effective PowerPoint Presentation	Workshop evaluation	Workshop Closing

Data Collection Instruments

To collect data during the workshop, different instruments were used. *Classroom observation protocol* (**Appendix B**) was developed and used by researchers to collect data about the structure of the lesson, interaction between the teacher and students, interaction among students, technology integration and use of other available resources. A total of 6 sessions (arranged in 6 groups) were observed and observations recorded.

Microteaching assessment rubric (**Appendix D**) was employed during microteaching sessions to assess the levels achieved in creating LOs, setting up activities, instructional strategies used and assessment strategies used to ensure that the LOs had been achieved.

Group participants used a *Group Reflection Summary* (**Appendix E**) to summarize their observations and the feedback they received from the 'students' highlighting the areas that needed improvement, the feedback received and how it was implemented in the lesson plan.

An exit survey was used to collect data. Finally, two focus group discussions were conducted focusing on questions related to the implementation of the model and its phases during the workshop and how the phases could be improved to increase effectiveness of the cascade process.

Evaluation form adapted from Kirkpatrick blended evaluation form was used to evaluate the two levels of training evaluation: reaction and learning, at the end of the workshop (J. D. Kirkpatrick & Kirkpatrick, 2016). Microteaching sessions were video-recorded by the research assistant for use during analysis and to recall the sessions later for detailed analysis of each session. Recorded videos were used as another source of data for triangulation of what was collected during the session itself. Frequency analysis was used to analyze data from workshop entry surveys.

Data Analysis

Data were analysed from their technology-enhanced lesson plans and classroom observation protocols to look into how teachers used integrated technology in their teaching practices. Data from observation protocols were collected by the researcher and the research assistant and compared for reliability. In this case, the main technology tools that were expected to be integrated into their lessons were mentimeter and padlet since they were familiar to them. A close comparison was made between the teachers' technology-enhanced lesson plans and the classroom observation protocols from six (6) groups, especially how the technology tool was used to achieve some or all of the stated learning objectives.

Video recordings were previewed to ensure the same actions and observations were perfectly recorded. Each group consisted of 2-5 teachers grouped based on their subject domains. Exit surveys were used to collect data on perception of learning the content (CK) from the workshop. Interviews and focus group discussions were used to collect responses to RQ3.

Results

Result 1: Aligning technology with the learning objectives during microteaching

From the frequency analysis of the submitted technology-enhanced lesson plans of 6 groups and the observation protocols that were used when taking microteaching session, as shown in Table 4.8, 4 of all the 6 groups were able to reflect well the two technology tools into their

lesson plan and demonstrate during their microteaching session. The remaining 2 groups managed to create questions using technology but faced challenges in either displaying results or selecting the right question type to set in the technology tool and receive a response.

Table 4. 8: Summary of Technology Integration during Microteaching Sessions from Different Groups

Group	Topic	Learning Objective	Technology	Question asked	Challenges
G1	Whole Numbers	1. Identify even, odd and prime numbers 2. List all even and odd numbers between 1 and 30	Mentimeter	1. Identify even, odd and prime numbers between 1 to 30 2. Which of the following is not a group of prime numbers? A) 2, 3, 7 and 11; B) 2, 5, 9 and 17; C) 23, 31 and 37	No
G2	Reading Literary Works	1. Read literary work in Chapter 1 2. Analyze characters in Chapter 1	Mentimeter	Provide one characteristic of each character found in Chapter 1	No
G3	Word Processing	1. Define Word processing 2. Outline the procedures for starting and ending MS Word program 3. Start and close MS Word program	Mentimeter	1. Define Word processing 2. Outline five procedures for starting and ending a word program	Improper setting of question on b). Word cloud vs. open-ended question
G4	Solar System	1. Define solar system 2. Identify components of solar	Padlet	1. With examples, outline three areas in which Geography relates with other disciplines	No

		system		2. Mention at least 5 new vocabulary you have gained from the lesson	
G5	Preparation of Oxygen	1. Meaning of Oxygen 2. Preparation of Oxygen using H_20_2 3. Analyze physical and chemical properties of Oxygen	Padlet	1. What do you understand by oxygen? 2. What are the physical and chemical properties of oxygen?	No
G6	Kitenzi	1. Maana ya Kitenzi Kikuu 2. Matendo yenye Vitenzi Vikuu	Mentimeter	1. Unaelewaje kuhusu kitenzi kikuu? 2. Angalia picha na andika kitenzi kinachofanyika	Challenge in displaying the responses in a) and b)

Result 2: Perceived teachers' confidence in using technology tools and sharing with other teachers

Data for RQ2 were collected using entry and exit surveys and analyzed to look into the frequencies of responses. All the 20 participants stated their confidence to use technology tools (mentimeter, padlet and PowerPoint presentation) in training other teachers. Before the workshop, participants knew less about padlet whereas they knew more about PowerPoint presentations. The confidence to train other teachers on PowerPoint presentation was the highest after the workshop. This is in line with the fact that most frequently used technology tools are those teachers will be more confident in them (Lim et al., 2012). This is due to the fact that some teachers had prior knowledge of using PowerPoint in teaching and learning. Figure 4.4 depicts the perceived confidence in using mentimeter, padlet and mentimeter in teaching and learning and in sharing with others.

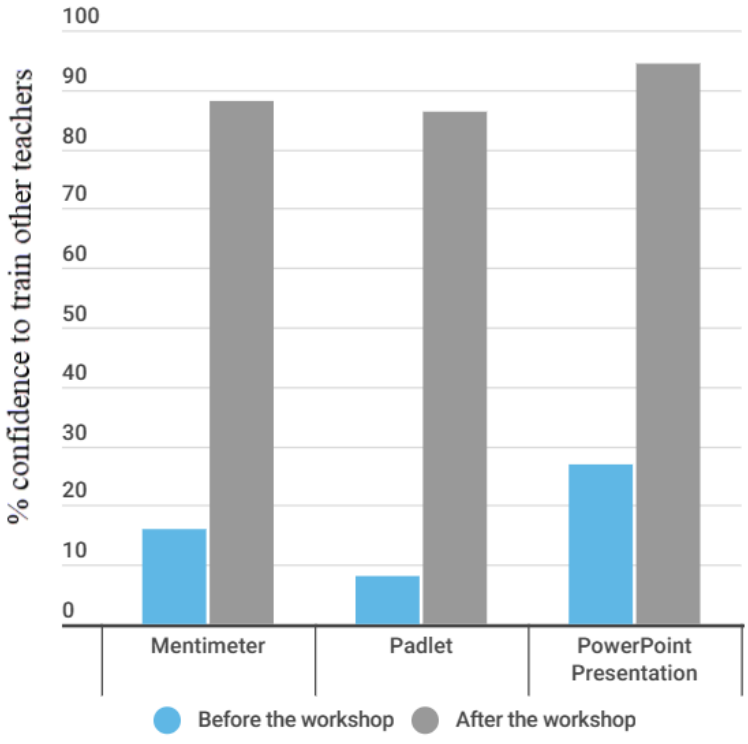

Figure 4. 4: Perception of participants in using technology tools in teaching and in training other teachers

Result 3: Perception of the role of microteaching session to participants

This research question aimed at examining the role of microteaching sessions taken up by the participants in Study 2. The question asked participants as follows: *"During the workshop, one participant from your group got some 20 minutes to teach a topic you all had developed. What did you learn during this teaching session? [Write in at least two sentences]".* Responses are as shown as themes in Figure 4.5.

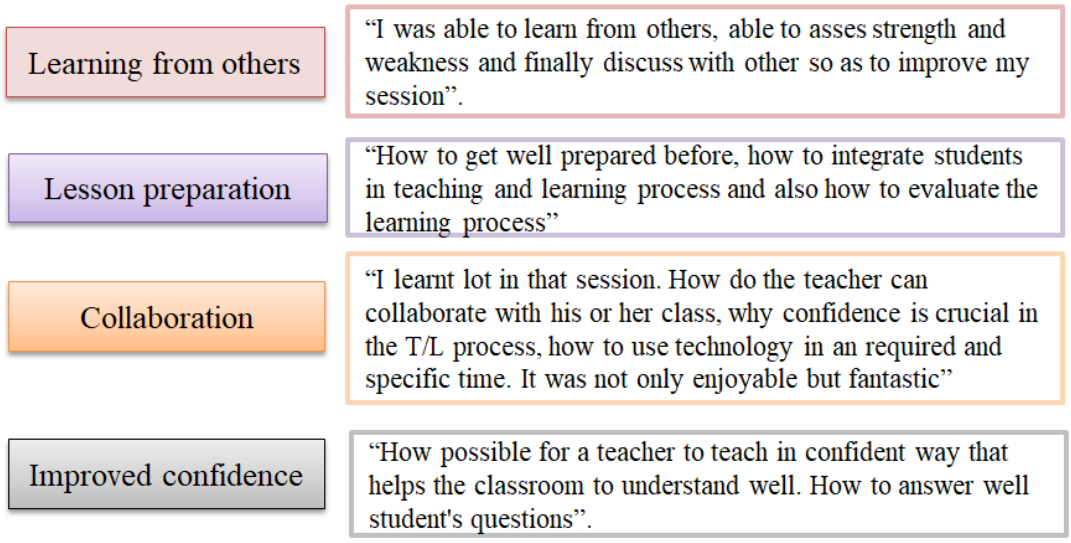

Figure 4. 5: Importance of microteaching to workshop participants

Result 4: Suggestions to the modifications of the A2IT model

The interview and focus group discussion responses were analysed using thematic analysis to identify the emerging themes to inform the research questions (Braun & Clarke, 2006). The unit of analysis in this case was taken to be the paragraphs from each of the respondents. In the first place, transcripts were generated from the video files. After re-reading the generated transcripts and familiarizing with the flow of responses, responses for each research question were identified. Repeating keywords or codes were identified and highlighted. The long list of codes generated was then categorised to generate themes from codes that had similar meaning. At this stage, the themes that were alike were merged to form one more meaningful theme. Some codes that emerged but not relevant to the research questions were dropped. The final three themes and sample voices from participants are shown in Table 4.9.

Table 4. 9: Suggested Improvement to the A2IT Model

Theme	Teachers' voices
Improve Confidence	"Teachers are required not to fear teaching their classes wherever they get chances to do so. Teachers are required to adhere to and participate in teaching wherever they are required without fear or feeling shy"
Participant's feedback	"Participants should admit their strengths and areas of improvements openly because in most instances people tend not to admit their shortcomings"
Time management	"Time management should be adhered to by every presenter from groups"

4.3.4 Reflections from Study 2 (CW2)

Confidence of the teacher trainers is one area that participants put emphasis after Study 2. Table 4.10 provides some insights that focus on improving the teacher training and developing the model. These inferences aided in improving the next Cycle.

Table 4. 10: Improvement to the A2IT2 Model

Findings	Inferences	Connection to the next Cycle
Teachers are motivated to learn more about technology tools	Workshops related to technology integration in teaching and learning are encouraged	The next workshops to integrate technology in teaching and learning
Participants learnt from master trainer and their colleagues to improve their lesson plans. One	Feedback provided was relevant to	Continued feedback and mentorship are

participant said: "…*When playing my video clip before the audience, one of the feedbacks I had received suggests that my video explains how to teach instead of teaching. I have appreciated that kind of feedback*"	participants	important during the co-teaching and training sessions by the developed teacher trainers
Transfer of training: Many teachers expressed that they were planning to share what they had been able to learn from the workshop in two ways: 1) using the knowledge and skills obtained in teaching their lessons in the class and hence improving their teaching and learning practices; and 2) to share the knowledge and skills with their colleagues (teachers) in their schools.	This implies that school leadership needs to support such initiatives from teachers	This helped in the design of micro-teaching sessions during co-training sessions.

Chapter Five

DBIR Cycle 2

Chapter Four covered DBIR Cycle One. In this Chapter, a continuation is made to discuss about DBIR Cycle Two. Like in Chapter Four, there are two iterations in this Chapter: Iterations 1 and 2 that are presented in Sections 5.1 and 5.2. Section 5.3 presents reflections from Cycle 2. A summary of the theoretical basis of A2IT2 model is given in Section 5.4.

Cycle 2 focused on the following goals:

i) To refine A2IT based on reflections from Cycle 1;
ii) To impart important teacher training skills to learning assistants;
iii) To engage learning assistants into micro-training and full training sessions; and
iv) To evaluate the final model through a study.

Figure 5.1 shows the different iterations of DBIR Cycle 2 with all the associated components and evaluation studies.

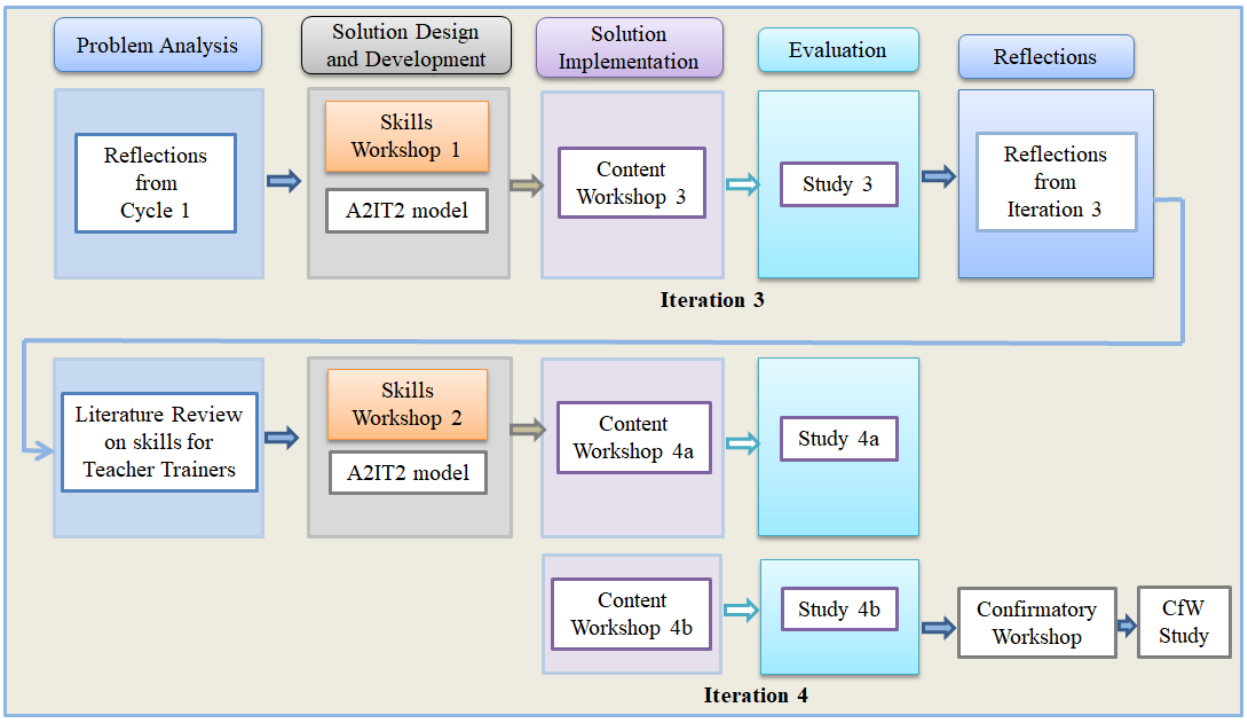

Figure 5. 1: The two iterations of DBIR Cycle 2

5.1 Cycle 2 - Iteration 3

This iteration involved refinement of A2IT model based on the reflections from Iteration 2. Details of the reflections and how each refinement was implemented are given in the sections that follow. In Cycle 2, Iteration 3 aimed at achieving the following objectives:

i) To impart the necessary teacher training skills to LAs that will allow them become co-trainers; and
ii) To conduct CW3 where co-trainers take up micro-training sessions to apply what they gained during the skills workshop.

5.1.1 Reflections from Cycle 1

Developing a teacher trainer involves not only knowledge of the subject area but also different skills that complete the whole process of teacher training. In DBIR Cycle 1, the teachers participated in two content workshops changing the roles from being learners becoming learning assistants (LAs).

Results from the data showed that the LAs need different skills that can make them competent at the same time be able to cascade the training to other teachers. The teach phase of A2IT model enabled teachers to collaborate while working on one topic as preparations to train participants on the same topic. This gave a chance to develop a lesson plan that is technology-enhanced to be implemented during the microteaching session. To other teachers, this was a session to learn from other peers and receive feedback from both the peers and the master trainer. The role of teaching session was to put into action what was presented theoretically, to give confidence to all participants on how to implement technology-enhanced lessons.

The feedback received from both the mentors and peers were used as a way to improve the developed lesson plans but at the same time to give confidence to the teachers on what it takes to ensure confidence is developed. One of the participants put it clear that:

> "*To build participants confidence through peer-reviewed feedback. I have seen participants received feedback in their first teaching session was improved to their second or third sessions. It was like learning by doing*".

As data from participants were analysed, the following were the findings:

Fear and shyness during microteaching: Some participants exhibited some fear to present in front of others. This is evident from the observation data as well as from the interview feedback:

> "*Teachers required not fearing teaching their classes wherever they get chances to do so. Teachers required adhering and participating in teaching wherever they are required without fear or feeling shy*".

Confidence: Teachers are confortable in teaching students. Teachers training other teachers need some preparations and competencies. One participant who doubted during presentations said that: "*Teachers need to be confident in what they are presenting*".

More facilitators during workshop: Training a group of teachers using one trainer is tedious and may not be productive. Participants get used to the trainer quickly and hence might get

bored. One of the participants of the workshop insisted that there is a need to have more facilitators, as he said: "*Having different facilitators per topic would sound good to participants*". This model paves a way to develop facilitators of such workshops.

Need for training skills: Teacher trainers need specific skills to ensure that they can plan, develop and implement a teacher training programme. Teaching children is different from training adults. Specific skills are needed to develop competences in teacher training.

The fear and shyness, and less confidence as participants took various sessions during the sessions prompted for the need to equip them with some training and facilitation skills. This was implemented during Skills Workshop 1 (SW1) to the 11 LAs. Completion of this stage helped to improve the skills of LAs as they took up a microteaching session during content workshop, CW1. Summary of the refinements is given in Table 5.1, while details of these workshops are given in the following sections.

Table 5. 1: Summary of Refinements to A2IT Model Leading to A2IT2

Area of refinement	How it was implemented
i) Less confidence, shyness of participants	i) Identify relevant training skills to improve training confidence
ii) Lack of teacher training skills	ii) Impart training skills to the selected LAs through SW1
iii) A2IT modification	iii) Practice training skills through a micro-training session

Review of Important Trainer Skills

The goals of conducting literature review on the important teacher trainer skills included:

i) Determining the skills, attitudes and attributes of effective teacher trainers; and
ii) Conducting a workshop to train LAs on effective teacher training skills and attitudes

To complete these training skills, a number of literature review questions (LRQs) were used while searching for the relevant skills. Table 2.2 shows the identified skills from different literature sources.

Analysis of these skills helped in planning and developing the skills workshops that aimed at imparting teacher training skills to the Learning Assistants. The skills workshops involved selected skill sets that were relevant to the teachers to become teacher trainers. The following section explains the first skills workshop.

Skills Workshop (SW1)

This workshop was done as a special workshop to equip learning assistants with important skills on how to conduct teacher training workshops. This was a 2-day workshop that involved the 11 learning assistants (LAs) who participated in CW2.

The main goal of SW1 was to equip LAs with important skills to become co-trainers. Three sub-goals existed:

i) To understand the participants of the workshop and the situations and contexts in their won schools;
ii) To introduce LAs to the observation skills which are required during teacher training sessions; and
iii) To find out the impact of CW2 to those who had some teacher training experience.

Design of SW1

The SW1 was designed as a blended workshop that involved two components: An online module and a face to face workshop, as shown in Figure 5.2. The details of these components are as explained in the proceeding sections.

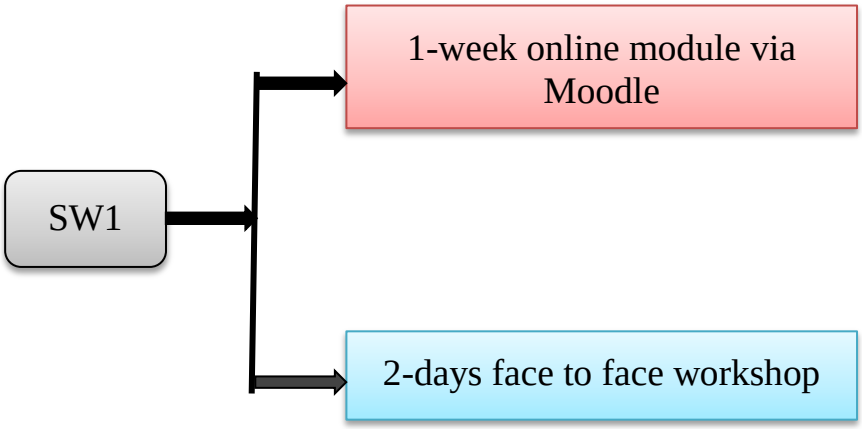

Figure 5. 2: Blended Training for Teacher Trainers during SW1

Online Module of SW1

This was conducted for one week from December 8 - 15, 2019 via Moodle Platform. Four activities were set for the LAs to work through. It was conducted online as participants were scattered in different locations; hence, it was easy to complete the activities on time. The activities and their goals are shown in Table 5.2.

Table 5. 2: Activities for Online Modules and their Implementation

Activity	**Goal**	**How it was done**
Activity 1: Summarizing the details of the previous participants from Workshop Entry Survey	To understand the participants of the workshop and the situations and contexts in their own schools	MT: Shared a checklist to help LAs summarize details of participants (Appendix G) LA: Used the checklist to create the summary from the entry survey

Activity 2: Given sample topics to be covered during the workshop. LAs to go through the workshop materials and make changes of what they would be able to do during the sessions	To familiarize LAs with the workshop content and how LAs can adapt it into their own contexts to meet the training needs of the participants in their own areas	MT: Shared a rubric to determine the level of content modification per topic selected (see Appendix F) LA: Used the rubric to create the summary from the entry survey.
Activity 3: Given a PI question LAs are made to decide whether the given PI question is an effective question or not	To ensure LAs can create engaging activities such as creating good peer instruction (PI) questions and explaining why the PI question you create is effective to engage training participants	MT: Created a checklist with features to determine an effective question (**Appendix H**) LA: Given a checklist with features of a good question to use in evaluating the created question
Activity 4: Given a video case of one of the previous sessions of teacher workshops and then to observe and reflect on the actions taking place	To introduce LAs to the observation skills which are required during teacher training sessions	MT: Shared an observation protocol to capture the level of interactions during the session (**Appendix B**) LA: Filled details about what he/she observed from the video scenario

All these activities involved going through them and submitting the given assignments and participating in the discussion forum based on their experiences. The LAs were required to respond to the posts and questions that might have been posted in the forum.

Face-to-face Session of SW1

The training was conducted for two days, from December 18 - 19, 2019. There were two sessions per day, morning sessions taking 3 hours and afternoon sessions taking 2 hours. SW1 was conducted on a face-to-face mode as it was convenient to meet during December holidays. This workshop emphasized LAs to think of questions/doubts that might be residing in the minds of the participants, to respond to participants' questions and to encourage participants to ask questions. The topics covered are shown in Table 5.3.

Table 5. 3: Topics covered during face-to-face Session of SW1

No	Topic	Objective (s)
1	Recap of the submissions of Online Activities	To discuss the activities and how they can help in the trainer development process
2	Introduction to Adult Learning Principles	Ability to apply principles of adult learning to training design and delivery
3	Planning, conducting and evaluating training sessions	• To understand the training requirements • To understand how to conduct and manage training sessions • How to evaluate training sessions using Kirkpatrick 4 Levels of Training Evaluation
4	The Review of the 4 topical areas to be taken by each LA during CW3	To get prepared for the topics each LA will take for CW3 workshop

	workshop	

SW1 Evaluation

Teachers are trained to develop competences in many areas. To become effective teacher trainers, many factors are involved, such as solid content knowledge and facilitation skills. This workshop was designed with the following research goals: 1) To understand how teachers develop skills of training over time; 2) to understand the skills developed during the transition from teaching to training; and 3) to understand the training designing considerations. These led to the following research questions:

Research Questions

SW1 aimed to find answers to the following research questions:

i) How do LAs perceive the usefulness of participant details?
ii) How effective are LAs in making observations?
iii) What is the experience of conducting training by experienced teacher trainers?

Sample and Sampling Technique

Participants in this workshop were teachers who met the entry criteria set in the Workshop Overview section. Eleven (11) teachers who were LAs in Study 2 were the participants of the workshop. Purposive sampling was deployed to invite the 11 participants to the workshop. This was because there was a need to develop their skills to be able to train other teachers during a micro-teaching session each was supposed to take during the next content workshop.

These were all males and majority of them had a teaching experience between 5-13 years, except two teachers who had 34 years and 1 year of teaching experience respectively. All of the teachers had varying levels of training teachers' experience, with 40% having trained teachers a number of times and with 60% of all the participants having trained teachers a few times respectively.

Data Collection Instruments and Procedure

In this workshop, more than one data collection techniques were used for gathering information, since no single research technique is self-sufficient (Cohen, et. al., 2000; Punch, 2009). The following section explains how each of the tools were developed, number of sections, questions, etc. Different tools were used to collect data. These tools are described in the sections that follow.

Checklists

The online module consisted of four activities that were submitted as assignments. For the online activity, data were collected using Moodle Platform itself by collecting all the submissions. Two checklists were created: one to determine the demographic details of the learners and the other to determine an effective peer instruction question that was created and submitted. The target was to look into the entry criteria of the workshop participants. For the face to face sessions, different tools were used. To determine the peer instruction (PI) questions created by participants, a checklist was used. It consisted of four expected features of a PI question used to compare to the submitted question. This is given as **Appendix H**.

Observation Protocol

To determine their workshop design skills when given a case, a group activity was given where presentation was done. This observational protocol (**Appendix C**) consisted of observational details such as questions from the trainer to participants; responses from the participants to the trainers; and the nature of feedback from the trainer to the participants.

A checklist was used for Activity 1 to collect participants' details including demographic data; computer and internet infrastructure in schools; and motivations to join the groups. Participants were also required to explain the usefulness of the data for Activity 1.

Interview Protocol

To collect data about skills needed to become teacher trainers and how school teachers make transition from teaching to teacher training, an interview protocol was created for both one-to-one and a focus group interview. The interview protocol was designed to meet the needs of the research questions. It consisted of four questions.

Validity and reliability testing of these data collection instruments was done. Face validity was established by refining the instruments three times after discussions with two experts in teacher education to ensure that they measured the expected parameters.

Data Analysis Procedure

Data from the workshop, W3, were analyzed using different approaches. Analysis of online submissions from the four Moodle activities was done based on the rubric and checklist that were prepared and shared with the participants. The rubric consisted of four aspects with three evaluation levels as seen in **Appendix I**. Checklist consisted of six aspects that needed responses from the participants (**Appendix G**). For face-to-face interviews and focus group interviews, thematic analysis (Braun & Clarke, 2006) was used to determine the themes emerging based on the research questions. For the open-ended questions, content analysis was employed to analyze the data.

Results

Based on the data collected, the results of the analysis of the data are given per each research question as follows:

RQ1: LAs perception of the usefulness of participant details

Activity 1 required LAs to give explanation as to why participants' details were important in the design of the workshop. Responses from the open-ended question were analysed and themes presented in Figure 5.3.

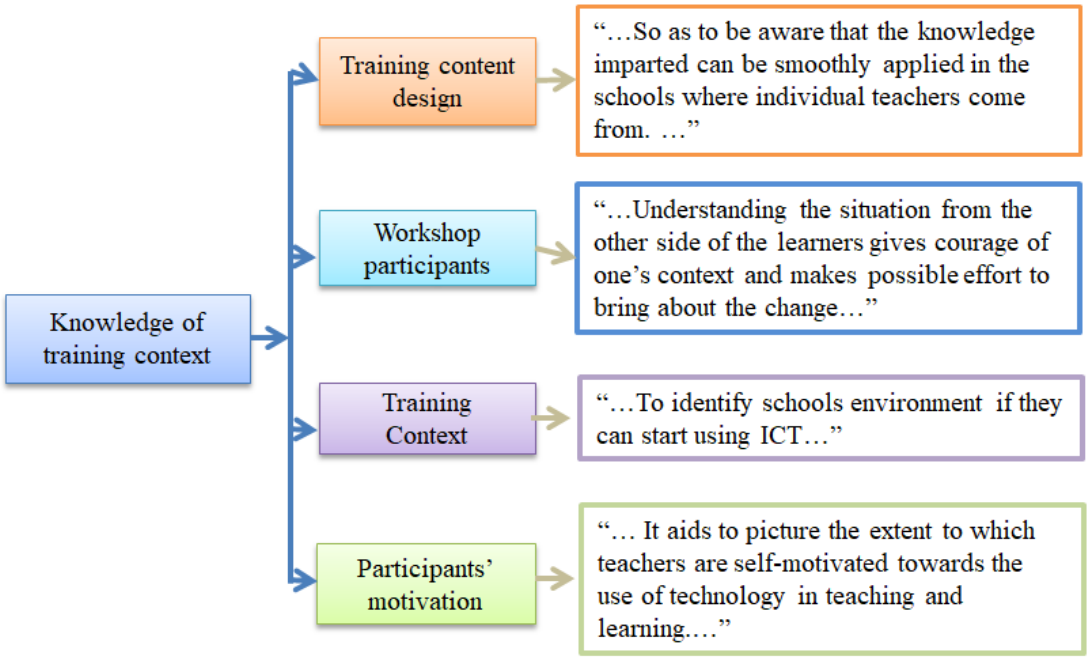

Figure 5. 3: LAs reflections on the importance of knowing participants' details

LAs stated that the details were required so that content designed for the workshop can be relevant to the context of the participants. Sufi et al. (2018) insisted on asking participants about their contexts including their confidence to work with technology tools. The details also help in knowing whether the school environment is ready to start implementing some innovative practices to improve teaching.

RQ2: *Effectiveness of LAs in making observations*

Data for this question came from the observation protocol as LAs responded to the open questions to what they were observing from the video shared. The observation protocol consisted of four sections covering:

i) Question from the Trainer to Participants
ii) Response from the participants to the trainer
iii) Feedback from the Trainer to the Participants
iv) Trainer observations

For the section on "Trainer Observations", some of the observations from the video were recorded as follows:

"…I would advise trainer to ask more interactive question and specific questions…"

"…The trainer was supposed to go around the class to attract attention to the trainees…"

"…Instead of only explaining since the area/class has desktops he was supposed to show the Microsoft word and Microsoft excel application software…"

It is evident that LAs were active in making observations from the video and this makes the basis of good observation of what happens in the workshop session.

RQ3: Experience of conducting training by experienced LAs?

Some of the 11 LAs had teacher training sessions back in their schools. They engaged in training their colleagues on some specific topics for their professional development. This research question aimed at extracting their experiences based on the skills workshop (SW1) they had attended. Figure 5.4 shows the themes that emerged from the open responses to the question.

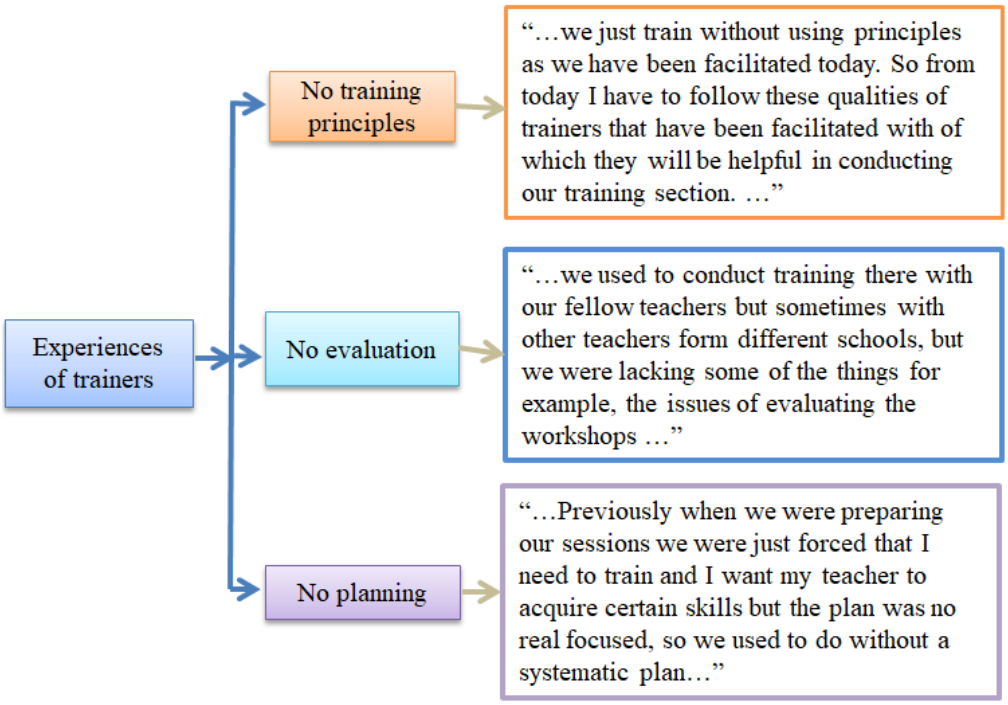

Figure 5. 4: Reflections from trainers about their previous experiences

SW1 consisted of a set of skills that LAs went through. Their reflections of the practices of their training sessions implied that SW1 helped them in realizing how best they can be able to plan and conduct teacher training sessions.

5.1.2 Refining A2IT Model: Extending to A2IT2 Model

Iteration 2 implemented A2IT model through the workshop CW2. Evaluation of the microteaching sessions of teachers in groups revealed that presentations from each group lacked some important components to engage teachers in the immediate application of the skills in teaching. This showed a need to incorporate training practices to the developing teacher trainers to have real-life experiences of engaging teachers as adults in learning. A2IT was refined by adding another TRAIN phase. This phase is detailed in the section that follows.

Train Phase in the A2IT2 model

The Train phase enables LAs to take up some sessions for a specified period of time. After their sessions, trainers receive feedback from the master trainer on how best to improve their sessions. Table 5.4 shows the details of the Train Phase (T). The new model is now A2ITT or A2IT2.

Table 5. 4: The Train Phase

Item	Train (micro training) Phase
Goal	• Practical implementation of specific portion of the training content
Coverage	• 35-40% of the training content • Specific skills
Nature of activities	• Content modification • Workshop planning, designing • Facilitating the session
Participant's role	Co-Trainer
Mastery level	• Content mastery • Content modification
Skills developed	• Participants analysis

	• Workshop planning, design and evaluation • Adaptation of content to context • Facilitation skills • Implementation (35-40%) of the content
Achievement	• Some training and facilitation experience

Transitioning from LAs to Co-trainers: Selection Criteria

Four co-trainers were selected among the 11 LAs who had participated in the SW1. Five criteria were set up for those who were selected for CW3 workshop as follows.

i) Prior teacher training experience
ii) Completion and submission of the four online activities
iii) Availability to train others during the next workshop
iv) Confidence level to conduct a small CW3 session (at least those who stated "very confident")

The following four LAs were selected to participate in CW3 as co-trainers (CTs) as part of the Train Phase of A2IT2. Table 5.5 shows the details of each of the co-trainers.

Table 5. 5: Co-trainers and their Characteristics

S/No	**CTs**	**Experiences**	**Availability for CW3**	**Confidence to conduct a small CW3 session**
1	CT1	He is a 10-year experienced school teacher. He teaches Biology and Chemistry at Farkwa Secondary School in Chemba District, Dodoma City.	Yes	Very Confident
2	CT2	He is a primary school teacher and head teacher at Kilombero Primary School located	Yes	Very Confident

		in Mvomero District, Morogoro Region. He had over 10 years of experience in teaching at the primary school level		
3	CT3	He had 10 years of experience teaching Maths and ICT at Kilangalala Secondary School in Kibaha District, Pwani Region, Tanzania.	Yes	Totally Confident
4.	CT4	He was a Geography teacher with over 10 years of teaching experience at Kiomoni Secondary School in Tanga, Tanzania. He had been training teachers for a number of years.	Yes	Very Confident

Co-Trainers Preparations for Co-training Sessions

As part of preparations, portions of the topics to be covered by the co-trainers were identified by the master trainer. Corresponding slides for each of the portions were sent to each of the co-trainers one week before the workshop. This went hand in hand with working on the presentations and adapting them to suit the needs of the audience they were going to train. They were also given access to the Google form with details of all the participants who had registered for the workshop.

Training of Research Assistants

The workshop involved three research assistants (RAs) in data collection process during the workshop. Their details are as below:

i) RA1: Bachelor of Arts with Education specializing in Linguistics and Kiswahili from St. Augustine University in Tanzania (SAUT), Mwanza, graduated in 2019. He was responsible for collecting observation data.
ii) RA2: Bachelor of Arts with Education specializing in Linguistics and Kiswahili from St. Augustine University in Tanzania (SAUT), Mwanza, graduated in 2019.

iii) RA3: Bachelor of Science in Multimedia Technologies and Animation, from University of Dodoma, 2018. He was responsible for video recording of all the sessions of the workshop.

RAs helped in running some research activities including data collection, collecting observational details, anecdotal details and multimedia data such as videos and pictures. To be effective in collecting data, RAs needed directions of what to do, how to do it and why to do that.

A day before starting CW3, the researcher met with the RAs for a briefing about what to be done, and the procedures to follow. RA1 and 2 were directed on the data collection instruments (observation and interview protocols and rubrics): when to collect which data and how to collect. They were also guided on how to manage filling of evaluation forms and online Google forms. RA3 was introduced on how to take videos and photos during the session, taking into consideration of what actions and events are appropriate to capture. Hints were given on how to position a video camera, collect videos of different sessions and photos of major events. These orientation sessions were very useful as they helped in collecting quality data for the research.

5.1.3 Implementation of A2IT2 through CW3

This workshop, CW3, was conducted for four days from January 13-17, 2020 in Mwanza City, North Eastern Tanzania. It involved 34 teachers from Primary and Secondary Schools as participants. The workshop was designed using A2IT2 model, including all the associated activities. Majority of the sessions were taken by the Master Trainer. Co-trainers were given some sessions to co-train as explained in the following section.

CW3 aimed at achieving the following goals:

i) To allow co-trainers to plan and conduct a teacher training session to apply the skills learnt during the SW1; and
ii) To improve the model A2IT based on the findings from the workshop sessions taken by co-trainers.

Sessions taken by the Co-trainers

A few days before the workshop started, each of the CTs was given a session to train. The same workshop resources as those used during CW2 were used here. They were required to adapt the resources to meet the requirements of the participants. They were required to use the existing topic materials and adapt them accordingly. They made the necessary modifications that were needed. Table 5.6 shows the session taken by each of the co-trainers.

Table 5. 6: Sessions Taken by each Co-trainer

Co-trainers' Initials	**Session Taken**	**Time Trained**	**Day**
CT1	Using Mentimeter in Teaching and Learning	90 minutes	Day 1
CT2	Creating Peer Instruction Questions	80 minutes	Day 1
CT3	Using Padlet in Teaching and Learning	90 minutes	Day 2
CT4	PowerPoint Presentations for Teachers	60 Minutes	Day 3

During the training, while one CT took the session, others were in the training room helping the participants in completing activities. The lead trainer and RAs observed the sessions of the TAs and took some observational notes. At the end of the daily timetable, TAs were given feedback on their sessions.

At the end of each day of the training, debriefing session followed in which a discussion about the content, the participants, and each other's training performance was set. This practice allowed for self-reflection and critique of each other's training session. The mentor also gave feedback of what worked well and the areas for improvement. The debriefing sessions also strengthened the working relationships and trust among the co-trainers and RAs and the master trainer. Building trust was essential to be able to receive and give feedback.

5.1.4 Evaluation and Reflection of Study 3

Sample and Sampling Technique

To conduct this workshop, school teachers were involved as participants. Mwanza City Education Director sent a request to heads of schools that had computer labs to select two teachers and be available for the workshop. The heads of schools were responsible for selecting two teachers from their schools to join the workshop. One of the criteria to join the workshop was that their schools had to have a computer laboratory. Another emphasis was put on the ownership of computers by the teachers. This was agreed so in order to ensure that they could practice what they were taught and also be able to complete some home works. A Google form was then shared to collect their demographic data. Of the 35 participants, 61.7% of the school teachers were males; 38.3% were females; and all co-trainers were males. Majority of the teachers (97.9%) had more than 4 years of experience with their ages ranging between 24-44 years.

Research Questions (RQs)

This study involved 3 research questions:

RQ3.1: What are the perceptions of participants on the session taken by a co-trainer?

RQ3.2: What are co-trainers' lessons from the sessions they took?

RQ3.3: What modifications do co-trainers need to improve their training sessions?

Data Collection Method

Data for this study were collected using two methods: observations and interviews with both participants and the co-trainers. An observation protocol was used during microteaching sessions to collect observations of the sessions taken by the co-trainers. It consisted of four keywords to be determined: enthusiasm, confidence in training, knowledge of the content area and mode of delivery (See **Appendix C**).

Data were collected using interview with sampled workshop participants and the co-trainers. Table 5.7 presents the tools and their connection to the research questions (RQs).

Table 5. 7: Data Collection Time, Method and Instrument per Research Question

Research Question	Time of Data Collection	Data Collection Method	Data Collection Instrument
RQ 3.1	At the end of the training	Observation during co-trainers session	Observation protocol
RQ 3.2	At the end of the training	Interview with co-trainers	Semi-structured interview protocol
RQ 3.3	At the end of the training	Interview with participants	Semi-structured interview protocol

Data Analysis Technique and Procedure

To analyse the three research questions, different methods were used. Data from the observation protocol were analysed based on the categories that were used to answer RQ3.1. For RQ 3.2 and RQ 3.3, thematic analysis was deployed in finding the themes that emerged. The six step thematic analysis by (Braun & Clarke, 2006) were used to define clearly the themes. The analysis started by reading and re-reading through the entire interview data that were collected. The next step was to generate some initial codes to start organizing data in meaningful groups. This step prompted the process of searching for themes by sorting the different codes into potential themes. The generated themes were then reviewed and refined. In another case, the transcripts of the interviews together with the research questions were coded by another teacher educator experienced in teacher training. This is done to ensure reliability of the generated themes. The agreement in the themes generated from the two coders is shown in the results section. The final agreed themes were then properly renamed to generate a list shown in Figures 5.5 and 5.6.

Results and Discussion

Result 3.1: Perceptions of participants on the session taken by a co-trainer

Results from the observation protocol analysis showed that the co-trainers did their best as they took their sessions. The four criteria were used to check how each co-trainer had scored. It was noted that the confidence of two of co-trainers was medium as they presented their lessons.

Looking closely into the data, it was found out that there was dependency on presentation slides on one of the co-trainers. While others engaged the class session, he focused mostly on one side, right hand side. As he was delivering his session, he involved less engagement with learners. Table 5.8 shows the results for each of the criteria used during the co-training session.

Table 5. 8: Co-trainer and their Performances for each Criterion

Co-trainer	**Enthusiasm**	**Confidence**	**CK**	**Delivery**
CT1	High	Medium	Excellent	Engaging but not engaging both sides
CT2	High	High	Excellent	Engaging
CT3	High	High	Excellent	Engaging
CT4	High	Medium	Excellent	Limited learner engagement

Result 3.2: Reflections from the co-trainers

From the data analysed during the focus group interview with all the four co-trainers, three themes emerged. They reflected on the knowledge they had gained during the different workshops and when delivering their sessions. They also insisted on the roles of both the team and the mentor. (Szűcs, 2018) insisted that self-evaluation and self-reflection are very important for a trainer. Reflections could happen at individual level, or in a dialog with peer trainers or in o-professional discussion with your mentor. Figure 5.5 shows the themes generated and the quotes from the co-trainers as they reflected on how the conducted their sessions.

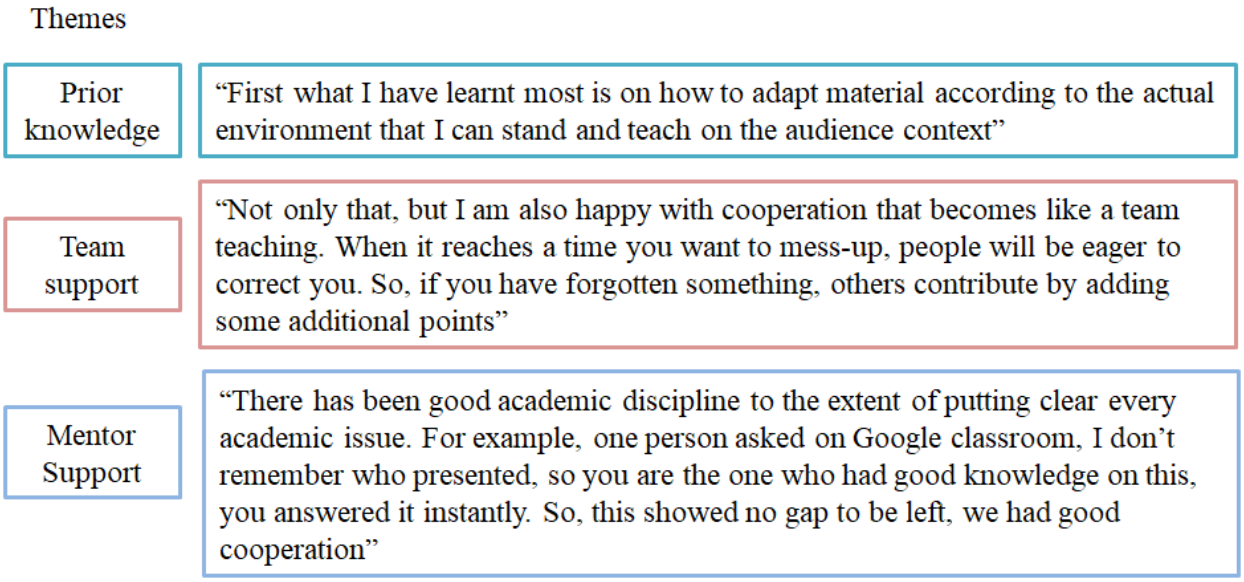

Figure 5. 5: What co-trainers learned from co-trainers' sessions

Result 3.3: Modifications needed to improve co-trainers sessions

Analysis of the one-to-one interview and one focus group interview showed that participants of the workshop gained knowledge and skills from the session. This was due to the fact that many of them (66%) had had a chance to attend only one teacher professional development session for more than three years ago.

When asked about their reflections on the sessions taken by each co-trainer, they gave their feedback and suggested what could be done to improve their sessions. The themes that emanated from the interview are shown in Figure 5.6.

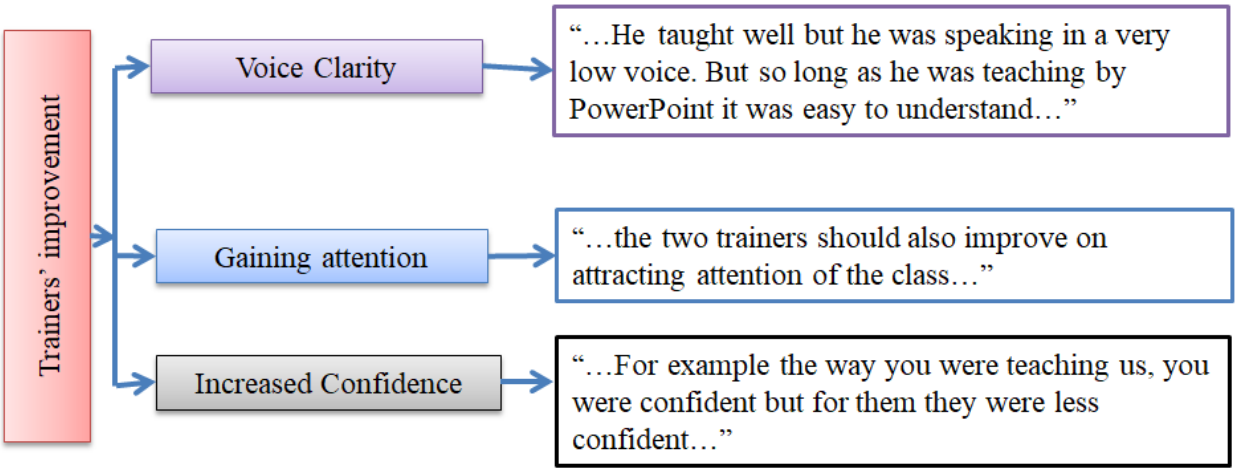

Figure 5. 6: Participants' suggestions to improve sessions by co-trainers

5.1.5 Reflections from Iteration 3

In CW3, the co-trainers took their sessions to train the participants of CW3. Results from the data collected from the interviews (one-to-one and focus group) and the observations made during the session gave the following reflections:

From the interviews, respondents showed a need for the co-trainers to improve on areas such as voice modulation. One of the interviewee stated that, "*He [co-trainer] taught well but he was speaking in a very low voice. But so longer as he was teaching by PowerPoint it was easy to understand*". On the other hand, there was a need to improve co-trainers confidence as they work with teachers to ensure that trainers are comfortable with the audience. Leong (2004) hints out that in face-to-face communication, 38% of the message comes from the tone of the trainer's voice; 55% from the body language; and only 7% comes from the actual words being spoken. This means that it is important to ensure that trainers can speak in a way that everyone in the training hall can hear well and the appropriate body language.

Observation: From observational notes, 50% of the co-trainers were not very confident presenting in front of the teachers as they were more familiar with student audience. For example, it was noted that one of the co-trainers did not have a direct eye contact with participants when it was needed.

Inference: The co-trainers needed activities that improve their confidence to lead adult learners. For SW2, components on presentation skills were part of the training modules. Table 5.9 depicts the refinements and how they have been implemented during the research process, with details of each refinement given within Iteration 4.

Table 5. 9: Refinements to the A2IT2 Model

Improvement Needed	**Refinement Implemented**
Skills to improve confidence	Skills workshop SW2
Practice of teacher training	Full teacher training session during CW4a
A2IT2 Model	Full Training Phase

5.2 Cycle 2 - Iteration 4

The final iteration, Iteration 4, refined the A2IT2 model by ensuring the following sub-goals:

i) To engage co-trainers into a full teacher training session to become teacher trainers; and
ii) To evaluate A2IT2 model through a workshop conducted by one of the participants in CW4a.

5.2.1 Skills for Effective Teacher Trainers

Reflections from Iteration 3 indicated that co-trainers needed to improve on skills to conduct teacher training sessions. To ensure that the co-trainers have enough skills they need to develop confidence and competence to train other teachers. Literature review was conducted to identify skills that trainers need to have. To achieve this, three main literature review questions were used while searching for relevant details on skills:

i) What are the expected experiences of teachers becoming teacher trainers?
ii) What skills do teacher trainers need to become effective?
iii) What personal attributes define an effective trainer?

Developing a teacher into a teacher trainer has some expectations. As a teacher, there are some features that are embedded in you as starting motivation to training. Knowledge of the content area and experiences in teaching are important to successfully become a teacher trainer.

Thompson (2001) insists that understanding of the audience is of crucial importance to manage a teacher training program. It is therefore important to conduct a training needs analysis that determines the nature of the participants and the contexts they come from.

Literature review showed a number of skills that are important for teacher trainers. Ng and Lam (2015) highlighted skills such as pedagogical knowledge of the subject domain, rich experience, self-regulation of emotions and facilitation skills as important components that make up a teacher trainer. Others include effective communication skills and presentation skills (Leach, 1996). As a trainer, it is also good to develop questioning skills (Galbraith, 1998); listening to the audience you are addressing (Stolovich, 1999); and provide rich, timely and constructive feedback to activities that the participants submitted (Wlodkowski, 1978). These skills might help to overcome any challenge that might occur as the session is going on.

For the second literature review question on personal attributes, literature suggests that a trainer needs to be confident and enthusiastic as the training session continues (Leach, 1996). A trainer needs to be open-minded to the participants to interact with him in a way that is confortable to everyone (Thompson, 2001).

The need for more teacher skills led to the need to design and develop a solution to equip the trainers with these skills. SW2 was implemented as an online workshop including only the four co-trainers as participants.

5.2.2 Skills Workshop 2 (SW2)

To equip the co-trainers with knowledge and skills to conduct teacher training sessions individually, there was a need to train them on specific skills so that they could be able to run all the sessions individually but with the desired efficiency. The skills workshop (SW2) intended to fill the skills gap for the co-trainers to take up full training sessions.

i) Instructional Goal

To prepare co-trainers for individual training sessions by equipping them with the relevant planning, executing and evaluation skills.

ii) Implementation of SW2

SW2 was conducted from August 24-27, 2020. It was purely an online workshop as all the sessions were conducted via Google Meet. It took one hour per day for 4 days. Within each hour, a number of activities were conducted. The first 20 minutes were used for introducing the topic of the day using examples and scenarios. The scenarios were for the co-trainers to be able to share about their experiences on training teachers. The next 20 minutes were for lecture session where the topic of the day was discussed. Finally, the last 20 minutes were used for activities that led to application of the knowledge into their contexts. For example, when discussing about the training cycle, the co-trainers were tasked to bring out their conceptual training cycle first and then the actual training cycle stages were revealed. These made co-trainers think of what they had missed and how they could integrate it in their teacher training sessions in their schools.

a) Areas Covered

This workshop intended to impart skills on how to plan, conduct and evaluate teacher training programs. One important part that was constantly insisted is in ensuring clarity in responding to questions and ability to keep the sessions live by ensuring the level of enthusiasm, involvement and content retention level. Table 5.10 shows the areas covered together with the intended areas of improvement.

Table 5. 10: SW2 Workshop Topics and Targeted Improvement

Day	**Areas Covered**	**Intended Improvement**
1	The training cycle	Training design
2	Creating a positive climate in the training room	Communication skills Regulating emotions
3	• Designing group activities • Presenting a session	• Activity design skills • Presentation skills • Facilitation skills
4	Evaluating the training	Training evaluation skills

5.2.3 Evaluation of SW2

Research Question

This workshop involved one research question which intended to capture the perception of co-trainers, as each of them plans to conduct a solo teacher training session in a different context.

RQ: How do co-trainers' training approaches change after the skills workshops?

Sample and Sampling Technique

This was a special workshop intended to impart training skills to the co-trainers. It involved the co-trainers who took sessions during the CW3 workshop. Before they joined this workshop, they had to meet certain selection criteria as described in Section 5.1.2. They were invited purposely as this was the only group of participants that was intended. They were to be imparted with the skills they needed to be able to take up full sessions on their own.

Data Collection

For this online workshop, data were collected using an online Google form. Apart from the demographic details collected, the form consisted of an open-ended question that aimed at collecting the responses. Such an open-ended question was as follows: "*What is one FEAR you face when training teachers in your school*? How did the online workshop help you in overcoming that FEAR?" All the four co-trainers responded and shared their fears.

Data Analysis

To discover the themes emerging from co-trainers' responses, thematic analysis was used. The six steps defined by Clarke and Brown (2006) were deployed to find the themes. The responses were first read a number of times to familiarize with the content. From the paragraphs, initial codes were thought of and organized in meaningful groups. From the groups of codes, searching for the themes was done. These themes were reviewed and combined to generate final themes that emerged from co-trainers' responses.

Results

All the four co-trainers provided their responses and were analysed and presented. The results for the question are shown in Table 5.11.

Table 5. 11: Reflections from Co-trainers after their Co-training Sessions

Co-Trainer	**Theme**	**Response**
CT1	Needs Evaluation	"I used to fear that some participants are ahead of me with knowledge I want to facilitate that will challenge me, this online workshop assisted me to do a pre survey in which I will know the participants and ready to use them during actual presentation".
CT2	Participant Engagement	"I feared that there might be participants who were knowledgeable on the topics than I was, but through the online workshop I learned that having that kind of participants might help to hasten the engagement of the participants".
CT3	Confidence	"One spotted fear was that of how could I manage to handle them in terms of my classroom presentation, my general confidence was low. But after the training I became sure of everything anyway, I knew then how confidence can be created from a clearly prepared training".
CT4	Workshop Management	"A very big fear I had was how I could conduct and manage a very big training session of about 39 teachers but this workshop ensured me much in keeping calm all classroom situations and fears through using different training skills such responding positively to all trainers' responses, using some probing clues which help to show your direct credibility and presence".

After SW2, co-trainers exhibited an increase in confidence to design, conduct and evaluate teacher training sessions. This included planning of activities ahead of time. This is evident from one of the co-trainers when he said:

> "…*Now I will change to have a complete planning and a long time for pre-preparations of my trainings. I will prepare required training assessment activities as well as its evaluating tools, and have a clear monitoring schedule to assure training sustainability*".

There was a need to apply the skills learnt in SW2 in an actual training setting involving teachers as participants. Full training sessions were planned for two of the co-trainers to exercise the skills. The workshop sessions for each of the co-trainers are explained as CW4a and CW4b respectively.

5.2.4 Implementation of A2IT2 Model through CW4a with Trainer 1

This was a solo workshop for the first co-trainer to practice what he had learned into an actual teacher training workshop. This would ensure that each co-trainer could transfer the skills he gained from the different workshops into other similar contexts, now with teachers as participants.

a) Research Goal

This research aimed at ensuring that the first co-trainer could apply the skills learnt in skills workshops by taking a full teacher training session with little or no support from the master trainer.

b) Design of CW4a

CW4a involved one trainer taking a full teacher training workshop for a number of days in a new setting with new participants. The design of CW4a is similar to CW2, the difference being that of being conducted by a developed teacher trainer instead of the master trainer. The additional Full Training Phase implies that the workshop is based on A2IT2 model.

c) Sampling of Participants for CW4a

This workshop was conducted at Forest Hill Secondary school, in Morogoro. Forest Hill Secondary school is one of the schools that have a fully functioning computer laboratory used by both teachers and students. This workshop consisted of 21 school teachers coming from the same school. The Academic Master of the school collected and shared an online Google form with all the teachers in the school. This form was meant to collect demographic details about the participants. The school administration requested all teachers to join the workshop to gain knowledge and skills that could help improve their teaching and learning practices. 57.9% of the

participants were males, whereas the rest were females. 47.4% of all the teachers had 1-5 years of teaching experience; 10.5% had 6-10 years of teaching; and the rest had more than 10 years of teaching experience.

In terms of their professional development activities they attended, 26.3% of all the participants had never attended any training or workshop before while the rest had attended one or more of such teacher professional development programmes. Among these teachers, 31.6% of the teachers had trained teachers in their schools or neighboring schools while the rest did not have any chance of training teachers before the workshop.

d) Trainer Preparation for the Workshop

One of the four co-trainers, CT1, was the trainer who took up the entire session to train the group of teachers. He agreed to participate in this training out of the four co-trainers as he was available and free. He was a school teacher who had been with the researcher from the first workshop till the completion of this research.

All the co-trainers were informed about this workshop 2 weeks before the training and that only one trainer was needed to ensure that he could take a full session during CW4a. CT1 agreed to participate as he was available to conduct the teacher training. He was informed to start all the necessary preparations for the workshop. The trainer made preparations in two ways:

i) Self-preparation: As a professional teacher, he prepared for the areas he was going to train; for instance, examples to be added, modifying the content.
ii) Preparations for the participants: This was in terms of knowing what they were supposed to have during the training session. For example, participants needed to have either computers or smartphones, with a strong Internet connection.

Figure 5.7 opens up the stages taken by the co-trainer as he planned, conducted and evaluated a full training session.

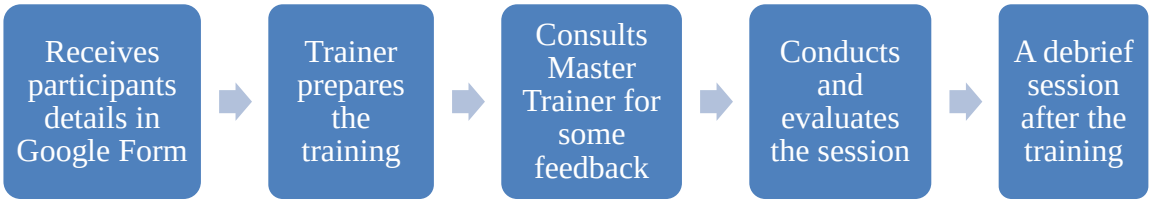

Figure 5. 7: Co-trainer' actions for a full training session

e) Training Plan

This workshop took place for 3 days from August 28-31, 2020. The same content as in CW2 was used as shown in Table 4.7. The training took 6 sessions (one hour each) per day for three consecutive days.

5.2.5 Evaluation of CW4a though Study 4a

Research Questions

This research study involved four research questions:

RQ 4.1: To what extent do A2IT2-based workshop participants integrate technology tools during a training programme conducted by a co-trainer?

RQ 4.2: How confident are teachers in technology tools in their teaching practices and sharing with other teachers?

RQ 4.3: What are the features of an effective teacher trainer for an effective teacher training session?

RQ 4.4: What are the reflections of the developed trainer from the solo teacher training?

RQ 4.1 intended to check how much a co-trainer was able to evolve and take up a full training session; RQ 4.2 intended to look at the improved confidence to use technology tools and to share with other teachers; RQ 4.3 aimed at finding out the general features each teacher trainer

possessed for effective training sessions; and RQ 4.4 focused on the experiences of the teacher trainer from the finished solo training.

Data Collection Methods and Tools

Two methods were used to collect data for the study. Data for RQ 4.1 were collected using participants' lesson plans and presentations. The tools involved the activities they had set to be completed in a lesson plan and the questions they had to work on to present in front of others. These were collected during the session of the workshop based on the activities they had completed. For RQ 4.2, data were collected using one-to-one interview and focus group interview. An interview protocol was used to collect the responses from the participants. Two types of interviews were completed: one-to-one interview and focus group interview with selected teachers. These data were collected at the end of the workshop. To answer RQ 4.3, a one-to-one interview with the teacher trainer was conducted. The interview protocol consisted of questions asking about the experiences of the teacher trainer after the workshop. Lastly, data for RQ 4.4 were collected from a one-to-one semi-structured interview with the trainer.

Data Analysis Techniques

Two data analysis techniques were used to analyse the data collected. For RQ 4.1, a microteaching assessment rubric (**Appendix D**) was used. It consisted of six criteria and three raying scales, all connected to achieve the intended learning objectives.

For analyzing RQs 4.2 and 4.3, thematic analysis was deployed on the interview set of data. The steps by Braun and Clarke (2006) were followed to generate the themes from the interview data. The interview data were first transcribed into text form for easy readability. Immersion into the data was followed by reading and re-reading it. The activity of generating initial codes from the data followed. Codes can identify the feature of the data that appears interesting to us. From there, searching for themes from the developed codes was done. The generated codes were then refined and reviewed to make sure that data within the themes were meaningful, with each theme being distinctive from the other. The last step in this analysis was to rename the themes so that each theme could be unique. The emerging themes are shown in the results section.

Results

Result 4.1: Technology Integration Levels during a Session by a Full Trainer

In this case, the participants were grouped into five groups, each of four participants. They were allowed to create groups based on the subjects they were teaching so that helping each other and discussions could be easily monitored. Each group selected a topic and worked on the topics shown in Figure 5.8. Creating learning objectives, integrating technology and creating assessment questions were part of the workshop completed by the teacher trainer. The participants managed to use both mentimeter and padlet at different instances of their lessons. There was alignment between the learning objectives set and the questions set using the technology tools. This is because the participants had been trained by a trainer who had gained a lot of experience and practice from the content and skills workshops using real-world examples, practice-based tasks and case studies to ensure transfer of training (Tonhäuser & Büker, 2016).

Group	Topic	Learning Objective	Technology	Question asked
G1	Theory of Demand	a) Define the term demand b) Describe the law of demand	Mentimeter Padlet	a) Indicates the lines that shows the demand curve b) Read the given scenario and answer the given that follow
G2	Human Activities	a) Explain the meaning of human activities b) Describe 4 types of human activities	Mentimeter Padlet	a) Which one is not a human activity? b) Discuss 4 types of human activities
G3	Natural and Whole Numbers	a) Identify whole and natural numbers less than 100 b) List natural numbers and whole numbers between 1 and 30	Mentimeter Padlet	a) Differentiate natural numbers from whole numbers b) Identify whole numbers from the list
G4	Literature in English	a) Define Literary device b) Identify and explain different literary devices	Padlet Mentimeter	a) What is literature? b) Identify any 5 literary devices which you are familiar with
G5	The computer	a) Define a computer b) Identify 4 types of computers c) Explain 5 needs for the computer	Mentimeter Padlet	a) What is a computer? b) List 5 uses of a computer?

Figure 5. 8: Technology integration during CW4a workshop

Result 4.2: Perceived Teachers' Confidence to Use Technology Tools and to Share with others

At the end of the workshop, participants stated their confidence in the use of technology tools (mentimeter, padlet and PowerPoint) in teaching and learning, and in sharing with other teachers through the end of workshop evaluation form. All the 21 participants submitted their perceived confidence. The minimum confidence threshold was set to 70% taking into consideration how

the training was conducted. Overall, the majority of the trainees perceived a confidence level of above 50%. The standard deviation error in Figure 5.9 bars exhibit a less overlap, indicating that the difference between the usage of the technology tools is probably not statistically significant. Using PowerPoint presentation in teaching and learning and in training others seemed easy with reference to other tools.

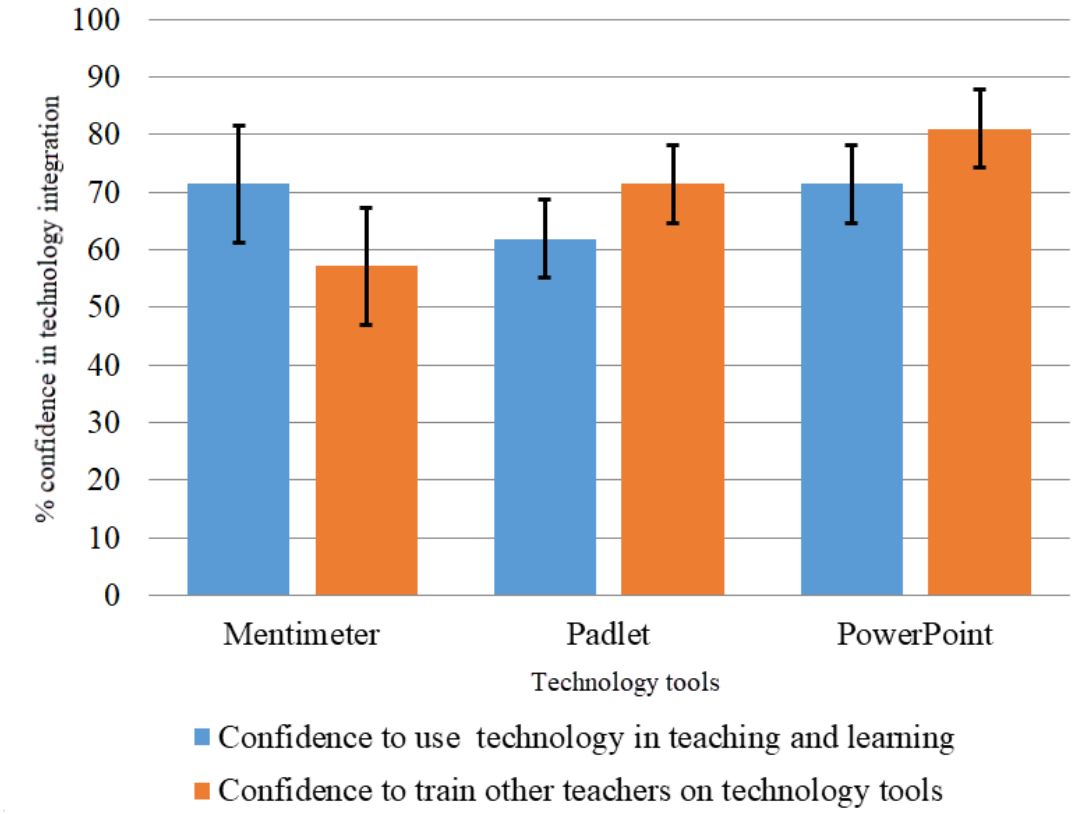

Figure 5. 9: Teachers confidence in technology tools after the workshop

Result 4.3: Features of an Effective Teacher Trainer

As thought earlier, there was a need to find out what participants say about the features of an effective teacher trainer. The results show that teacher trainers need to have both training management skills and a number of specific attributes that are important to master teacher training. Personal attributes, for example, the ability to interact freely with anyone as you facilitate a session, raise your confidence level to manage the training session. To manage well, preparations are important, including planning, designing and conducting a training workshop.

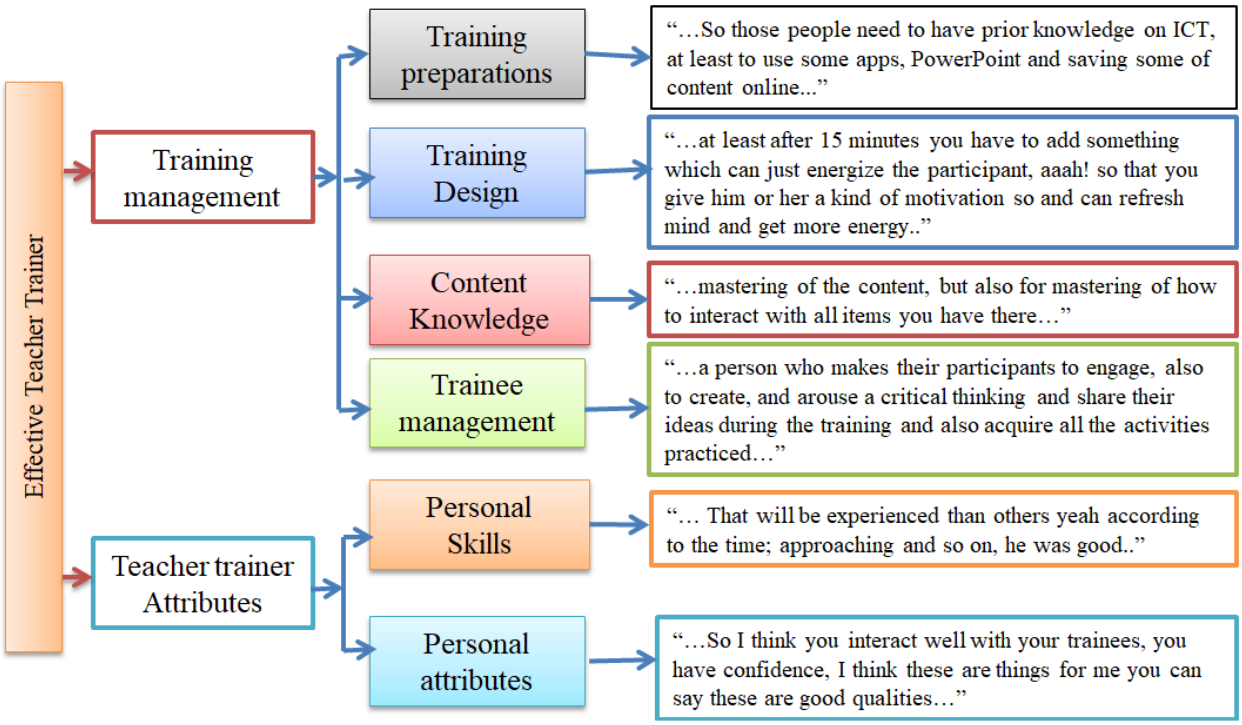

Figure 5. 10: Characteristics of an effective teacher trainer

Result 4.4: Reflections of the Developed Trainer from the solo Teacher Training

The trainer shared experiences of the training session. Three themes emerged from the interview. The experience from other workshops helped the trainer in managing the training session. Training teachers in a context away from your own motivates the trainer to do more. Figure 5.11 shows the emerging themes and some examples of quotations. From this experience, engaging group teachers from different backgrounds and in different schools gives the trainer a chance to learn from them. This improves confidence when facilitating a session.

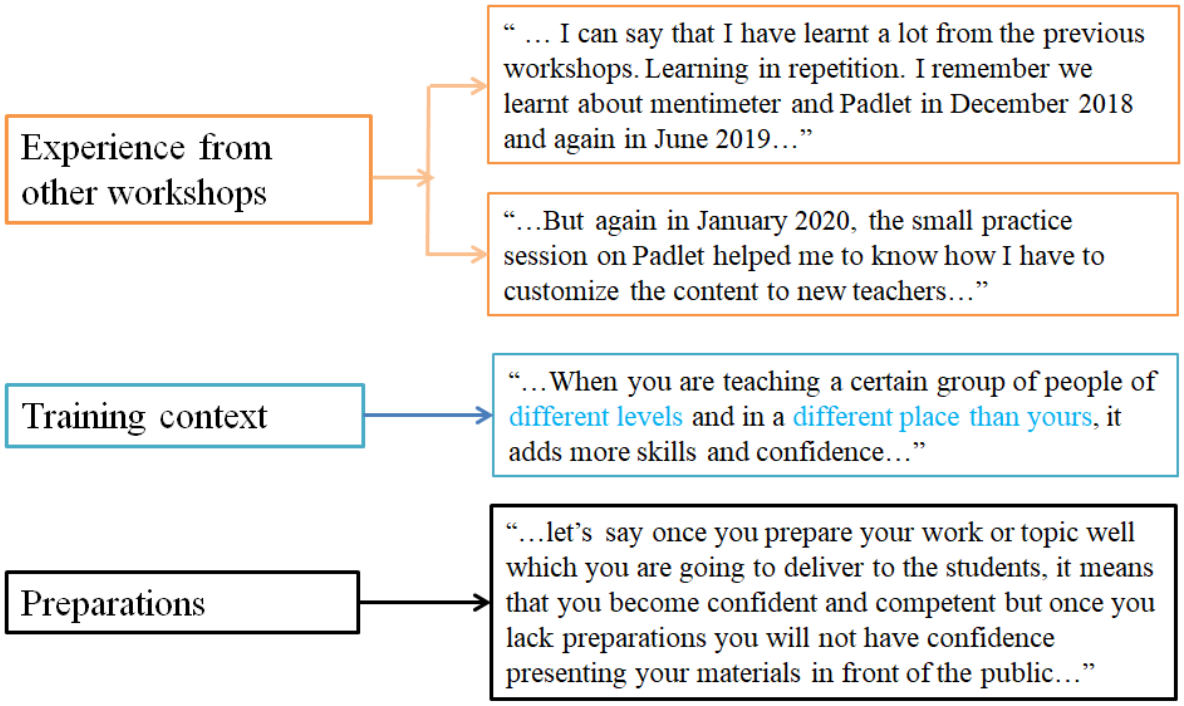

Figure 5. 11: Experiences from the developed trainer

5.2.6 Reflections from Study 4a

Becoming a teacher trainer involves some activities and skills that are needed to deliver a training session successfully. In Study 4a, the trainer reflected on what he had gained from the different content and skills workshops that helped him in taking a solo teacher training workshop. Prior preparations are important for one planning to take a workshop with teachers (Sufi et al., 2018).

The trainer reported that he was able to manage the training well as he had been familiar with the content since he had been able to learn the content in the first hand. On the other hand, learning in repetition played a key role to managing the teacher training, as he says:

> "*I have gone through topics such as Multimedia and Padlet in 2018 and 2019, and repeated it in 2020. This repetition has helped build confidence and abilities to train this group of teachers*".

These remarks imply that those aspiring to be trainers have to be well trained in both content and pedagogical skills.

To ensure that A2IT2 model had the same impact to all the teacher trainers, the next teacher trainer was involved to train teachers in a similar workshop to CW4a but with different teachers and in a different context. This was Content Workshop 4b (CW4b) that involved Study 4b.

5.2.7 Implementation of A2IT2 Model through CW4b with Trainer 2

This workshop is similar to CW4a. It follows the same procedure as followed in CW4a using similar data collection tools and procedures. It is based on A2IT2 model. It took place from March 29-31, 2021 at Morogoro secondary school, in Morogoro region, Tanzania.

a) Instructional Goal

This research aimed at ensuring that another co-teacher trainer, now CT2, takes a full teacher training workshop and receives feedback of the session from the mentor. The master trainer played the role of a mentor who might or might not be in the training room but could provide feedback on workshop activities.

b) Sampling of Participants for CW4b

This workshop was conducted at Morogoro Secondary School, in Morogoro, Tanzania. It consisted of 22 school teachers coming from different schools in Morogoro region. Purposive sampling was used to invite teachers as participants to the workshop. Announcement was shared in different teacher networks in Morogoro region to inform about the workshop, date of the workshop and venue for the workshop. The participants needed to ensure that they owned their computers and their schools had computer labs for them to practice when they went back to their schools.

Out of the 22 participants, 77.2% were males and the rest females. Participants were both from primary schools (50%) and secondary schools (50%). Majority of the participants had more than 6 years of teaching experience. Half of the participants had not received any professional development program for the past 3 years; 10.5% had 6-10 years of teaching; and the rest had more than 10 years of teaching experience.

In terms of their professional development activities they attended, 26.3% of all the participants had never attended any training or workshop before while the rest had attended one or more of such teacher professional development programmes. Among these teachers, 50% of them had never trained teachers before while the rest had attended one or more of the formal teacher training.

c) Trainer Preparations and Training Plan

Since Study 4b was similar to Study 4a, the preparation and the training plan was the same as that of Study 4a explained in Section 5.2.5.

5.2.8 Evaluation of CW4b through Study 4b

Research Questions

The same research questions as for Study 4a were used in this study.

Data Collection Methods and Tools

The same set of data collection tools and methods as used in CW4a were used in this workshop. There was no change in tools as the same level of teacher trainer was deployed to ensure that teacher training takes place.

Data Analysis Techniques

Two data analysis techniques were used to analyse the collected data. The same microteaching assessment rubric (**Appendix D**) was used. It consisted of six criteria and three raying scales, all connected to achieve the learning objectives intended.

For analyzing data collected during Study 4b, thematic analysis was deployed on the interview set of data. The same steps by Braun and Clarke (2006) as described in the data analysis section for CW4a were used.

Results

Result 4b.1: Technology Integration Levels during a Session by a Full Trainer

Participants were grouped into four groups, each of five participants. The groups were formed based on the subjects they were teaching. Each group selected a topic and worked on the topics shown in Table 5.12. Creating learning objectives, integrating technology and assessment questions were part of the workshop completed by the teacher trainer.

Table 5. 12: Technology integration during CW4b workshop

Group	Topic	Learning Objectives	Technology
G1	English Tenses- Present tense	*1. To explain the meaning of Simple present tense correctly* *2. To construct five (05) sentences correctly using simple present tense*	Mentimeter and Padlet activities
G2	Statistics	*1. Represent data into a pie chart* *2. Interpret a pie chart*	2 padlet activities
G3	States of Matter	1. Define Matter correctly 2. List the three states of Matter	Mentimeter and Padlet activities
G4	Kuwasiliana	1. Kueleza dhana ya lugha na sifa za lugha	2 mentimeter activities

Result 4b.2: Confidence to Use Technology Tools in Teaching and Sharing with others

Like in Study 4a, in this study (Study 4b), there was a need to know what participants could say about their confidence to use technology in teaching and learning and the confidence to train other teachers on the same content. A course exit online survey using Google forms was used to collect data and participants shared their feedback. Again, the minimum confidence was set to be 70%.

Results showed that, on average, the confidence to train other teachers on mentimeter was low below average compared to when training them on Padlet and PowerPoint. This is again depicted by the standard deviation error bars which do not seem to overlap for the mentimeter and padlet with a little overlap for the use of PowerPoint in teaching and training. Figure 5.12 shows the perceived confidence of participants to use the tools and share with others.

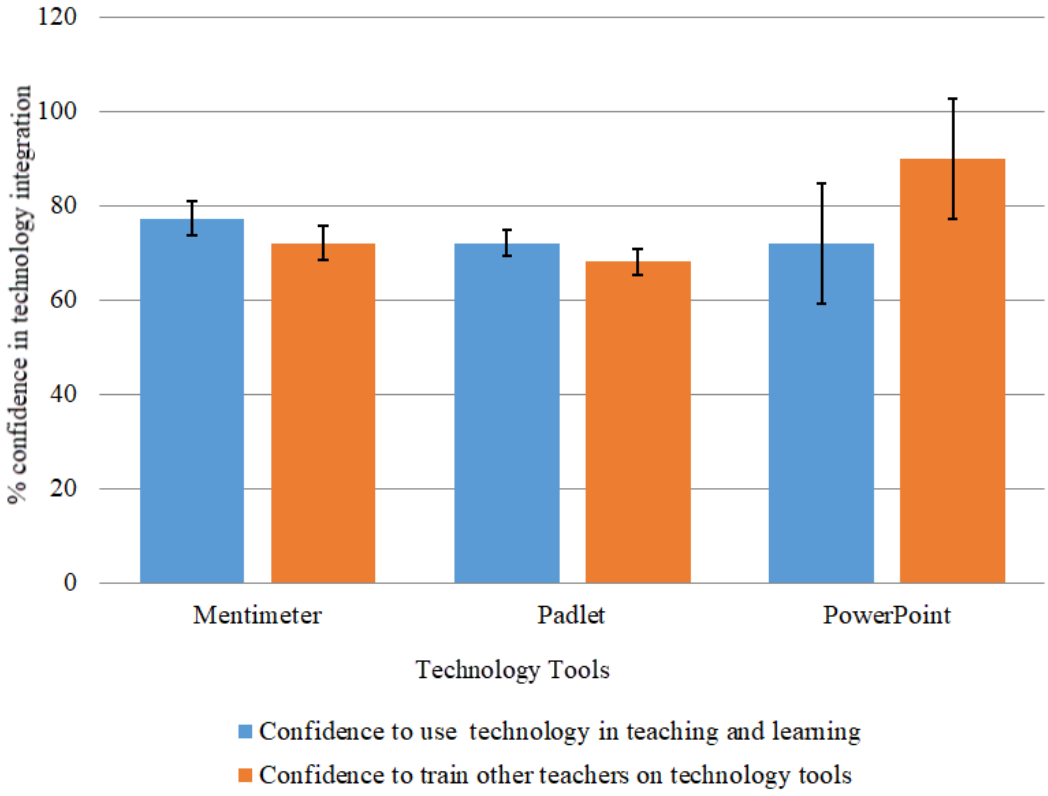

Figure 5. 12: Confidence to use technology tools in teaching sharing with others

Result 4b.3: Features of an Effective Teacher Trainer

As thought earlier, it was important to find out what participants say about the features of an effective teacher trainer. The results show that teacher trainers need to have both training management skills and a number of specific attributes that are important to master the area of teacher training (See Table 5.13).

Table 5. 13: Features of an Effective Teacher Trainer

Feature	Meaning
Content knowledge	Knowledge of the workshop content
Reflective	Reflect and change methods
Confidence	Demonstrate confidence in front of the audience
Knowledge of audience	Understand contexts of the workshop participants

Result 4b.4: Reflections from the Developed Teacher Trainer

Through an online interview, at the end of the workshop, the developed teacher trainer shared his experience of conducting a full teacher training. Three themes emerged highlighting the competencies developed across the different workshops. Th trainer stressed on how the continued use of the tools in the content workshops had helped him master the topics very well. On the other hand, the skills from the previous skills workshops were one of the factors that made his success in the solo training. Figure 5.13 shows the emerging themes and some examples of quotations.

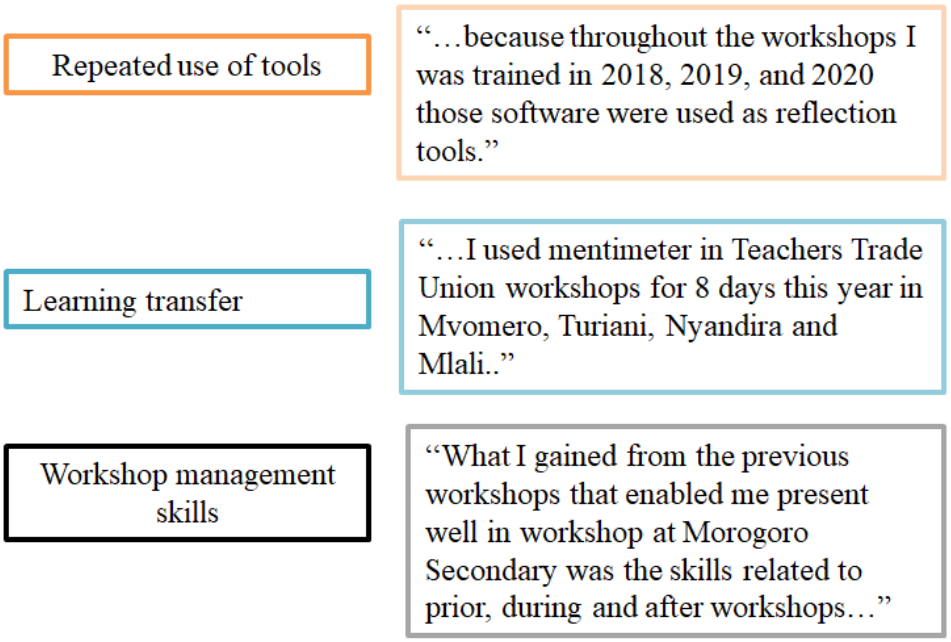

Figure 5. 13: Reflections from the developed teacher trainer

5.2.9 Reflections from Iteration 4

Study 4b, like in Study 4a, highlighted the abilities of the trainer of the workshop. The sessions of the workshop were interactive and participants appreciated the way the workshop was facilitated. This was evident from the comparisons made by some participants who were interviewed about the session and the trainer. The participant said:

> "*Participants were able to interact with the trainer directly as the facilitator moved to the next activity when he ensured that all the participants have understood the current activity. This was also possible as the participants were manageable, unlike the previous training I attended, where participants were about two hundred*".

This implies that, training few teachers becomes an advantage to the trainer as training orchestration is ensured.

Apart from the responses from participants, trainers in each case responded to their familiarity with the topics of the workshop, as T2 says:

> "*Generally, the use of mentimeter and padlet has become the part and parcel of my teaching career. I usually use these tools in seeking for feedback in the classroom and in the meetings with teachers. For example, in February 2020 I was training the newly elected Teachers Trade Union at school level representatives about how to communicate within the organization; I used mentimeter to have their opinions*".

Transfer of training happened to the trainers as they had managed to go through rounds of the same content in different workshops.

Comparing results from both studies (Studies 4a and 4b) to the study conducted by the master trainer during CW2, results still show improved confidence in the use of technology tools. Table 5.16 shows similar results have shown that the teachers can be effective teacher trainers if they have the right combination of content knowledge and presentation skills that are necessary to

manage the training sessions. Reliance on content knowledge as a means to develop a teacher trainer may not work in the right way in cascading the training to other teachers.

5.3 Reflections from DBIR Cycle 2

DBIR Cycle 2 combined both iterations (Iterations 3 and 4) to ensure that the developing trainers take some micro-training and full training sessions. During this cycle, trainers reflected on some aspects of their sessions.

One of the trainers was asked about his experience as a trainer and what made him manage the session alone. As a response, he replied that he was able to conduct this training alone because he had learnt mentimeter and padlet in completeness and in repetition. He stated that he learnt the same topics in December 2018 in the first place, but again in June 2019. So, learning by repeating the same topics made him capable and confident. On the other hand, training different people in a different context with the same topics gives more confidence during preparations. Training adult learners implies you need to make enough preparations in advance.

From the perspective of the individual participants, a comparison of the two developed teacher trainers (trainer 1 in Study 4a and Trainer 2 in Study 4b) in terms of the expressed level of confidence to use the technology tools and to train others in relation to the workshop by the master trainer (Study 2) was made. Percentages of individual participants who expressed a confidence level of 70% and above were taken in each case. Tables 5.14 and 5.15 show the stated confidences from participants of the three studies (Studies 2, 4a and 4b).

Table 5. 14: Confidence in Using Technology Tools in Teaching and Learning

	% of Participants with confidence of >=70%		
Perceived confidence in	**Study 2 (N=20)**	**Study 4a (N=21)**	**Study 4b (N=22)**
Using mentimeter in teaching and learning	85	71.4	77.2
Using padlet in teaching and learning	80	61.9	72
Using PowerPoint in teaching and	90	71.4	72

learning			

Table 5. 15: Confidence in Training other Teachers on Technology Tools

	% of Participants with confidence of >=70%		
Perceived confidence in	**Study 2 (N=20)**	**Study 4a (N=21)**	**Study 4b (N=22)**
Training other teachers on mentimeter	85	57.1	72
Training other teachers on Padlet	80	71.4	68.1
Training other teachers on PowerPoint	85	81	90

At the group level, a comparison of the integration of the technology tools in their lesson plans and their operationalization during microteaching sessions was done. This was achieved by looking at the number of instances a technology tool was used. Each study was arranged into 5 groups of 5 participants in each group, coming with similar backgrounds. In each of the studies, 80% of the groups had 2 or more instances of technology integration in the lesson plan, whereas only 20% (1 group) had one instance of the technology in their lesson plan. This implied that the developed teachers had managed to engage workshop participants to align technology tools effectively into their lesson plans.

5.4 Summary of Theoretical Basis for A2IT2 Model

i) Transfer of Training

This is the application of what a trainee learns in a training programme into their work environment (Baldwin & Ford, 1988). Transfer of training was emphasized during the implementation and evaluation of the studies in A2IT2. Literature highlighted many ways to achieve transfer of training. For example, Kemerer (1991) developed a framework that suggests three strategies to increase transfer of training. Kemerer stresses on structuring expectations by clarifying activities to be completed by the trainees; engage participants in active participation by talking and sharing; and giving individual and collaborative exercises. Incorporating these

elements into a training plan ensures that trainees can transfer what they have learned into their context and make an impactful contribution.

ii) Observational Learning

Bandura (2008) explains observational learning as the acquisition of attitudes, values and styles of thinking and behaving by observing examples exhibited by others. This involves learning from direct experience. Each of the A2IT2 model workshops for teachers involved participants observing how the trainer performs certain activities during the workshop. The teacher trainers acquired lasting experiences, attitudes and emotional reactions towards the master trainer. Researchers such as Hoover, Giambatista, and Belkin (2012) have even developed learning methods that place observational learning as the key element in the learning process. In A2IT2 model, observational learning is followed by feedback that helps the observer to reflect on what they have gained.

iii) Adult Learning Principles

The process of learning differs from individual to individual. In the same way, children learn differently (pedagogy) from the way adults learn (andragogy). Knowles (1977) made a distinction between what encompasses adult learning and children learning. Adults learn best when the session involves self-directed activities; is relevant and practical in their context; uses learning style that stimulates many senses; and the session is planned in such a way that participants are active and engaged in asking questions and interacting with their peers. In A2IT2, all participants in the different studies were adult learners. The workshops were designed to be interactive and engaging, involving practice activities. Completion of these activities needed participants to connect to prior knowledge and get feedback of what was submitted.

iv) Gradual Release of Responsibility

The gradual release of responsibility (GRR) model aims at providing instruction to learners from teacher-centric to joint activity, and finally towards student independence. Pearson and Gallagher (1983) conceptualized GRR as a way to provide a focused instruction, followed by guided instruction that leads to collaborative learning to fully independent learning. A2IT2 model

deployed GRR model when developing teacher trainers during the different iterations. Figure 5.14 represents the shift in responsibilities across the different iterations. As you go across the iterations, mentor engagement decreases while trainer independency increases.

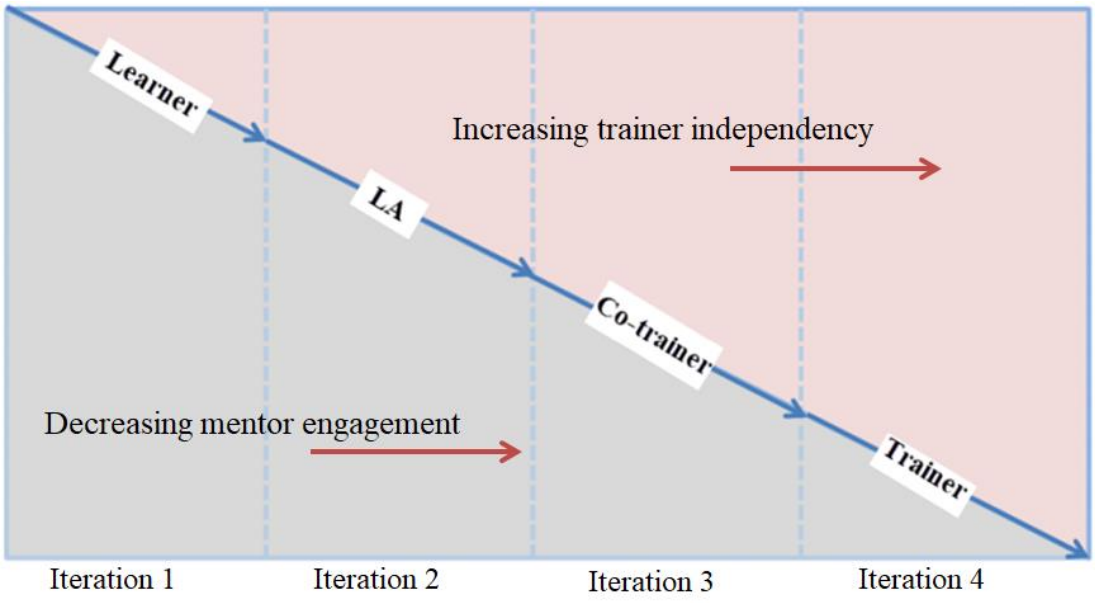

Figure 5. 14: Trainer development across the different iterations

As an additional confirmation, a cascaded workshop using one of the participants of CW4a was considered in order to mark the confidence of one participant (a secondary trainer in this case) to train other teachers. In this regard, a confirmatory workshop (CfW) was planned and conducted. Details of the CfW study are given in Chapter Six.

Chapter Six

Confirmatory Study of A2IT2 Model

In Chapter Five, Iteration 4 from DBIR Cycle Two highlighted two studies (Studies 4a and 4b) where the workshops were planned, conducted and evaluated by the teacher trainers at different times and in different contexts. In this Chapter, Study 4 was extended by taking one of the participants from CW4a to conduct a full teacher training session of the same content as that of CW2. The teacher training workshop was taken to compare the performance of the trained secondary trainers in Study 4 and the untrained secondary trainer after the session. It is termed as the confirmatory workshop (CfW). Details are given in Section 6.1. On the other hand, section 6.2 presents the trainer preparations and procedures. Research design and implementation for this confirmatory workshop is explained in Section 6.3. Finally, findings of the confirmatory study are presented in section 6.4.

6.1 The Confirmatory Workshop

The main goal of the workshop was to evaluate a typical cascaded A2IT2-based workshop using a participant from CW4a to cascade the training to different teachers from different schools.

6.1.1 Confirmatory Workshop Details

The confirmatory workshop (CfW) was conducted for two days, from November 7-8, 2020 at Kola Hill Secondary School in Morogoro, Tanzania. It involved the same training resources as for the previous CW1-CW4a workshop with teachers. 21 teachers from different schools participated in this workshop.

6.1.2 Selection of the Workshop Trainer

The trainer of this workshop was selected from among the 21 participants of CW4a. The trainer joined the workshop to enhance knowledge and experience on the use of ICT in teaching and learning. A number of criteria were used to select one participant from the 21 participants as a

trainer for this workshop. These criteria were in comparison with those from the trainer of CW4a to ensure that there is contextual similarity. The following are the criteria of the trainer during CW4a.

i) One that had never trained fellow school teachers before;
ii) Who had above 6 years of teaching experience;
iii) One that had at least a bachelor's degree; and
iv) One who had participated in at least one workshop or ICT training.

One of the participants who met these criteria was a female teacher whose characteristics were as follows:

i) She had never trained fellow school teachers before;
v) She was a bachelor's degree holder;
vi) She had 6-10 years of teaching experience, teaching Geography and Mathematics; and
vii) In the past 3 years, she participated in only one 3-day ICT workshop.

6.2 Trainer Preparations and Procedure

Knowing that she was going to conduct a training session based on what she had learnt from the workshop, she made some preparations. Having been informed that the next training would take place two months after completing CW4a, she requested for the workshop resources to go through and manage her training programme.

The workshop was conducted for two days involving the same topics as in the previous CWs. Each day consisted of six sessions of one hour each. The master trainer first introduced the session by covering a topic on Introduction to ICT to participants on the first day. This was done as a way to set the ground for the teacher trainer to take the stage. The next sessions involved delving into a specific technology tool and looking into how each could be fully utilized in teaching a lesson. At the end of the first session, master trainer then introduced the trainer to all the participants and let the trainer to continue with the next sessions for that day. She also took the sessions for the next day of the training. Table 6.1 shows the workshop plan for the trainer. The master trainer remained available for the duration of the workshop to help the trainer in case of any challenges.

Table 6. 1: Training Programme Layout for CfW Workshop

	Session 1	**Session 2**	**Session 3**	**Session 4**	**Session 5**	**Session 6**
Day 1	Introduction to ICT	Mentimeter for Classroom Engagement	Mentimeter for Classroom Engagement	Mentimeter for Classroom Engagement	Padlet for Classroom Collaboration	Padlet for Classroom Collaboration
Day 2	PowerPoint Presentation Design	PowerPoint Presentation Design	Mentimeter and Padlet Integration	Microteaching Sessions and Feedback	Microteaching Sessions and Feedback	Evaluation and Workshop Closing

6.3 Research Design and Implementation

Research Questions

This confirmatory study involved 3 research questions:

RQ1: What is the perceived self-confidence of workshop participants to train other teachers on technology integration tools?

RQ2: What difficulties do first time teacher trainer face when training other teachers on technology integration in teaching and learning?

RQ3: How do workshop participants perceive a session taken by a first time teacher trainer?

Sampling Technique for Participants

The sample involved 21 school teachers coming from 8 different schools in Morogoro region. Again, purposive sampling was used to invite the participants as those who possessed their own computers/laptops and coming from schools with computer labs were invited. Possession of own computer/laptop made it easier for each of them to participate in individual activities during the session and homework at the end of the day. The presence of a computer laboratory was

important for them to practice and apply what they gained into their school/classroom context. 63.6% of the participants were males whereas the rest were females. They joined the workshop through an invitation shared with teachers in their social groups and from their colleagues. Majority of the participants had 6-10 years of teaching experience. Majority of the teachers (81.8%) were in the age range of 31-40 years, whereas the rest were in the age range of 21-30 years.

Data Collection Methods and Instruments

For the first two research questions, data were collected using End of Workshop evaluation Google form. This form consisted of six questions that asked about specific areas of the workshop sessions: Improved confidence to use mentimeter, padlet and PowerPoint in teaching and learning; improved confidence to teach mentimeter, padlet and PowerPoint to other teachers; reasons as to why they selected that confidence level; and what should the trainer do to improve participants' confidence to 100%. Other questions focused on the number of instances participants used mentimeter and padlet in their microteaching sessions and the role of microteaching session during the workshop.

For the third research question, data were collected from a focus group interview with three participants of the workshop. The three participants to the interview were selected because of: 1) they had attended at least two workshop sessions before; and 2) they had an opportunity to train some teachers in their schools. The interview protocol consisted of four questions that focused on the different aspects of the workshop conducted by the first time teacher trainer.

Data Analysis

Data analysis involved cleaning, transforming, and modeling data to extract useful information that can be used in making informed decisions. This process is completed using different analysis techniques. To analyse data for the first two research questions, frequency analysis was used to gauge the performance in terms of frequencies of the participants. For the last research question, thematic analysis (Clarke & Braun, 2006) was deployed through its six steps to generate themes of the responses.

Results and Discussion

RQ1: Perceived Self-confidence of Teachers to Train other Teachers on Technology Integration Tools

At the end of the workshop, participants were asked, through a Google form, to rate their confidence to train other teachers. This was given on a percentage of 100%. Many participants showed an increased confidence to train other teachers on PowerPoint presentation compared to other technology tools. This could be due to the fact that many teachers had some prior experience with the use of PowerPoint presentations. In all tools, the confidence to train other teachers on technology was above 40%. Figure 6.1 shows the participants' levels of confidence to teach others on the three tools after the workshop.

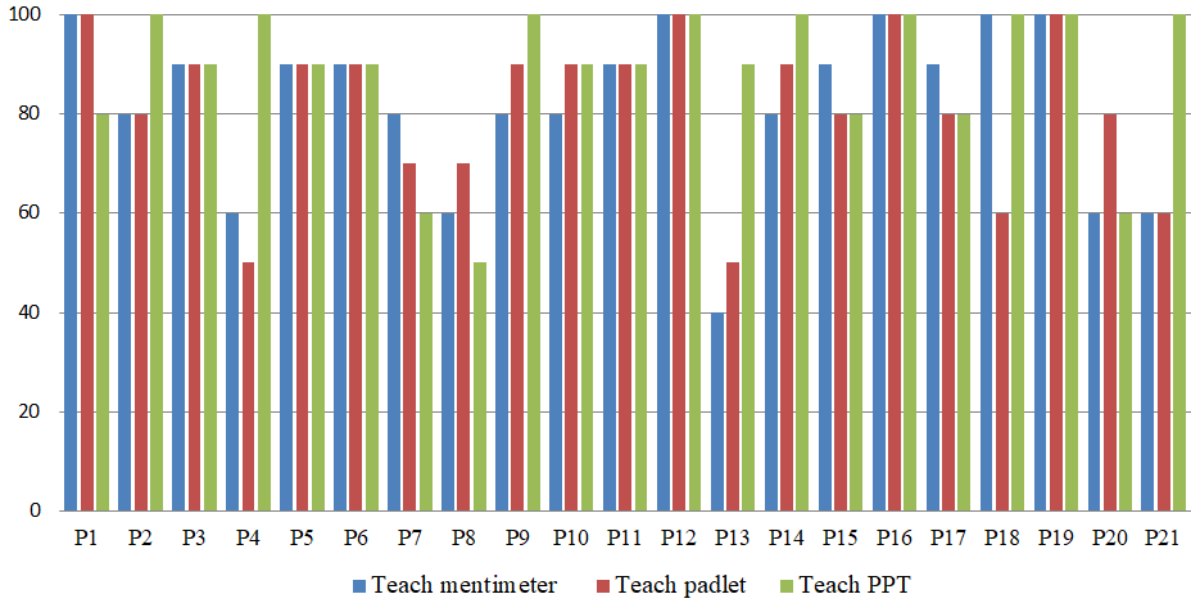

Figure 6. 1: Trainees' confidence to train others on the tools

RQ2: Difficulties to Train other Teachers on Technology Integration

Apart from those who had a confidence of 70% and above to train other teachers on technology integration in teaching and learning, responses of the participants who had perceived less confidence (less than 70%) were analysed as to what difficulties they can face when they have to transfer to other teachers. 22.7% of the participants perceived less confidence to train other

teachers on mentimeter while 18% and 13.6% of the participants were for padlet and mentimeter respectively. Figure 6.2 shows the emerging themes and examples of responses.

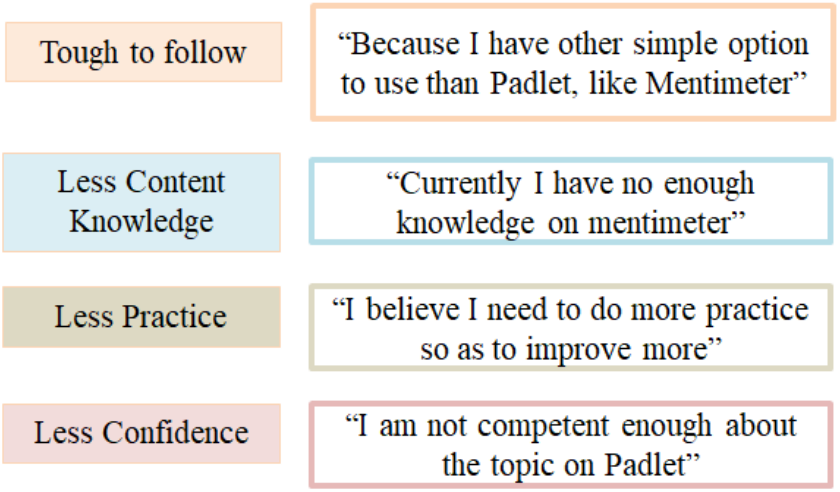

Figure 6. 2: Difficulties to transfer the learned knowledge to other teachers

RQ3: Participants' Perception of a Session by a First Time Teacher Trainer

This research question aimed at evaluating perception from participants about the workshop session conducted by the first time teacher trainer. Analysis of the data collected showed that while the trainer tried to manage the session, still some more skills were needed to ensure she attained the competence needed. Figure 6.3 shows the responses of participants for this workshop.

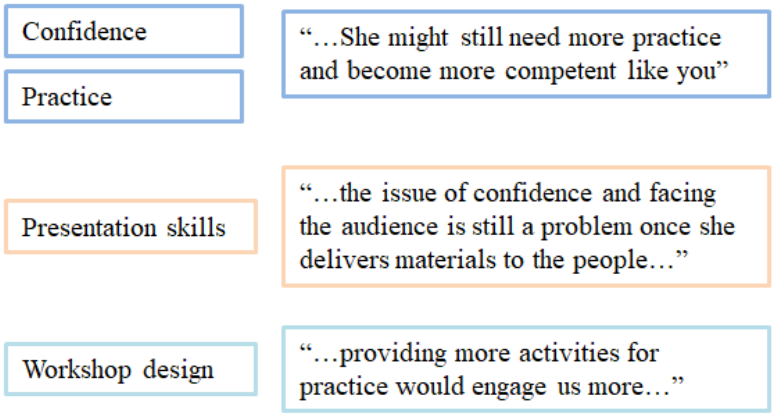

Figure 6. 3: Participants perceptions about a session by a first time trainer

Activities are part of the learning process and designing them to suit the participants is one skill to know. The trainer did not manage to include enough activities in the workshop that could help participants in practicing what they had learned. This could partly be due to less preparation for the workshop or lack of subject knowledge that helps to structure activities for different trainees.

This study involved first time teacher trainer to have a real cascade setup when participants of a workshop go back to their schools and start training other teachers. Results showed that, trainers in such a setting had low confidence and were not trained on important skills such as presentation and facilitation. Implementing A2IT2 workshops develop trainers who go through stages of practice and skills relevant for teacher training. A2IT2 model develops these competencies as the participant goes through a number of content and skills workshops before they conduct solo training sessions.

Through the confirmatory study, the participants in this workshop reported that the first time trainer had some difficulties in handling the session. This was evident from the fact that during the interview, one participant said that:

> "*Actually you are still the best as you are still training the madam although am not sure that you are the one who trained them. It means that she might still to more practice and become more competent like you. While she delivers, she lacks confidence somewhere. For example once madam 'presenter' was starting to the public she spoke that she is not much aware of something so she is not that much able to deliver something".*

This made a difference from what the trainers in Studies 4a and b did as they went through a number of content and skills workshops that improved their competencies. This made it easier to conduct solo workshop sessions without challenges.

6.4 Findings from the Confirmatory Study

i) Comparing Confidence Level of Participants of Two Secondary Trainers

At the end of CfW Study, evaluation of the training was performed to find the confidence of study workshop participants from each study in using the technology tools and in training other

teachers on the same technology tools. Table 6.2 gives the percentage of participants whose confidence was 70 or more. Participants of Study 4b gained more knowledge and confidence in using the technology tools.

Table 6. 2: Confidence in Using Technology Tools in Teaching and Learning

	% of Participants with confidence of >=70%	
Perceived confidence in	**Study 4b (N=22)**	**CfW Study (N=22)**
Using mentimeter in teaching and learning	77.2	68.1
Using padlet in teaching and learning	72	54
Using PowerPoint in teaching and learning	72	63

To determine confidence of the study participants in training other teachers on the different technology tools, Table 6.3 shows the levels of confidence at a threshold of 70 or more.

Table 6. 3: Confidence in Training other Teachers on Technology Tools

	% of Participants with confidence of >=70%	
Perceived confidence in	**Study 4b (N=22)**	**CfW Study (N=22)**
Training other teachers on mentimeter	72	59
Training other teachers on Padlet	68.1	68.1
Training other teachers on PowerPoint	90	81

From Tables 6.2 and 6.3, more participants in Study 4b perceived more confidence to train teachers on technology tools such as mentimeter and padlet as compared to those in the CfW Study. This is a similar case for those participants who have confidence to train others in PowerPoint presentation. This implies that a developed teacher trainer can effectively impart the skills and knowledge to the participants of the workshop compared to the untrained participant taking the role as a secondary trainer.

ii) Comparing Confidence in Using Technology Tools for Master Trainers, Secondary Trainer and Confirmatory Studies Sessions

To compare the perceived confidence for each study, data were collected at the end of each study from participants of the three different studies (Study 2, 4a and Confirmatory Study) using an online Google form. Study 2 was conducted by the master trainer (MT) and consisted of 20 participants; Study 4 was carried out by the Trainer (T) and consisted of 21 participants; and Confirmatory Study consisted of 22 participants and was delivered by one of the participants of Study 4. The form consisted of demographic questions and research questions that aimed to capture the confidence in using the technology tools and in training other teachers.

The collected data were analysed using Frequency Analysis with SPSS 26 package to Compare Groups. As seen in Figure 6.4, the error bars for the use of the three technology tools in the CfW Study show no overlap. This implies that the difference in the error bars may be significant. On the other hand, there is less overlap on the error bars for Studies 2 and 4a across different technology tools. This means the difference might not be statistically significant. This is attributed to the low number of participants in each study (20-22 participants).

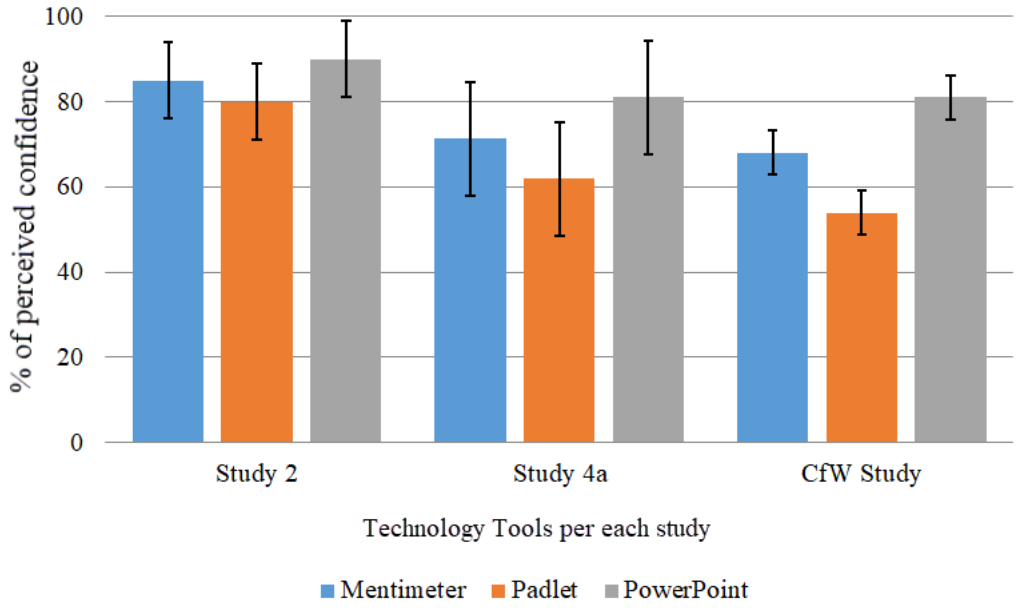

Figure 6. 4: Confidence in using technology tools in teaching and training

iii) Technology Integration in Group Lesson Plans

During activities, participants (grouped in same or similar domains) worked in groups 4-5 to complete a technology-enhanced lesson plan. This means that they had to indicate the purpose of a technology tool (mentimeter and/or padlet) in a lesson plan; where to be implemented; the trainer would set up questions and indicate what participants will do with the technology tools; and how a technology tool will be integrated. This was followed by microteaching session by one of the group sessions to teach the lesson developed in the lesson plan.

All the groups from Study 4b had deployed 2 or more instances of technology tools in their lesson plans and implemented it during presentations. With the CfW Study, all their lesson plans did not include technology instances and only 60% of the groups deployed 2 or more instances of technology during presentation. During microteaching, QR codes of two of the presentations did not work at all. It is clear that even with preparation, the undeveloped secondary (first time) trainer might have missed some instances of how best to instruct participants on how to work with technology tools. It means that a developed teacher trainer can pass on the knowledge and skills to the participants and ensure transfer can happen. Therefore, it was concluded that the additional phases in A2IT2 are essential.

In Chapter Seven, a summary of the A2IT2 model focusing on the iterations and the different phases, Attain, Align, Integrate, Teach and Train and their features, is given. Towards the end, details of the different design principles for A2IT2 model and their operationalization are given.

Chapter Seven

A2IT2 Model and Its Features

This Chapter gives detailed discussion of the developed A2IT2 model based on the different iterations to incorporate reflections from each iteration. Section 7.1 gives a summary of the model iterations while section 7.2 explains the teacher trainer development stages. The different content and skills workshops are described in Section 7.3. Section 7.4 presents the different phases of A2IT2 model. Section 7.5 discusses the design principles of A2IT2 model while its operationalization is discussed in Section 7.6. The last two sections (Sections 7.7 and 7.8) discuss about teacher agency and a qualitative comparison of A2IT2 model features with other TPD models.

7.1 Summary of the Model Iterations

A2IT2 model evolved through four different iterations defined in the two DBIR cycles as explained in Chapters 4 and 5. Each iteration consisted of one content workshop that produced a study to conduct a research with school teachers as participants. Additionally, iterations 3 and 4 consisted of two skills workshops, one for each iteration, for specially selected previous participants of the CWs. The participants for each workshop varied in number depending on the nature of the workshop (content or skills) and other criteria for selection. At the end of the workshop(s), an evaluation study was conducted to record the reflections and refinements that need to be made to improve the model. Each iteration involved a shift in responsibilities of the teachers developing as teacher trainers as detailed in the next sections. Figure 7.1 shows an overall structure of all the iterations.

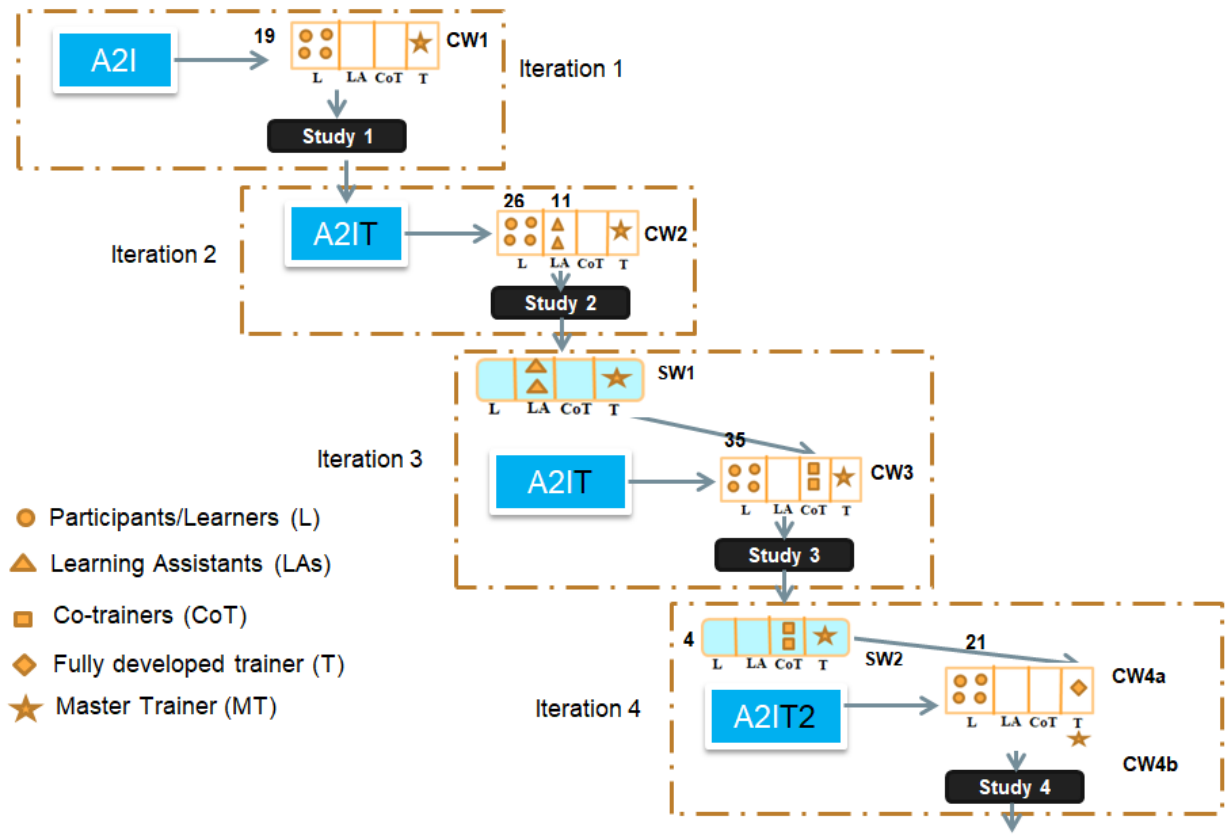

Figure 7. 1: An overall structure of A2IT2 model Iterations with key components

a) First Iteration

During the first iteration, A2I model was deployed as the core of design of the study for evaluation. The 19 participants in CW1 joined as participants who were learning the workshop content for the first time. CW1 was designed purely based on the phases of the A2I model. It involved school teachers as learners (L) into the workshop being trained by the experienced trainer (T). Study 1 was used to evaluate the iteration to give suggestions for improving and refining A2I for teacher trainers. Figure 7.2 shows the layout of the first iteration including the participants.

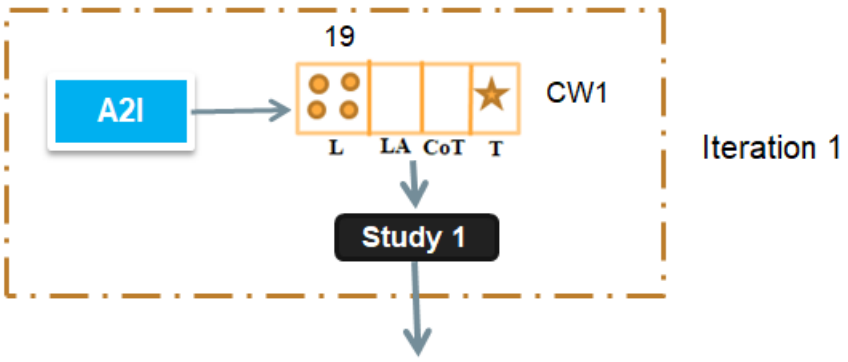

Figure 7. 2: Iteration 1 of A2IT2 model

b) Iteration 2

Iteration 2 involved refinements from Iteration 1. The completion of Iteration 1 produced some reflections that were used to refine the design of CW2 and Study 2. To improve CW2, a microteaching session was added to the design of A2I. CW2 consisted of 26 new participants and 11 selected participants from CW1. The 11 participants were selected from CW1 for a special role. They assisted the 26 participants during individual and group activities, and in answering questions that were related to the content of the workshop. Other times of the workshop they were learners, learning more on the content. At the end of the workshop, Study 2 was conducted to evaluate the workshop and reflect on the iteration. Figure 7.3 shows the activities in Iteration 2.

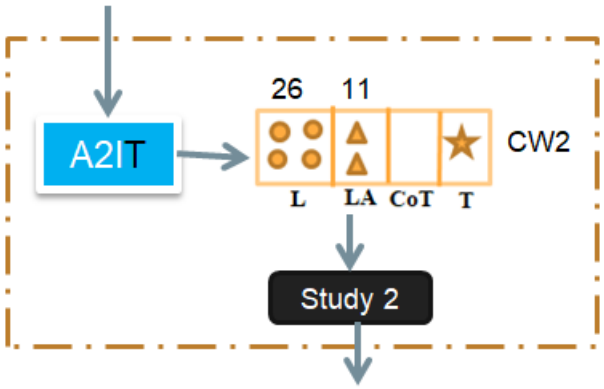

Figure 7. 3: Iteration 2 of A2IT2 model

c) Iteration 3

Reflections from Iteration 2 did not mean to refine the model A2IT, but to improve the trainer by imparting some skills. Literature review was conducted to understand the skills of effective trainers. The findings helped in designing a skills workshop (SW1) that was attended by all the 11 LAs. SW1 imparted skills to the LAs that were important to manage a teacher training session.

Using the same A2IT model, CW3 was designed and implemented in a workshop with 35 participants. During CW3, 4 of the 11 LAs were selected to join as co-trainers (CoT). Each of the co-trainers was given a topic from CW1 to develop and be ready for the training. During CW3, the role of the co-trainers was to conduct a short session and hence getting an opportunity to apply the skills they learnt in SW1. To evaluate the workshop, Study 3 was conducted to give reflections for improvements. Figure 7.4 depicts Iteration 3.

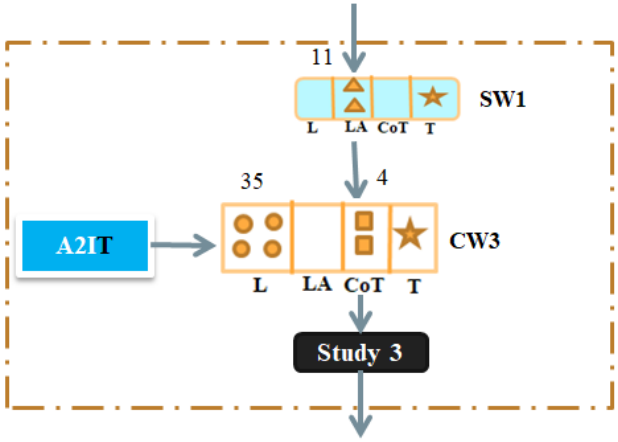

Figure 7. 4: Iteration 3 of A2IT2 model

d) Iteration 4

Analysis from Study 4 led to the reflections that helped to refine the model. On the one hand, it was found out, while co-trainers tried to manage their training sessions, they seemed to lack some skills that are important for training. SW2 was planned and developed for the 4 co-trainers to get the necessary skills, including building confidence, designing activities and presentation, communication and facilitation skills.

On the other hand, A2IT model was refined to include a full teacher training (T) session that takes place with different teachers and in a different context. A2IT changed to A2ITT (A2IT2). CW4a and CW4b are two different content workshops involving two different co-trainers from SW2 as trainers of the sessions. During CW4, the master trainer takes the role of a mentor to provide support to the trainer as they take their full solo training sessions at different times. Figure 7.5 shows Iteration 4.

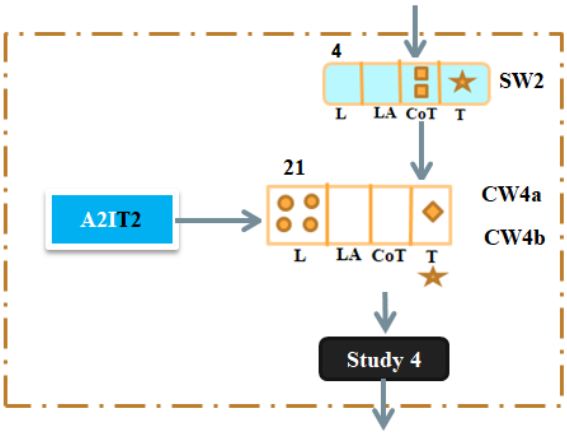

Figure 7. 5: Iteration 4 of A2IT2 model

Overall, iterations have helped in approximating A2IT2 model to its final stages. A similar work is shown in research conducted by Brion and Cordeiro (2018) when observers transitioned to facilitators and finally to become trainers. Brion and Cordeiro ensured that during the facilitation stage, co-facilitators covered one-third of the training materials during the first training session and close to two-thirds of the training materials during the second training session before taking a full solo training.

7.2 Teacher Trainer Development

Implementation of A2IT2 model through different iterations developed teacher trainers. These have evolved from CW1 through CW4, including the skills workshops (SW1 and 2). Their participation in each workshop gave them a role to play to achieve the objectives. The different stages of transitioning from teaching to teacher training have been described in the following section:

a) Learner (L)

All content workshops involved new participants from different backgrounds and contexts. The participants of the content workshops are termed as learners. They engage in all sessions and learn from the trainer(s) and completed all activities. At the end of the workshop, they acquired content knowledge (CK) and technology knowledge (TK).

b) Learning Assistant (LA)

At the end of CW1, all participants were introduced to the plans and timelines of the next workshop (CW2). Participants were invited to join in CW2 some participants (learners) were selected as learning assistants, mainly to help the new participants in learning the content by responding to their questions and completing activities. Apart from helping the participants, LAs also joined in groups and developed lesson plans from the lessons they teach, integrated technology in the lesson plan and micro-taught the lesson to the rest of the participants. The 11 LAs, like other members of the groups, received feedback from the trainer and from fellow teachers on their microteaching sessions.

c) Co-trainer (CoT)

During CW3, 4 out of the 11 LAs were selected to join as co-trainers. Each took their sessions with the 35 participants, each on a separate day of the workshop. Each session lasted for approximately one hour. While one co-trainer was presenting his session, the other 3 co-trainers were engaging participants in activities and responding to questions. At the end of the workshop, debriefing followed and each participant received individualized feedback from the master trainer. CW3 was designed using A2IT model with similar content as CW1 and CW2.

d) Trainer (T)

Evaluation of CW3 through Study 3 informed of the refinements that need to be made to the model. Participants reported that during the co-training sessions by CoTs, some CoTs were not very confident in front of the participants. They lacked some crucial skills to manage their sessions. For example, one participant reported that some CoTs relied more on PowerPoint presentations in explaining the content of the workshop. An online skills workshop (SW2) was

designed and implemented with the 4 CoTs as participants. SW2 consisted of sessions such as: training planning and implementation, confidence building, communication, presentation and facilitation skills. After the workshop, two participants were invited to solo teacher training workshops, including CW4a and b.

To participate in solo teacher training workshops, each trainer was required to plan for a full 2-3 days training session; analyse the participants and adapt the content to the contexts of the participants; and conduct a full training session in a new context. At the end of each day of the solo training, the co-trainer reflected on his experience of a full day session during a debriefing session with the mentor. At the end of the entire workshop, the mentor gave constructive feedback covering the sessions of the workshop. Co-trainers acknowledged that the feedback was important and helped them to improve their training sessions. This result was consistent with the findings of Corbett et al. (2017) who reported on how providing constructive feedback helped the local trainers in imparting training skills to nurses.

Two of the trainers took their solo teacher training sessions at different times, in different contexts. Workshops CW4a and CW4b were designed using A2IT2 model and implemented in Studies 4a and b. Table 7.1 shows the shift in expertise as the transition happened.

Table 7. 1: Transitioning from Teaching to Teacher Training

Iterations	**Teacher Trainer Development Stages**			
	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**
Iteration 1	Teacher/ Learner (L)			
Iteration 2	Teachers	Learning Assistant (LA)		
Iteration 3	Teachers		Co-trainer (CoT)	
Iteration 4	Teachers			Trainer (T)

The gradual release of training responsibilities from the master trainer to the teacher trainers ensured the trainers have the required skills to cascade the teacher training to lower levels. In each of the iterations, participants were engaged in activities that improved them for the next stage.

7.3 Content and Skills Workshops Details

A number of training content and skills workshops with guided practice sessions were involved in the development of the A2IT2 model. Figure 7.6 is composed of the blocks that make up a teacher trainer to cascade a teacher training workshop with efficiency.

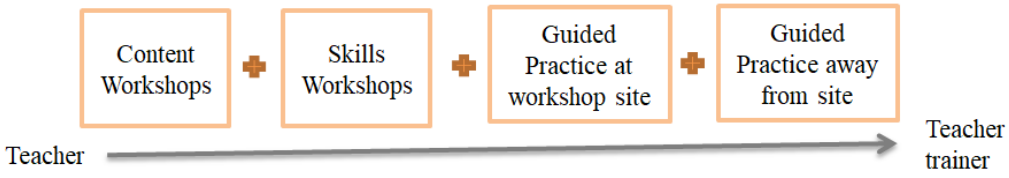

Figure 7. 6: The teacher trainer development continuum

7.3.1 Content Workshops

Content workshops consisted of modules that had to be covered to achieve training objectives. The participants of each workshop were teachers from different schools, teaching at either primary or secondary schools (See Figure 6.3).

These workshops were a result of the training needs that was done to cover an observed gap in the teaching and learning practices. Workshop topics were developed as a result of the needs analysis that was conducted to 74 school teachers via a Google form. This collected different topics that teachers wanted to learn more about, to help them integrate ICT in their teaching and learning. After categorization of the responses, the topics with high frequencies were selected for design and development. Table 7.2 shows the topics that composed content workshop (CW) for all the training sessions.

Table 7. 2: Content workshop – Overall Topics

Topic	Instructional Goal
Introduction to ICT in Teaching and Learning	To introduce teachers on how to access resources from the Internet and YouTube
Mentimeter for Classroom Engagement	Teachers to use mentimeter to engage students in active learning
Padlet for Classroom Collaboration	Teachers to use padlet to enhance collaboration among students
MS PowerPoint Presentation	To effectively present their engaging technology-enhanced lessons

There are four important workshop studies that make up the content workshop sequence, CW1 through CW4. The studies have defined how a teacher develops into a teacher trainer, including the changes that take place at each of the workshops. All these workshops consisted of new teachers joining the workshop for the first time. During CW1, participants of the workshop are all learners, learning the content for the first time. At the end of CW1, some participants from CW1 are selected to join CW2. These participate in answering questions of the participants and guiding them through activities. Some of those who joined CW2 are selected to join CW3.

During CW3, the selected participants are given micro-training sessions to conduct and they receive feedback from both the participants and the master trainer that guides them to improve their solo training sessions. At CW4, the co-trainer takes a full teacher training workshop with new teachers in a new context alone. This may be supported by the mentorship of the master trainer (as shown in Figure 7.7).

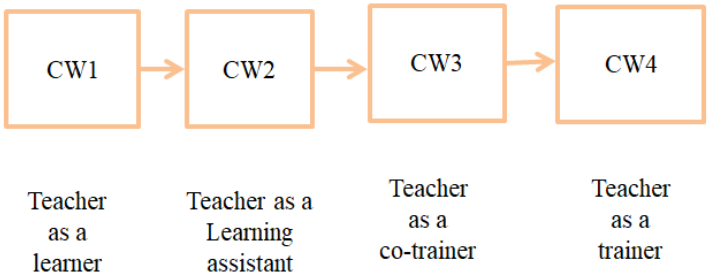

Figure 7. 7: Content workshops (CWs) and teacher transitions

7.3.2 Skills Workshops (SWs)

Cascaded training programmes that are designed to engage selected participants as the next level of trainers need to ensure that the trainees have acquired the knowledge and skills needed to train the next group of participants. To improve the effectiveness of cascaded teacher training programmes, participants need to develop both content knowledge and training skills. In a study conducted by (Dichaba & Mokhele, 2012) to define confidence of trainees to train others after returning to their centres, 55% of the trainees did not feel comfortable to train others. It was therefore urged that when trainers possess relevant content knowledge and appropriate training skills, effective teacher training and transfer of learning can be promoted.

The topics for the skills workshops emerged from literature on what skills teachers need to become effective teacher trainers and from results of the data collected during content workshops. This enabled the development of topics for the two workshops.

Trainers in this research went through two skills workshops (SW1 and 2). These were spaced among content workshops to ensure that there was time to apply the learned skills in the next workshops that followed. Participants in these workshops were the selected teachers who were elevated at different times as they transitioned from one level to the next. Table 7.3 shows the contents of the two workshops that were involved in this research.

Table 7. 3: Contents of the Two Skills Workshops

SW1 Content	SW2 Content
Adult Learning Principles	Opening a Training Session
Training Needs Analysis Skills	Activity Design Skills
Planning and Conducting Training	Presentation Skills
Content Adaptation Skills	Communication Skills
Observation Skills	Facilitation Skills
Training Evaluation	Training Management Skills

SW1 was conducted in a blended form while SW2 was a full online session. In both workshops, evaluation was done to find out the impact of the training it had to the participants. Participants

in each workshop reflected on their experiences and how they felt confident to conduct solo training sessions after these workshops. The design of each workshop is based on the principles described in the next section.

7.4 The Phases of A2IT2 Model

A2IT2 model consists of five (5) phases: Attain, Align, Integrate, Teach and Train. Each of these phases has a focus, coverage, nature of activities and the role of the master trainer and the participants of the workshop. Table 7.4 shows the different phases and the actions under each phase.

Table 7. 4: A2IT2 Model Phase Summary

	Phases					
	Attain	**Align**	**Integrate**	**Teach**	**Train**	
					Co-train	*Full Training*
Goal	Introduce participants to the idea of student-centeredness	◦Assessment strategy to the learning objectives ◦Instructional Strategies to the learning objectives ◦Technology to the learning objectives	Technology-integrated lesson plan	-Practical integration of technology in class -Practical mastery of training content	Practical implementation of specific portion of the training content	Experience a full training with teachers in a different context
Coverage	◦Introduction to ICT in Teaching and Learning ◦Constructive Alignment ◦21st Century Teaching	◦Introduction to technology tools ◦Technology Integration in the lesson plan	◦Specific technology tools (mentimeter and Padlet)	◦Teaching a 20-minute lesson to participants	◦30-50% of the training content -Specific Skills	◦100% of the training content
Nature of activities	◦Individual activities: Identifying SMART	◦Individual activities: e.g.	◦Group activities: e.g. integrate technology	◦Teach participants a 20-	◦Content modification ◦Workshop planning	◦Workshop implementation

	LOs Creating smart learning objectives	Create a PI question from the subject you teach ◦Group activities: e.g. develop a lesson plan	in your lesson plan to achieve your learning objectives	minute lesson	and designing ◦Facilitating the session	◦Provide feedback
Instructor Role	Instructor	◦Facilitator	◦Facilitator ◦Identifying potential LAs	◦Facilitator ◦Researcher	◦Co-Trainer ◦Researcher	◦Mentor ◦Researcher
Participant's role	Active learner	◦Individual practices and group practices ◦Previous participants help new participants lead group activities	◦Work collaboratively to ensure that technology is aligned at strategic points of the LP to achieve the learning objectives ◦Previous participants help new participants lead group activities	◦Group representative (Selected participants) teaches while others become 'students'	◦Co-Trainer	◦Trainer of the session
Mastery Level	◦General knowledge of the 21st teaching and learning using well	◦Some mastery of content and technology used	◦Mastery of content and technology	◦Application of technology in teaching	◦Content mastery ◦Content modification	◦Content mastery ◦Training

	aligned LP					orchestration
Mode of delivery	◦Lecture ◦Discussions ◦Brainstorming	◦Exploration ◦Discussions ◦Presentations ◦Feedback	◦Discussions ◦Presentations ◦Feedback	◦Role playing ◦Presentations ◦Feedback	◦Training	◦Training
Achievement	◦Components of a well-designed technology-integrated lesson plan	◦Constructively aligned lesson plan	◦Technology-enhanced lesson plan	◦Practical mastery of content and technology	◦Some training and facilitation experience	◦Full training experience
Skills Developed		◦Implementing constructive alignment	◦Technology-enhanced lesson plan	◦Implementation of the lesson plan in the class ◦Activity design skills ◦Adult learning skills	◦Participants analysis ◦Workshop planning and design ◦Content adaptation skills ◦Facilitation skills ◦Observation skills ◦Implementation (30-50%) of the content	◦Workshop implementation ◦Question asking skills ◦Training management skills ◦Presentation skills

7.5 Design Principles of A2IT2 Model

Design principles are embedded within the project to ensure a high probability of project effectiveness. They help in improving the product that is under development. Matsson and Wood (2014) have defined design principles as propositions that are used to guide the design process to a more effective outcome. These principles aim to improve efficiency of the design of the original product (Perez et al., 2012).

A2I Model

A2I is a complete model that is used to train educators in constructive alignment. The three components of constructive alignment (Biggs, 1999) of learning objectives, instructional strategy and assessment strategy are embedded as modules in the model. Each of these components is realized in the three phases of the model: Attain, Align and Integrate (Warriem et al., 2014). Details of phases of A2I model are shown in Table 4.6. The focus and coverage of the three phases define the activities that participants need to do in the workshops to achieve their learning outcomes.

Microteaching

Microteaching is a scaled down teaching experience that is intended to minimize the complex nature of the normal teaching to increase the level of feedback given to the teacher (Allen & Eve, 1968). It is s session that includes the following elements: a teacher, a micro class, a short lesson of about 5-20 minutes and some pre-defined objectives. One microteaching session ensures that teaching takes place; number of students, time taken, and scope of presentation and length of a class are reduced with purpose to achieve the goal.

One unique feature of microteaching sessions is that of the high degree of control that is embedded within the elements such as restriction to the time of 5-20 minutes, the use of few students and how feedback is provided to the teacher. The feedback to the teacher is based on students' reactions and trainees' self-evaluation and evidence from video tapes.

Mentorship

Mentoring is defined as a relationship between two parties, who are not connected within a line management structure, in which one party (the mentor) guides the other (the mentee) through a period of change and towards an agreed objective (Kay & Hinds, 2012). A mentor possesses features such as being an independent source of help to the mentee, one who sets purposes of the relationship between them, who is knowledgeable in the area of mentorship and who sticks to what was planned. Mentorship involves a number of stages that help in building the mentee. In his work, Megginson (2006) defined five stages of mentorship. Initially, a rapport is built between the mentor and the mentee, ensuring that the two can work together effectively to achieve a goal. Once this stage is achieved, enter into the next stage of setting and refining a goal to be achieved. The period of prolonged mentorship for the mentor and mentee to progress is another stage that is important for the mentee. As the goal is almost being achieved, winding up stage happens. This is the time when the mentee is full of confidence and can manage to move forward easily with minimal or no support. Finally, once the goal is achieved, a time to move on occurs where both the mentor and the mentee create friendship to work for each other.

7.6 Operationalization of Design Principles in A2IT2 Model

A2I Principle

The three A2I phases consist of constructive alignment (Biggs, 1999) and active learning strategies, all embedded in the content workshops. Each strategy was operationalized in different ways depending on the functionality of the phase.

Constructive alignment was operationalized in the content workshop by ensuring that:

i) There is alignment between individual and group activities with the learning objective for each of the workshop modules.
ii) Assessment strategies per each activity by participants are well aligned with the learning objectives to be achieved.

Active learning strategies were implemented when conducting the workshops by ensuring that participants are engaged in activities that promote collaboration and working together. Participants were also introduced to the concept of active learning during the first day of the content workshops. During SW1, participants completed an activity to create a peer instruction question from the subjects each one teaches.

Microteaching

Microteaching was operationalized during the design and implementation of content workshops (CW2 through CW4). Participants developed a technology enhanced lesson plan for the courses they teach. This activity involved integrating technology in a lesson plan to ensure constructive alignment. From the developed lesson plan, participants from similar domains, in a group of 3-4, prepared a 15-20 microteaching session where one of the group members presented to the rest of the participants. During the microteaching session, the rest of the participants role-played as students and participated actively. At the end of each microteaching session, the team received feedback from both the master trainer and the rest of the participants.

Microteaching session helped participants and learning assistants to reflect on their lessons and used the received feedback to improve their lesson plans. This was coupled with the application of the different skills they had developed during the skills workshops.

Mentorship

Mentoring is the act of guiding or giving direction (by a mentor) to another person (a mentee) for a prolonged period of time, with the purpose of achieving a career. In this research work, mentorship happened at different stages of the teacher trainer development, as trainers were applying the skills they gained in the skills workshops (SWs). Mentorship happened when the LAs changed to become co-trainers and eventually trainers. For example:

- Before a microteaching/micro-training session, LAs needed to make prior preparations such as participant analysis and content modification. In this case, guidance was required on what to work on and how to achieve the goal.
- During a microteaching/micro-training session, the mentor would be present in the training room to follow-up the session and give guidance on what needed support.

- At the end of any activity such as co-training or full training was completed, a debriefing session followed. This was the session to give feedback on what went well and what did not work well and the areas to improve.

7.7 A2IT2 Model and Teacher Agency in TPD

Agency highlights the role that actors play by means of their environment to bring changes that are meaningful to them. It gives the quality of engagement of the concerned actors without considering the quality of the actors in the process. Teacher agency is the ability of teachers responding with purpose to improve their professional growth at the same time leading to the growth of other colleagues (Biesta et al., 2015). It is more in the ability of individual teachers to act towards bringing changes that improve their profession while directing their actions (Molla & Nolan, 2020).

Teacher agency is emphasized as an important consideration in any form of professional learning (Biesta et al., 2015; Gurney & Liyanage, 2016). Calvert (2016) insists that teachers need to own any professional development program that aims to improve their career. Teachers who have agency respond positively by participating in the design and development of any learning opportunity to achieve their goals. This is more evident in the planning stage of any TPD, where teachers need to express their training needs to be incorporated in the design.

The design of the first content workshop that was cascaded across the different iterations of A2IT2 model resulted from analyzing the needs collected from the teachers. 74 teachers responded to the question "*Which ICT topic(s) would you like to learn to help in ICT integration?* Analysis and categorization of the responses led to the topics that formed the content workshops (CW1 through CW4). This is the possible level of teacher agency that A2IT2 makes to teachers.

In cascaded programmes that are in large scale, teacher training activities normally involve pilot stage. During pilot, the training content is tested on a small scale for the purpose of improvement. Once the pilot stage is completed, participants reflect on the areas to be improved

for the final large scale training. In this way, participants (teachers) participate in ensuring a successful implementation of the cascaded training on a large scale.

7.8 Qualitative Comparison of A2IT2 Model with other TPD Models

Efficiency of any TPD program depends on many factors which are inherent to the design of the program, trainers of the sessions and contextual factors. Table 2.1 showed the benefits and the challenges of the different TPD models. Kennedy (2005) classifies these models as transmission (training, award-bearing, deficit and cascade), transitional (coaching /mentoring and community of practice) and transformative (action research and transformative). A highlight of the A2IT2 model in relation to the transmission models, focusing more on need, design and delivery of the training is given. Transmission models involve trainers (at one level) transmitting content/information to the trainees (at the other level). Table 7.5 depicts the transmissive models against their common features.

Table 7. 5: Comparing A2IT2 with the Transmissive Models of TPD

Model	**Need of the Model**	**Design Goal**	**Duration of the Training**	**Deliverer**	**Size of Participants**
Training Model	To update teachers skills	More on content knowledge	Usually less than 5 days	Expert other than teachers	In the order of tens in the same school
Deficit	Perceived difficult in teacher performance	To improve the perceived deficit	Depends on the deficit	Expert other than teachers	Limited to a few from one school
Award-bearing	Completion of an award-bearing program	Meeting the requirements of the award	Depends on the length of the program	College or university instructors	Depends on the requirement

					of institute
Cascade	To train many teachers in a short time	More on content knowledge	Usually more than 5 days	Participants of the training	Usually in the order of thousands
A2IT2	To develop teacher trainers	Content knowledge and facilitation skills	Usually more than 5 days	Trained teacher trainers	Usually in the order of thousands

The change in behaviour and the impact of the training is measured as training participants start applying what they learned from the workshop. Majority of the transmissive models use external experts to conduct the training to teachers, except with cascade model that used participants of the workshop as trainers and A2IT2 model that deploys trained teacher trainers to engage the teachers. Compared to the rest of the models in Table 5.2, the design of A2IT2 focuses on mastery of both content knowledge and facilitation skills. This can ensure effective delivery of teacher training programs.

Chapter Eight discusses the findings, claims and implications of this research. The Chapter focuses on summarization of all the studies and discussion of the major findings. Other areas that are covered include how A2IT2 solves the challenges associated with the cascaded teacher training programs, the implications of the results, generalization aspect of this research and its limitations.

Chapter Eight

Discussion of Findings, Claims and Implications

This research aimed to improve efficiency of trainers in the cascaded teacher training programmes. A2IT2 model was developed as one solution to some of the mentioned challenges in Chapter Two, Section 2.4.

This Chapter summarizes and discusses the findings from the five studies (Study 1 through Study 4b) and the Confirmatory Study of this research and their implications. The results are discussed mainly to focus on the following areas:

i) Improvement in terms of the performance of the A2IT2-developed trainer compared to the undeveloped teacher trainer; and
ii) Levels of technology integration for the two sessions taken by both the trained teacher trainers.

First, a summary of the findings from the different studies is given in Section 8.1, followed by discussion of the major findings from this research in Section 8.2. Section 8.3 highlights on how A2IT2 model is a solution to the challenges of cascaded teacher training programs. Sections 8.4 through 8.7 highlight the claims and evidence of this research; implications of the results; and generalizations and limitations of this respectively.

8.1 Summary of the Research Studies

8.1.1 Study 1: Learning and Transfer

Study 1 (in Iteration 1, detailed in Section 4.2) was set out to train teachers on the selected topics to improve their confidence in using technology tools in teaching and learning. This study was

designed using A2I model and was set out to answer 4 research questions focusing on learning and transfer into their own contexts. While many participants indicated a higher learning gain from the workshop, they also thought of how to transfer the skills and knowledge into their contexts. Hence, 57.73% of the workshop participants planned to use the skills in teaching their students; 28.87% aimed at sharing the experience with other teachers; and 13.4% planned to use their learning into other applications such as creating videos and searching for resources on the Internet. Generally, majority of the participants showed that transfer is possible despite the challenges they face in their schools. Data for this study were collected through semi-structured interviews with participants and feedback surveys.

Based on the findings from the research questions, it was concluded that for effective technology integration in teaching and learning and for transfer of training, presentations of activities and peer feedback were necessary. Furthermore, for transferring to their contexts, group and individual activities need to be provided for more practice. Refinement of A2I model was done by implementing microteaching sessions during Study 2.

8.1.2 Study 2: A2IT Implementation

This study (in Iteration 2, detailed in Section 4.3) focused on developing technology-enhanced lesson plans and implementing them during microteaching sessions. There were 4 research questions that focused on evaluating the improved confidence on technology integration and suggesting improvement to the A2IT model for effective transfer. Results from the study have shown that participants showed interest in transferring the training in their context in two ways: 1) while teaching their lessons; and 2) to share the learned knowledge and skills with other teachers in their contexts. Participants, arranged in groups, worked collaboratively to develop a technology-integrated lesson plan, with mentimeter, padlet and PowerPoint as the technology tools. Data for this study were collected through one-to-one and focus group interviews, observations and reflections.

From this study, it was found that the addition of the Teach Phase to A2I (resulting in A2IT) increased their confidence in using technology in teaching and learning. This was attributed to the microteaching session that gave them an opportunity to practice and receive feedback from

peers and the master trainer. This implied that embedding small sessions in workshops where participants get to practice what they are learning becomes relevant for transfer.

8.1.3 Study 3: Co-training Session in A2IT2

Study 3 (as detailed in Section 5.1) aimed at empowering LAs through a co-training session to become co-trainers. This study consisted of 3 research questions, all focusing on the role of co-trainers and the refinement to the developed model. The 4 co-trainers each prepared and conducted part of the workshop content to the participants in the same workshop. Data were collected from interviews with co-trainers and participants; observations during co-trainers' sessions and using rubrics to assess microteaching sessions.

From the results, the additional Train Phase (leading to A2IT2) gave opportunity to co-trainers to practice the skills in a training session. They were able to take up small sessions they had a chance to prepare. It was suggested to engage in activities that could improve their confidence to work with adult learners.

8.1.4 Studies 4a and 4b: Full A2IT2-based solo Training

These two studies (detailed in Section 5.2) aimed at implementing a solo A2IT2-based workshop with the developed trainers. Each of the studies was conducted by one developed trainer at different times and with a different audience and context. The design and implementation of the studies were all similar with 4 same research questions each for evaluation. Data for these studies were collected from the lesson plans and presentations; semi-structured interviews with the trainers and the participants; and observations.

Compared to the sessions conducted by the undeveloped secondary trainer during a Confirmatory Study (CfW), the developed teacher trainer showed better results. This was evident in the technology integration in teaching and learning, confidence to use technology tools and to train other teachers to use these technology tools.

8.2 Discussion of Major Findings

The main goal of the workshop was to evaluate a typical cascaded workshop using a participant from CW4a to cascade the training to different teachers from different schools.

8.2.1 Perceived Confidence in the Usage of Technology Tools

Each of the content and skills workshops consisted of school teachers who had similar backgrounds and contextual factors. Some of these factors included:

i) Teachers coming from same school contexts (primary and secondary schools);
ii) Teachers with similar educational level, majority of whom had a bachelor degree;
iii) Experienced teachers (above 70% had more than 5 years of experience);
iv) All of the participants came from schools that were within the municipalities; and
v) Less than 25% of the participants reported to have had some experiences with training their fellow teachers.

Results show that confidence to use technology tools in teaching and learning improved during the training session conducted by a developed teacher trainer (Study 4a). Even though the teachers might have knowledge of technology, this cannot be enough if teachers are not confident to use the technology tool in the class (Ertmer & Ottenbreit-Leftwich, 2010). For the teacher training session conducted by the untrained trainer, many participants had less confidence to use padlet in teaching and learning (taking 70% as the threshold).

On the other hand, participants expressed their confidence to train other teachers in the same technology tools. The two studies were compared with the two trainers (a developed teacher trainer and a secondary trainer). While confidences in each study looked almost similar, training on PowerPoint and mentimeter was perceived as better compared to training of mentimeter. With PowerPoint, there is a possibility that the participants in CfW were already using PowerPoint in teaching their subjects and hence it became even easier to train others on that.

8.2.2 Technology Integration in Lesson Plans during Microteaching

As part of the activities during the sessions, participants of all content workshops developed technology-enhanced lesson plans during microteaching. Table 8.1 shows the results of each group per each of the two studies conducted by a trainer (T) developed through A2IT2 and a participant from an A2IT2-based workshop.

Table 8. 1: Technology Integration in Lesson Plans during Microteaching

Details	**Study 4 (With a Developed Trainer)**	**CfW Study (With a Workshop Participant as a Trainer)**
Participants	21	22
Context	Different teachers, from different schools, different place	Different teachers, from different schools, different place
No of groups	5 (G1-G5)	5 (G1-G5)
Technology integration in lesson plan	Visible in the lesson plan and in slides	Missed it in the lesson plan but available in slides
Challenges	All groups worked well	-Issues in aligning technology to learning objectives -Some links provided did not work, e.g. QR codes failed to open

From Table 8.1, there were no observable technology challenges when different groups of participants in Study 4 completed their microteaching sessions. For the study with the workshop participant as a trainer, two groups, G2 and G3, worked well; while for the rest of the groups, there were some challenges with technology application in microteaching sessions. For the other groups, it is important to stress on the design thinking skills relevant to teachers to design a technology-enhanced lesson plan (Tsai & Chai, 2012). Knowledge of design principles and other factors such as knowledge of the content by the secondary trainer, time and amount of practice are crucial in integrating technology in teaching and learning.

8.2.3 Increased Trainers' Self-efficacy to Conduct Training Programs Successfully

The two teacher trainers said that they were able to conduct teacher training programmes because of the sessions they had taken. It became easy for them to even use the technology tools for their day to day teaching, as one of the two trainers responded:

> "*Generally, the use of mentimeter and padlet has become the part and parcel of my teaching career. I usually use these software tools in seeking for feedback in the classroom and in the meetings with teachers*".

The efficacy was enhanced because of their extended engagement at different levels and in different roles during the research work. The different roles they participated in during the different phases of A2IT2 made them have a better understanding of the content of the workshops and hence minimized any chance of distortion or dilution during their solo workshop sessions.

8.3 Solution to Some Challenges of Cascade Model

Cascade model of TPD is reported to have challenges during implementation. These can be categorised into training design-related and trainer-related (cf. Section 2.4.3). This research aimed to develop a solution that would minimize them. Table 8.2 shows the challenges reported in literature and how this research helped to minimize them.

Table 8. 2: A2IT2 Solutions to the Cascade Implementation Challenges

Cascade Implementation Challenges	Solution by A2IT2
Training Design-related	
Focus on content knowledge (Karalis, 2016)	Specific skills were embedded in the training programme
Dependency on Top-Down approach (McDevitt, 1998)	Needs analysis is conducted to determine requirements from participants
Less feedback from top to bottom (Dichaba, 2013; Mathekga, 2006)	Continuous mentor support is available throughout the workshops
Trainer-related	
Insufficient knowledge about workshop content (Hooker, 2008)	The secondary trainers learnt the same content in 4 different workshops (in repetition)
Content distortion and dilution (Dichaba & Mokhele, 2012)	The secondary trainers are trained on the same content in repetition to master the content
Content misinterpretation (Engelbrecht et al., 2007; Jansen, 2003; Suzuki, 2011)	The secondary trainers learnt the same content in 4 different workshops (in repetition)
Lack of confidence (Bax, 2002; Engelbrecht et al., 2007)	Shift in expertise from learner to learning assistant to co-trainer and finally trainer during the workshop

8.4 A2IT2 Model Implementation in a Cascaded Teacher Programme in Tanzania

The project Enhancing the Quality of Secondary School Education through a holistic approach in Zanzibar (EQSSE-Z) aims to improve the quality of education in secondary schools, especially for Mathematics, Science and English (MSE) subjects by employing a holistic approach to improve the overall academic environment and targets all relevant stakeholders including teachers, Head Teachers (HTs), Teacher Centre (TC) Coordinators and ICT Hub Coordinators. The project focuses on two areas:

i) Implementation of competence-based curriculum (CBC) in teaching MSE subjects; and
ii) Integration of ICT in teaching and learning of the MSE subjects.

This is a 4-year project (January 2021 to December 2024) that is being funded by KOICA and implemented by three consortium partners: Good Neighbours, NIRAS and UNOPS, in collaboration with the Ministry of Education and Vocational Training (MoEVT) in Zanzibar. In this summary, a description of the teacher training design is given.

8.4.1 Preliminary Work

After the diagnostic study to identify the needs of the MSE teachers in Zanzibar, the first task was to develop 13 training modules that covered all the identified gaps. These modules were developed by a selected team of experts from different academic institutions in Tanzania. The development of the modules took one month to complete. After that, training packages for each of the modules were developed by the same experts from each subject area. These included preparation of PowerPoint presentations and competence-based assessment tools such as pre-posttest tool, training evaluation tool, teachers' reflection tool, students' reflection tool and lesson plan assessment tool.

8.4.2 Implementation of the Cascaded EQSSE-Z Project

To ensure that the implementation of this project could achieve the intended outcome within the specified time and using the available resources, the lead consultants designed the INSET training for MSE teachers in a cascaded model. The top level consisted of educational experts (EE) who were the project consultants (one being the researcher). The two EEs oriented 13 Master Trainers (MTs) on the 13 different modules. The activities during orientation included developing the training package for Resource Trainers (RTs) and developing INSET. The MTs then trained 173 RTs, who would in turn train the 1357 MSE teachers. Figure 8.1 shows the cascade model for the MSE INSET

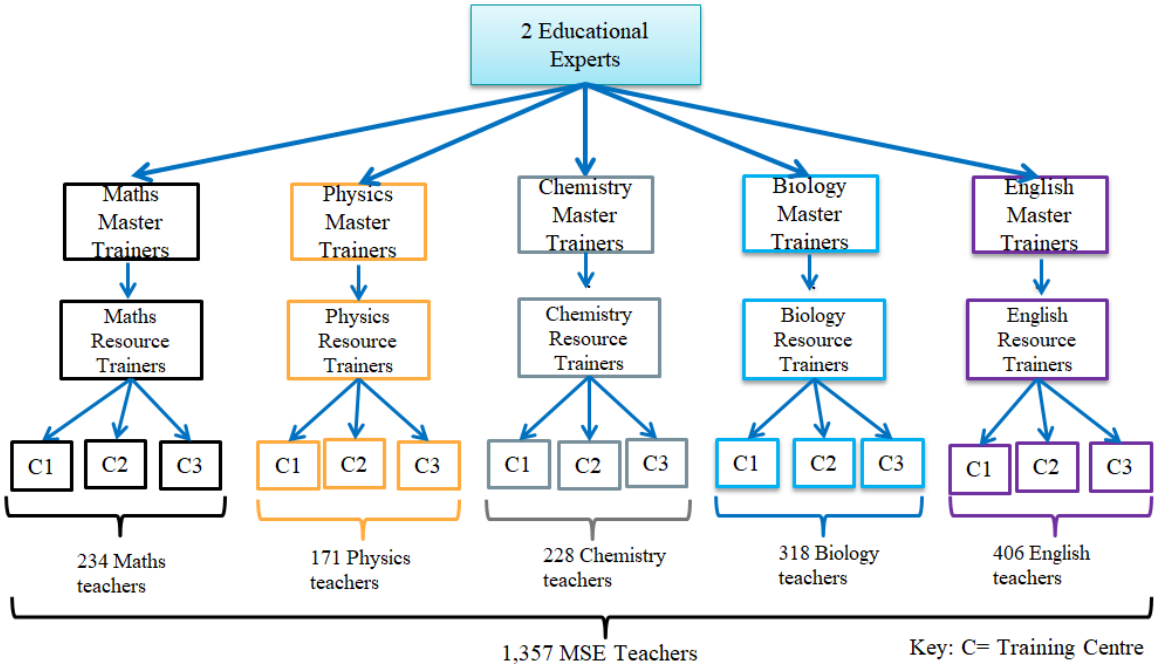

Figure 8. 1: The cascade model implementation

8.4.3 Resource Trainer Development

Resource Trainers for all cohorts were selected from among teachers of Maths, Science and English so as to ensure effective implementation of the program. The following were major criteria:

i) Tanzanian teachers teaching MSE subjects;
ii) Having a university degree from any recognized institute in the relevant field;
iii) Having a minimum of three years of professional experience in teaching practices; and
iv) Prior teacher training experience.

The RTs were then trained for six (6) days. Each day consisted of six sessions of one hour each. The first five days were used in training on introduction to CBC, ICT integration in teaching and learning, and then on the module content. The focus was more on applying CBC in teaching English lessons. Figure 8.2 shows the RT training plan for English teachers.

Figure 8. 2: RT Training plan for English teachers

On the last day of the training (Saturday), the focus was on imparting training and facilitation skills. This day was divided into five sessions (each of one hour) as follows:

Session 1: Features of a trainer; setting up activities; and facilitating activities.

Session 2: Facilitation skills; running sessions; dealing with difficult participants; and adult learning principles.

Session 3: Communication skills; opening a training session and content adaptation.

Session 4: Motivating participants during facilitation and conducting interviews.

Session 5: Training evaluation (how to evaluate, tools to use in training evaluation).

At the end of the RT training, a selection was made to identify the qualified RTs who could conduct solo training sessions for all MSE subject teachers. For example, for the 38 English RTs, only 27 (71%) qualified as RTs to train English teachers while 11 (29%) did not qualify.

8.4.4 Piloting the Training Programme Using Resource Trainers

Before the actual teacher training, a pilot training was conducted. 5% of the total expected English teachers were taken as a sample of teachers who were invited to be trained by the qualified RTs. The RTs conducted the same training on the same content as used during RT training for 6 days. During RT piloting exercise, the RTs were expected to put what they learnt during their RT training into practice before they start training a larger group of English teachers.

8.4.5 Solo Training for English Teachers

In this case, one of the MSE subjects is taken and unpacked on how A2IT2 model was deployed at training specific group of teachers. Let us consider the training session for English teachers. Figure 8.3 shows the layout of the training sessions for the 6 days. During the English teacher training, the RTs applied their content knowledge with a group of English teachers but also demonstrated their facilitation skills.

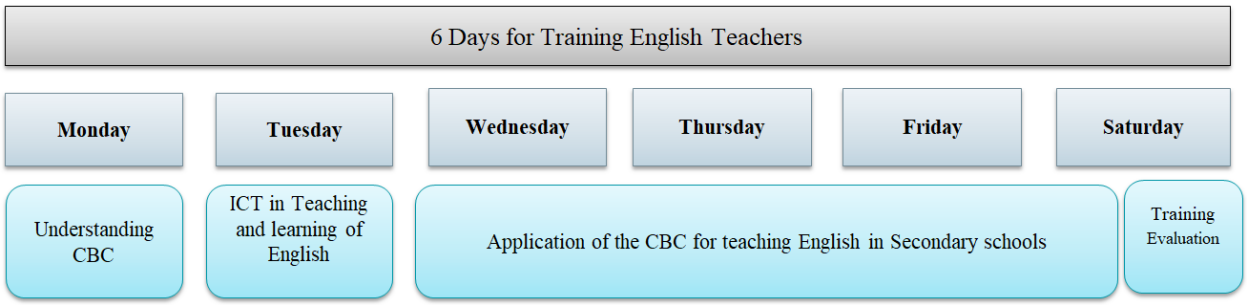

Figure 8. 3: Schedule for training English teachers

8.4.6 Phases of A2IT2 Model during Trainer Development

The teacher trainer development phases took place at different stages of the training program. These stages are evident from the RT training to the large-scale teacher training sessions. Table 8.3 shows the occurrence of the phases while Table 8.4 shows the expanded version of the phases showing other attributes.

Table 8. 3: A2IT2 Phases during EQSSE-Z Project

Attain	Align	Integrate	Teach	Train	
				Practice training	Full training
During the RT training	During the RT training	ICT integration during RT training	Microteaching during RT training	During pilot training	During training of English teachers

Table 8. 4: A2IT2 Model Implementation in Training English Teachers

	Phases					
	Attain	**Align**	**Integrate**	**Teach**	**Train**	
					Co-train	Full Training
Goal	Introduced teachers to the concept of competence-based curriculum and its implementation	◦Assessment strategy to intended competencies ◦Instructional strategies to intended competencies ◦ICT to intended competencies	ICT-integrated lesson plan for English subject	◦Implementation of CBC in English lesson ◦Integration of ICT in a CBC-based class	Training of a small number of selected teachers the same English content with supervision of Master Trainers	Experience a full training with teachers in the training centres
Coverage	◦ Shift from content-based teaching to competence-based teaching ◦Introduction to CBC ◦ICT in teaching of English subject	1. Speaking Using Appropriate Language and Context 2. Listening Skills 3. Writing Skills 4. Language Structure 5. Reading Skills	◦ Effective integration of visual and audio visual resources in teaching English	◦Teaching a 20-minute lesson to participants during RT training	◦Entire English content as per schedule	◦All the training content for the duration stated
Nature of activities	◦Pair activities ◦Open-ended questions and	◦Pair activities, e.g. identifying main skills and sub-skills	◦Group activities, e.g. listening to long and short vowel	◦A 20-minute microteaching session from	◦Guide the selected English teachers on the training content	◦English teachers training ◦Provide feedback

	activities ᵒDiscussions	ᵒGroup activities: e.g. develop a competence-based lesson plan	sounds	groups		
Master Trainer's Role	Instructor	ᵒFacilitator	ᵒFacilitator ᵒidentifying potential school-based INSET coordinators	ᵒFacilitator	ᵒMentor to support the RTs	ᵒMentor to support the RTs
Resource Trainer's role	Active learner	ᵒ Work on pair activities ᵒ Lead group discussions	ᵒEnsure CBC is implemented in teaching English ᵒEnsure ICT is integrated in teaching a CBC-based lesson	ᵒGroup One group member to microteach a lesson while others become 'students'	ᵒTrainer of the selected English teachers ᵒSuggest improvements to be made to improve the content	ᵒTrainer of the selected English teachers
Mastery Level	ᵒGeneral knowledge of CBC and its implementation in MSE subjects	ᵒSome mastery of English content and CBC techniques	ᵒMastery of English content and CBC techniques	ᵒImplementation of CBC in teaching English	ᵒEnglish content mastery ᵒEnglish content modification	ᵒCBC implementation in English lessons
Mode of delivery	ᵒLecture ᵒDiscussions	ᵒGames ᵒGallery walk	ᵒGallery walk ᵒJigsaw	ᵒRole playing ᵒPresentations	ᵒTraining	ᵒGames ᵒGallery walk

	◦Brainstorming	◦Jigsaw ◦Group discussion	◦Group work discussion	◦Feedback		◦Jigsaw ◦Group discussion
Achievement	◦Different perspectives of CBC and its application in teaching of MSE subjects	◦Constructively aligned lesson plan	◦ICT-enhanced lesson plan	◦Practical mastery of CBC techniques and ICT integration	◦Some training and facilitation experience	◦Full teacher training experience
Skills Developed		◦Creating competence-based activities	◦ Competence-based, ICT-enhanced lesson plan	◦Implementation of CBC in teaching English in the class ◦Designing CBC-based activities	◦CBC-based lesson design ◦Training skills ◦Facilitation skills	◦CBC-based lesson design ◦Training skills ◦Facilitation skills

8.5 Thesis Claims and Evidence

i) A2IT2 model enhances content knowledge of the training.

- The different roles teachers took through the different content and skills workshops increase their confidence to train other groups of teachers in different groups and different contexts. The different roles are shown in Table 8.5.

Table 8. 5: Content Ownership across Transitions of Teachers

Iteration	Role	Content ownership
1	Learner/Participant	The participant learnt about the workshop content
2	Learning Assistant (LA)	At this stage, the LA assisted the master trainer in some activities during CW2.
3	Co-trainer (CoT)	• CoT selected subtopic and adapted it to the new audience • Skills from SW1 helped the CoT in managing the micro-session • The rest of the CoT helped in facilitation of the content to the participants
4	Trainer	Managed the entire training session from beginning to the end using the same CW1 content.

ii) The developed teacher trainer plans, conducts and evaluates a teacher training programme effectively.

- The skills workshops (SW1 and SW2) introduced the teacher trainer to skills such as facilitation skills, presentation skills, and activity design that are relevant to teacher training.

- Co-training and full training sessions taken by the teacher trainer gave opportunities to apply the skills learned in a real-life setting, e.g. in CW4a and b.

iii) Teacher trainer development is important to effectively cascade teacher training programmes.

- Teachers teach students. Changing their roles to become teacher trainers needs training. There are important pedagogical and presentation skills that teachers need to plan and conduct adult training as it was done during SW1 and SW2.
- While more research is available on teacher professional development, less is available on trainer development. It is important to build skills and competencies of teachers as they transition to becoming teacher trainers. This is as it was for the skills workshops (SW1 and SW2).

iv) A2IT2 model produces competent trainers who can sustain cascaded training programmes.

- Sustaining training programmes is important to ensure that transfer of training happens at the different levels of the cascade. The training competence is evident from the session taken by the fully trained teachers who conducted Studies 4a and 4b.

v) Challenges associated with the cascade model of teacher training such as trainer confidence, distortion, misinterpretation and dilution of the training content are minimized.

Learning of the same training content repeatedly across different content workshops engaged trainers in many activities. The trainer of CW4a said that:

> "*I learnt the topics in repetitions because we learnt the same topics in Dec 2018 in the first place, but again in June 2019. So, learning by repeating the same topics has made me confident*".

The content learned repeatedly enhanced the trainer's confidence to manage solo training.

8.6 Implications of the Results

The findings in this research have both practical and theoretical implications:

i) *Teachers:* Teaching students is different from working with adult learners. Teachers who look forward to becoming teacher trainers need specific skills to manage the adult participants in workshops. Adults learn more when the topic is connected to the practice happening in their contexts. The sessions need to be job-oriented, practical and engaging. Trainer needs skills that are relevant to engage adult learners in a learning scenario.

ii) *TPD programme designers:* Most of the teachers training programmes aim at reaching many teachers in a short period of time. This is achieved through cascaded training programmes. Teacher training programme designers need to ensure that few selected individuals can be best developed as trainers if they are given opportunities to develop knowledge of the content and equip with the necessary skills. This is achieved through different roles they go through such as being a learner, learning assistant, co-trainer and finally becoming a full teacher trainer. This gradual release of responsibility helps the developing trainer acquire the necessary skills that are important for training teachers.

   Careful analysis of training context is a key ingredient in the successful implementation of any TPD programme in countries such as Tanzania.

iii) *Teacher Trainers (implementers of cascaded TPD programmes):* Current practice during teacher training sessions that focus on technology integration is on knowledge of the technology tool. It is important that for the duration of the training, time is set to impart important pedagogical and presentation skills that can help those who will cascade the training sessions back in their schools.

iv) *Local Facilitators:* Implementing scaled cascaded TPD programmes in Tanzania involves the facilitation of regional, district and ward education officers. These facilitators focus on scaling up the training programmes to as many schools as possible in their areas. Scaling up these efforts successfully require trainers at each level. These trainers need skills and content knowledge to help them in training teachers. A2IT2 model will be useful in creating the trainers at the local level to sustain such scaling ambitions.

8.7 Generalization of the Findings

8.7.1 A2IT2 Model in Teacher Training Programs

A2IT2 model evolved from a research work that involved activities with school teachers who came from primary and secondary schools located in seven (7) different regions of Tanzania. All the teachers had similar characteristics as listed in Section 9.1.1. This implies that, A2IT2 can extend to teacher training programmes that aim to train many teachers in a short period of time.

A2IT2 model is also suitable in the fields that aim to use local people as trainers of others to equip them with the necessary skills that are important for the work. This is similar to the work by Brion and Cordeiro (2018) when implementing a Train the Trainer (ToT) model in building capacity of nineteen (19) school leaders as local trainers in five (5) different African countries. This training used design principles including active learning strategies and learning transfer theory.

8.7.2 Implementation of A2IT2 Model-based Workshop in other Domains

One of the features of a valid model is its generalizability to other contexts and settings (Leung, 2015). Teacher training models that are generalizable can be applied in training teachers from different disciplines and domains. In this section, an example of a domain other than ICT was selected and implemented in a teacher training programme.

In this case, a six (6) days training program is considered. The training was conducted from Monday through Saturday. The selected training programme name was: *Implementation of CBC for teaching Biology in Secondary Schools in Zanzibar, Tanzania*. As part of the preparations when developing training packages, it was important to consider the following assumptions:

i) Participants are Biology teachers;
ii) Participants have strong Biology content knowledge (CK); and
iii) Participants use one lesson from Biology module.

Appendix L gives 17 steps that can be considered when conducting a 6-day workshop planned, developed and implemented using A2IT2 model. This implementation involves a mixture of activities and lectures depending on the phase.

8.8 Limitations of this Research

The following are some limitations to this research work:

i) *Few participants per workshop:* This research was implemented in a workshop format. Each of the workshop involved school teachers. On average, each workshop consisted of 20-30 participants. This number could be small to make generalizations to the entire teacher community in Tanzania and beyond. In future studies, workshops can focus on increasing the number of participants that will increase generalizability of similar research.

ii) *Male teacher trainers:* While it was important to include participation of all genders in the research work, many participants of the workshops happened to be males. There are reasons for this case. News about the workshops was advertised and shared to school teachers and in social communities of teachers. Many females did not join the workshops. In the future, more engagement of female teachers can be considered to ensure a balanced participation of all genders and generalizability of findings.

iii) *Technology-related workshop content:* Since the focus of this research was on developing teachers to become teacher trainers, the content of the workshop was developed to help teachers in teaching and learning with technology tools. While many teachers who had some good prior experience enjoyed all the sessions, some took that chance to learn about technology integration for the first time.

Chapter Nine is the final chapter in this research. It mainly highlights the contribution of this research including the scientific, practical and societal outputs. Towards the end, recommendations from this research are given.

Chapter Nine

Conclusion and Future Work

In a typical cascaded teacher training programme in Tanzania, every trained participant is assumed to be a teacher trainer, thus entrusted with the responsibilities to train other teachers after the training session is completed. This is a common problem to teacher training programs due to the challenges the trainers face to cascade down the training to lower levels. TPD programme designers need to design in such a way that they focus on how adults learn. Adults learn differently; hence, adult learning principles need to be followed when training these school teachers.

This study developed A2IT2 model to improve the efficiency of sessions taken by secondary trainers. It focused on developing few competent teacher trainers who can effectively cascade the training programmes at lower levels of the cascade. The model developed quality teacher trainers who in turn improve the quality of the training. The studies deployed Design-Based Implementation Research (DBIR) methodology. This Chapter discussed the major contributions of the research (Section 9.1); recommendations (Section 9.2); and areas for future research work (Section 9.3).

9.1 Contribution of the Thesis

The studies conducted have contributed scientifically and practically to the improvement of cascaded TPD programmes. In the same line, there have been some contributions to the society, especially in improving the quality of education.

9.1.1 Scientific Output

i) *The A2IT2 model:* This model enables cascaded TPD planners and designers to design and develop training programmes that can be cascaded with efficiency and effectiveness.

Effectiveness is determined by how the trainers expressed confidence after planning, conducting and evaluating their solo training sessions.

ii) *Design Principles for cascaded training programmes:* The challenges of implementing cascaded TPD programmes can be reduced or minimized when the design incorporates a number of important activities, namely:

- Microteaching: This principle involves engaging participants of the workshops in teaching short lessons that give them an avenue for practicing what was learnt and at the same time master the content of the workshop.
- Co-training: With micro-training, the selected participants of the workshop take part of the workshop content, adapts it to the training context, and co-trains a group of different teachers with the guidance of the master trainer who gives constructive feedback that helps the co-trainer to prepare for a solo training session with other participants.

9.1.2 Practical Output

Completion of this research contributed to some changes in the way teachers deploy technology in their teaching and learning. Several changes took place in the classroom that made clear contributions to practice. During evaluation of the impact of one of the content workshops, some teachers reflected as:

> "*The training sessions were important to me as I am now able to prepare PowerPoint presentations which I use to teach my lessons*". Another teacher reflected by saying, "*teacher motivation to use ICT tools in my school has increased. The two projectors that were rarely used are now actively being used in classes*".

This implies that teachers have changed in the ways they used to teach. This is a practical output.

i) *Technology-enhanced lesson plan:* Workshop participants in domain-based groups created technology-enhanced lesson plans that were operationalized during a microteaching session. The lessons were taken from the topics participants planned to teach for the next semester. This made it a starting point for them as they went back to

their schools. **Appendix M** is the technology-enhanced lesson plan for one of the microteaching sessions while **Appendix N** is the PowerPoint presentation to operationalize the lesson plan.

ii) *Cascading effect in schools after the workshop:* Teachers from three schools who participated in the workshop trained other teachers on the same content. The training sessions were hindered by factors such as time limitations, motivation of teachers, and availability of the necessary infrastructure. However, the workshop participants ensured that they shared the knowledge and skills with other teachers who did not get a chance to participate physically during the workshop sessions. One of the teachers who trained a large number of teachers stated that:

> "*I trained a total of 126 primary and secondary school teachers from Turiani, Mvomero, Mlali and Mgeta wards in Morogoro region. The training centres were Mvomero Primary School, Madizini Primary School, Nyandira Primary School, Kibogoji Experiential Learning Inc (KELI) and Mzumbe Secondary School. I trained them on PowerPoint and mentimeter applications*".

This implies that the workshops extended to a number of schools, impacting a number of teachers.

9.1.3 Societal Output

i) *Teachers trained:* This work has trained a total of 143 professional school teachers through the content workshops. Skills workshops involved participants from content workshops. Table 9.1 shows the number of teachers who attended the different content and skills workshops during the different iterations of the model.

Table 9. 1: Total Number of Teachers Trained for each Workshop

Content Workshops					**Skills Workshops**		**Confirmatory Workshop**
CW1	CW2	CW3	CW4a	CW4b	SW1	SW2	CfW
19	26	35	20	22	11	4	21

These teachers have been able to bring changes in their areas of work by improving their teaching practices to integrate technology. Others have managed to share their experiences of the content of the workshop with teachers in their schools and adjacent schools. Participants of the different workshops came from different parts of Tanzania as shown in Figure 9.1.

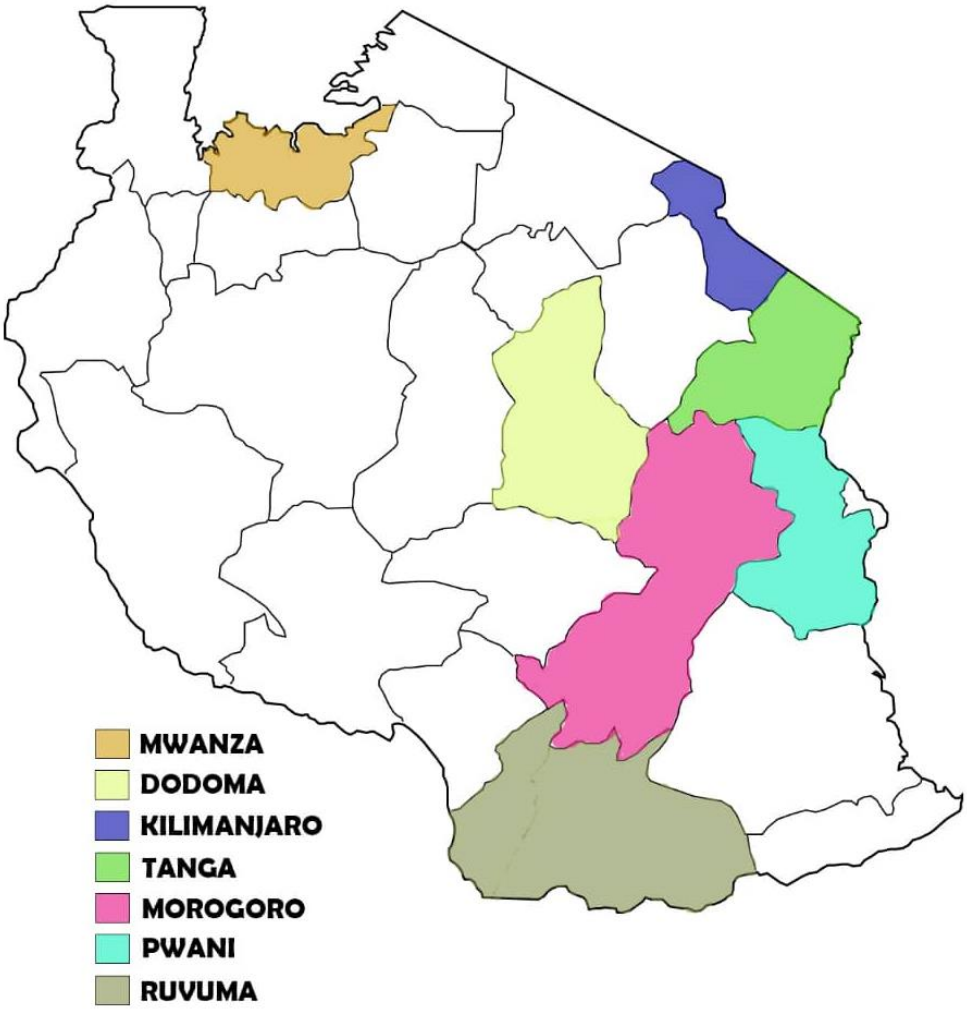

Figure 9. 1: Location of workshop participants

ii) *Teacher trainers developed:* Out of the 143 participants at the different content workshops, 4 of them progressed to becoming teacher trainers. They participated in co-training sessions and conducted solo teacher training sessions at different locations with different participating teachers. The 4 teacher trainers were ready to cascade the same teacher training as they were fully aware of the content of the workshop and had the skills to conduct training sessions.

iii) *Transfer of knowledge among participants across workshops:* The content workshops involved school teachers as participants. Across the four studies and the confirmatory studies, a total of 143 participants were trained. Figure 9.2 shows the number of teachers who responded to the question about sharing experiences.

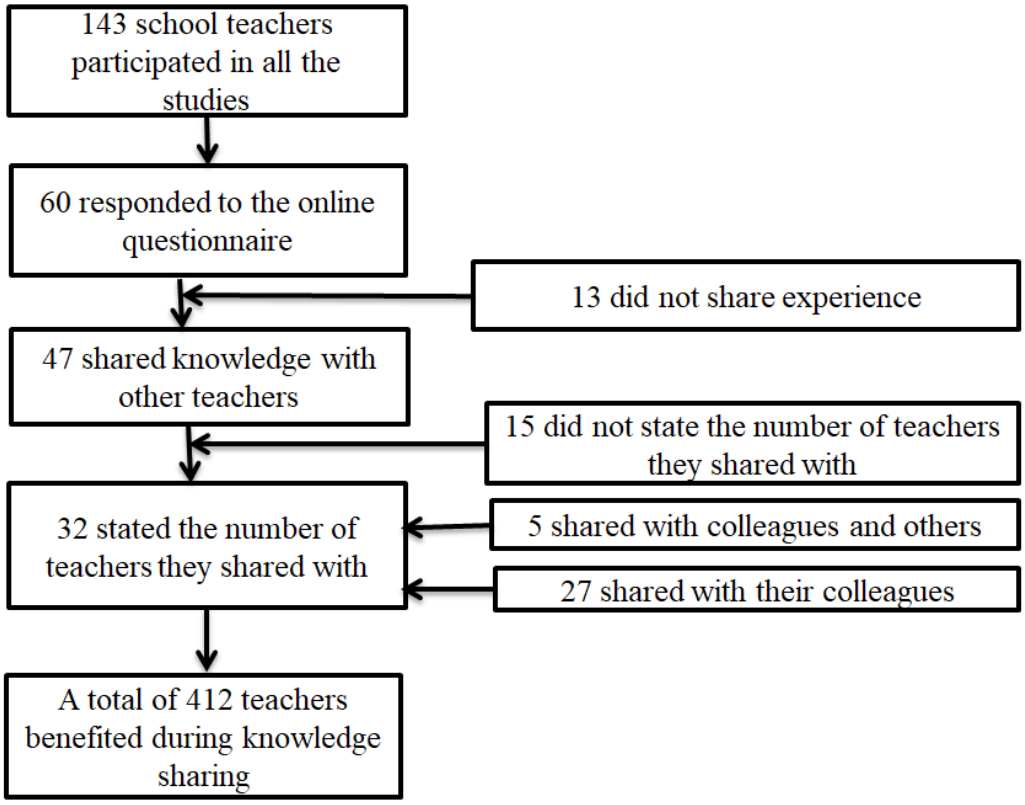

Figure 9. 2: Sharing experiences from participants from different workshops

Most of those teachers who responded to the questionnaire [47 (78.3%)] shared knowledge with either colleagues at their schools, in a school-based training, or both colleagues and teachers from other schools. As the sharing happened, they shared more on the content of the workshop, all focusing on improving in the use of technology tools in teaching. For example, while the participants shared on the tools discussed during the workshop equally, they also went beyond by training on topics such as introduction to computers and even advanced topics such as Excel for processing examination results.

9.2 Recommendations

A2IT2 model aims to develop teachers to become teacher trainers. This involves teachers as participants across the different studies. These teachers have different individual characteristics and interests. The teachers also come from schools that have different backgrounds in terms of infrastructure and support. The following are some recommendations that could be seen as design principles from this research as A2IT2 model is being deployed in teacher training. These may be used by training designers in comparable contexts.

9.2.1 Planning for Teacher Training Programmes

i) *Selection of training participants:* The development of A2IT2 model involved teachers participating in different content workshops while changing their responsibilities. This can be looked up in two perspectives:

From the teacher perspective: The bare minimum requirements as a participant in A2IT2 model-based workshops is 1) basic knowledge on computer operations such as switching on and off computers and file and folder management; and knowledge of basic MS Office applications, such as MS Word and PowerPoint. For quality teacher training, selection of teachers to join as workshop participants should also consider their motivation, both internal and external motivation. Some criteria to select workshop participants can be set to ensure those who really need the training participate and hence leaving out those who are motivated by factors such as financial gains, as one participant said that: "*Most teachers were not ready for the training as they were after money, they wanted to be paid for the training*". It is important to select participants who are passionate to learn and share, and who can transfer the learning into their own contexts.

From the school perspective: It is important to ensure that the schools are prepared in terms of the availability of minimum infrastructure to support the trained teachers. Depending on the number of students and teachers per class, a school with the following minimum requirements will support them: A functional computer lab with functioning computers and availability of projectors.

ii) *Training Design:* In some cases, adult learners become anxious when learning about computers in teaching and learning. For ICT-based teacher training sessions that are designed to be carried out in a number of days, set the initial session to be on basics of computer use and smartphones (installation of applications, registration to platforms); projectors connections to devices; and Searching for resources from the Internet. This helps to familiarize with all the necessary components and devices which will help participants as they practice and connect prior knowledge to different sessions. It also motivates participants and builds up their confidence, and the necessary comfort to prepare for the next sessions. Involve both in-class group activities and individual activities to help participants practice what they learn during the different sessions. Providing homework to participants engages them more on the content of the workshop.

iii) *Design for Transfer:* It is important to have a training program that will be impactful, involving components that will aid in the transfer of the learned knowledge to other contexts. This is achieved by how long participants undergo a training program. For the content workshops, the number of hours per day that teachers are trained can help them get time to work together collaboratively and achieve the goals. For our face-to-face workshops, 5-6 hours were used per day, for 3 days. On the last day of training, encourage participants to plan how to use the knowledge and skills when they go back to their schools, with predetermined objectives. Encourage participants to prepare a training plan while still at the training site and set a minimum threshold to achieve the objectives. Those who go beyond the minimum threshold can be motivated in many different ways such as certificates of recognition or even a special award.

iv) *Use of DBIR Methodology:* Design-based implementation research develops and implements interventions for the classroom and other learning environments. It undergoes cycles of iterations until when the intervention is stable for deployment. The output of a DBIR project is approximations of the real prototype that is a stable solution to the educational problem. This practice improves sustainability of the projects (Penuel et al., 2011).

9.2.2 Preparation of the Training Session

i) *Developing Teacher Trainers:* To have participants who will be relevant and who will play a role to cascade the training, it is important that qualified and committed participants are selected. To develop teacher trainers in this research, a selection mechanism was employed at two levels: 1) Criteria for inviting teachers to participate in the training workshop and 2) selection of participants who became teaching assistants, and selection of co-trainers. A number of selection criteria were set to invite these teachers at different training sessions. One of the criteria was to ensure that their schools possess a functional computer laboratory. This criterion ensured that the selected participant would be able to apply what he/she was able to learn back in their schools. Selecting suitable participants ensures that the right people are taken to develop into competent trainers who will ensure the quality of the training, and hence achieving the intended objectives.

ii) *Bring Your Own Device (BYOD):* In case the agreed training centre does not have enough ICT facilities, encourage participants to bring their own devices. In A2IT2 workshops, participants were encouraged to bring their mobile devices (laptops, tablets and smartphones) to the training venue. These devices made individual activities to be completed within the stated time. As participants worked on group activities, they selected one device to use for presenting what they had compiled as a response to the activity. BYOD rule can be used to ensure teachers come with their own devices to the training venue. This is evident from the statement from one of the participants of the cascade model: *"Most teachers had no computers for practice as they were learning only theoretically not practically; this made the training not effective"*.

iii) *Blended Workshops for TPD:* In many developing countries such as Tanzania, it is a common experience to find teachers with 5 or more years of experience who have not been able to participate in any professional development activities within the school or beyond. With the advancement in communication technology, designing and implementing blended TPD programmes is one way of improving professional development of teachers. Skills workshops (SW1 and SW2) were implemented in

blended and full online respectively, and participants of these workshops revealed that they learnt the skills and applied them during content workshops.

9.2.3 What to do during the Training Sessions

As the training session progresses, a number of points need to be taken into consideration. These are on both sides: the trainer side and the mentor side. For the trainer, as the session is going on, it is important to ensure that:

i) You divide the participants into groups. The groups need to be formed based on participants from similar domains. For example, teachers teaching Physics can be in one group while those teaching Maths can be in the other. This is done so to ensure creating examples from their domains is easy.
ii) Explain the procedures/steps clearly to all participants. Ensure everyone has understood the activities clearly. This will ensure similar responses come from participants.
iii) Expect the support from your mentor when something does not go as planned.

From the mentor side, the mentor needs to ensure the following:

i) Provide support when needed to the session trainer. This helps the trainer move to the next steps in case something was not clearly explained.
ii) Note some points that will help in shaping the discussion during a debriefing session where the trainer will be summarizing what happened (what worked and what did not) during the sessions.

9.2.4 Assessment and Follow-up

i) Assessment and Feedback: Feedback is one of the components of any training programme. Cascaded TPD designers need to incorporate a feedback mechanism that will be collected and submitted during and after the training sessions. Trainers should not be left alone; a follow-up needs to be done to ensure that the objectives of the training programme are reached.

ii) *Use of Technology Tools for Follow-up:* Effective and systematic use of technology tools, such as WhatsApp and video conferencing tools such as Google Meet, have been

found to be helpful in making follow-up of some activities of the workshops that were planned for studies. In these research studies, WhatsApp and Jitsi Meet were common applications that were used for quick communications and in making presentations respectively. Technology applications can help in following up with the trainers especially when they are preparing for their sessions; collecting feedback from the trainers and experts in case of scattered schools; and giving general instructions about some related activities.

9.2.5 Guidelines for Planning and Implementation of A2IT2 Model-Based Cascaded Teacher Training

Implementation of A2IT2 model in development and implementation of teacher training program can be achieved using few stages outlined in Table 9.2. The stages outlined depend on how the programme is designed. The first stage assumes that planning, design and development of training content is developed in advance.

Table 9. 2: Implementing A2IT2 Model-Based Cascaded Teacher Training

Stages	What Master Trainer does	From participant to trainer
Stage 1: Training programme design	Plan, design, develop training materials	
Stage 2: Participant selection	Select participants based on the criteria for the content to be trained on	Participants are selected for the workshop
Stage 3: Attain-Align-Integrate	• Instructs on introduction • Facilitates the activities during	• Active learner during Attain Phase • Engage in group activities during Align Phase • Technology integration to achieve learning objectives
Stage 4: Training of teachers	• Uses approximately 90% of the time on content • Use approximately 10% of the time in facilitation skills	• Become learners who learn about the content • Go through the content and suggest adaptations (add/delete, examples, activities, etc.) • Get trained on workshop facilitation skills

Stage 5: Microteaching during training [Teach Phase]	• Based on the nature of training, involve some microteaching sessions to practice some teaching skills (Teach Phase)	• Participants to take up microteaching sessions to implement a developed lesson plan
Stage 6: Pilot Training [Train Phase]	• Monitors the training • Provides feedback on the training session during reflection • Performs the suggested improvements	• Adapt the training content, contextualize it • Conduct a full training during pilot • Reflect on their training sessions • Evaluate the training • Suggest any improvement on the training plan and training packages
Stage 7: Full training [Train Phase]	• Oversees the training • Mentors the trainer	• Take full training sessions • Evaluate the training • Reflect on the training session

9.3 Future Research Work

9.3.1 Combining the LA Functions into the CoT Stage

A2IT2 involves the learning assistant (LA) stage where selected participants from the previous workshop engage in supporting the workshop participants in the learning process. Answering questions and directing participants in group works are some of the roles LAs do. While one of the co-trainers takes up a co-training session, the rest of the co-trainers can engage in helping participants in the training room. Further research could extend these roles to be done by the co-trainers as part of their roles and determine the effectiveness of the training sessions. The success of this combination will reduce the stages that each developing trainer go through to graduate as a trainer.

In case when participants have the desired characteristics, such as content knowledge, experience in ICT workshops and motivation, the training programme can be designed in such a way that Study 1 is avoided and the desired participants start at Study 2. This will make them start with the learning assistant role in the workshop.

9.3.2 Design to Develop Gender-Balanced Teacher Trainers

Even though the selection criteria for identifying potential teacher trainers was open to all participants, male participants were more motivated and ready to participate in the trainer development process by A2IT2. Female participants preferred to remain participants in the content workshops, CW1 and CW2. The 11 learning assistants who joined CW2 and the 4 co-trainers who joined CW3 were all males. Research on the implementation of the model with a gender-balanced trainer team can produce interesting observations that can enrich the teacher training domain in Tanzania.

9.3.3 Determine the Impact of Application of A2IT2 Model in Training Teachers

During this research, A2IT2 model was deployed in workshops including small (20-30) participants. Deploying the model in workshops with large number of participants can lead to results that can be interesting to note. This can also set up the number of trainers to be developed and the number of levels of cascade to design, given the population to be reached. For example, if the goal is to train 10,000 school teachers in one region of Tanzania, how many trainers are needed to develop and how many levels of the cascade will need to be planned to ensure a quality training programme that leads to transfer? All these questions can be answered if A2IT2 is implemented several times in a large group of participants.

9.3.4 Education Management as a Catalyst to Technology Integration

Even though participants from some schools demonstrated motivation to use technology back in their schools, they reported that the school management did not support such efforts. For example, education management did not like the idea of using a soft lesson plan and scheme of work compared to the hand-written documents. One of the participants of CW2 said:

> *"I used to prepare schemes of work by using my computer and printed them, but unfortunately academic education officials and some education Quality Assurers did not accept. They reported that they found me without schemes of work and ordered me to write by pen and paper".*

There is a need to conduct research on the best practices to bring about a change in leadership that can embrace the technological advancements in the teaching and learning space, especially in schools that have limited resources.

9.3.5 Investigating Generalizability of A2IT2 Model

The studies in this research work worked with school teachers. As they worked in their groups to create a technology-enhanced lesson plan, they operationalized it during a microteaching session. It is worth investigating whether A2IT2 model can be generalizable to other domains with the same effect. On the other hand, it is important to evaluate whether this model can be generalized in programs that use participants other than school teachers in different contexts and at different times of the year. Investigation will lead to the conclusion on generalizability of this model in other settings.

9.4 Impact of this Research to the Researcher

This research work impacted my professional career in many ways. The following are some areas that have been well developed out of this research:

i) *Researcher as a Designer, Trainer and Mentor:* From the time the research part officially started in July 2018, I assumed the roles of the workshop designer and trainer throughout first three studies (Study 1 through Study 3). This meant that I had to design the training program and then implement it as a trainer across the different training sessions. For Studies 4a and 4b, I changed the role to become a mentor. In this role, I supported and provided feedback to solo training sessions conducted by the developed teacher trainers.

ii) *Improved training competencies:* Completion of this research work impacted my training skills in many ways. I have a thorough understanding of what it takes to plan, conduct and evaluate training programmes for different purposes. All the 5 content workshops and 2 skills workshops involved prior planning and ended with evaluation to find out their impact. Conducting all these workshop sessions helped me know the various components that are important when training adults. For example, the use of energizers after every 15-20 minutes really helped a lot to keep participants active and engaged.

iii) *Integration of Technology Tools in Teaching and Learning:* Even though content workshops focused on two technology tools, mentimeter and padlet, I have been able to explore more technology tools (Nearpod, piazza, socrative and PollEverywhere) that I have shared with groups of teachers during online workshops. On the other hand, participants have been able to explore these tools and other tools in their teaching and learning practices. For example, when asked about technology tools teachers had used beyond mentimeter and padlet, they reported to have used other tools such as Google forms, Kahoot, Edpuzzle and PowerPoint. It is therefore seen that the teachers who participated in this research across the different workshops have been able to practice a number of technology tools even after going back to their schools.

For the number of years I have worked on this research, I have changed in many ways. This helps me engage in other related projects by taking different roles. The more I engage in these projects the more I gain expertise in designing, developing, implementing and evaluating projects within the teacher education field and beyond.

PUBLICATIONS FROM THESIS

a) Conference Papers

1. Ngeze, L. V., Khwaja, U., & Iyer, S. (2018). *Cascade model of teacher professional development: Qualitative study of the desirable characteristics of secondary trainers and role of primary trainers*. Proceedings of the 26th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education.

2. Ngeze, L. V. & Iyer, S. (2019). *Developing a Model for Effective Cascaded School Teacher Training on ICT Integration in Tanzania*. Proceedings of the 27th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education.

3. Ngeze, L. V. & Iyer, S. (2019). *Online Teacher Professional Development in ICT Integration in Tanzania: An Experience Report.* Proceedings of the 27th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education.

4. Ngeze, L. V. & Iyer, S. (2021). *From Teaching to Teacher Training: Embedding Important Skills Needed to Develop a Teacher Trainer in Cascaded Teacher Professional Development Programmes.* Proceedings of the 29th International Conference on Computers in Education, Online: Asia-Pacific Society for Computers in Education.

b) Book Chapter

Ngeze, L. V. & Iyer, S. (2021). *Teachers Co-Creating For Teachers: Design and Implementation Of An Online Teacher Professional Development Course In Sub-Saharan Africa*. In Global Perspectives on Educational Innovations for Emergency Situations. Springer. Accepted for publication

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APPENDICES

Appendix A: Sample Lesson Plan for Technology Integration in Teaching

Class:	**Subject:**
Topic:	**Lesson Duration:** 15 minutes
Prepared by:	**Group No:**

Lesson Summary

Describe what this lesson is about, purposes of the lesson and technology you will integrate.

Learning Objectives (Two Learning Objectives)

At the end of this lesson, teachers should be able to:

1.
2.

Materials/Resources Needed

What materials do you plan to use during your lesson (e.g., software tools, handouts, overheads, and media)? Why will you use them?

Instructional Procedures

Describe the instructional strategies that you will adopt to implement the lesson. Be specific about what activities that students will do, how you will engage students and so on.

What teacher will do	*What students will do(activities)*	*Duration*

Technology Integration

Revisit the table above from a technology integration perspective. Describe the role mentimeter and its position in the teaching-learning process.

What teacher will do	*What students will do(activities)*	*Role of Mentimeter*

Assessment

(i) What methods would you use to assess how well the students learned the materials

(ii) Show how your assessment is aligned with learning objectives.

Appendix B: Classroom Observation Protocol

Part 1: Background Details

Observer Name(s):

Observation date:	Observation start time:
Length of Observation:	Observation End Time:
Class:	Instructor name:
Topic:	Subject:
Participants:	Technology:
Setting:	

Part 2: Observation Notes

Please take detailed notes in real time as you observe classroom activities

a) Structure of the lesson

Describe the structure of the lesson that you observe. What is happening in the classroom? What are the teacher and students doing?

What You See	**What You Think**

b) Interaction between the teacher and students

How do the teacher and students interact? Try to capture examples of questions the teacher asks students and how students respond.

What You See	**0-3 min**	**4-7 min**	**8-11 min**	**12-15 min**	**16-19 min**
Talking to each other					
Listening carefully					

c) Interaction among students

Do students have an opportunity to interact with one another? Do they work on a task together? Do they provide feedback on one another?

What You See	**What You Think**

d) Technology Integration

Is technology being used as part of the activity? For what purpose is it used? Are students experiencing difficulties in using the technology?

What You See	**What You Think**

e) Use of Other Resources

What other resources does the teacher use (eg. Blackboard, visuals, computers,)

What You See	**What You Think**

Part 3: Reflections on the Lesson

1. What is the teacher's overall approach to classroom instruction (facilitator, classroom manager, teacher as co-learner, etc.)?

2. Did the students seem to be clear on the procedure of the activity?

3. How did the students respond to the technology used? Did they seem bored, interested, involved?

4. Was there something about technology that seemed difficult for the teacher or students to do? Did any glitches with technology impede the process of the lesson?

5. What other reflections do you have about the lesson?

Appendix C: Co-trainers' Observation Protocol

Part 1: Background Details

Observer Name:

Observation date:	Observation start time:
Length of Observation:	Observation End Time:
Class:	Instructor name:
Topic:	Subject:
Participants:	Technology:
Setting:	

Part 2: Observation Notes

Please take detailed notes in real time as you observe classroom activities

a) **Enthusiasm**

Describe the trainer's voice tone and body language. How is the trainer's voice?

b) **Confidence**

Explain about the confidence of the trainer: How does he control the session?

c) Knowledge of the Content being Taught:

How does the trainer:

- Respond to questions
- Stick to the point under discussion
- Give examples?

d) Mode of delivery

What modes of training delivery does the trainer use? Lecture alone? Discussions? Presentations? Activities?

Appendix D: Microteaching Assessment Rubric

Group No:	*Date:*
Class:	*Topic:*
Teacher Name:	*Date*
Total Participants:	*Class setting:*

	Aspect(s)	**Not Observed (0)**	**Approaching Expectations (1)**	**Meeting Expectations (2)**
1	A learning objective(s) was clearly stated P	Not LO	Available but not specific and measurable	Stated LO, specific and measurable
2	An activity that achieves the learning objective was designed CA	No activity	Present but not directly towards achieving the LO	Present. Designed to meet the LO
3	Technology integration in the classroom to meet the learning objective(s) TP	Just mentioned about technology	Technology has been used by the teacher only to enhance instruction	The technology effectively used to enhance instruction and involved participants in a meaningful way
4	The instructional approaches used are student centered P	The approaches used were only teacher-centered	The level of student participation was	Student participation in the class was high

			low	
5	Assessment of the expected skill has been aligned to the learning objective(s) CA	No assessment of the skill developed has been included	Assessment has not been included but not matched to the developed skills	The skill developed has been assessed accordingly
6	Inclusion of real life examples	No inclusion of the real life examples when teaching	Real life example was included but not directly connected to the learning objective	Teaching of the skill has been associated with a real life example to aid learning

6. Specific areas that were worked on well:

7. Teacher's general strength in technology integration in the lesson:

8. Suggestions for improvement:

Appendix E: Group Reflection Summary

Class:	**Subject:**
Topic:	**Lesson Duration:** 15 minutes
Designed by:	**Group No:**

Based on your observation when one of your group members was teaching and the feedback you received other peers, complete the following table:

Areas that met Expectations	**Areas that Need Improvement**

Response to the Feedback Received

Areas that Need Improvement	**Feedback Received**	**Feedback Implementation**

Appendix F: A Rubric to Assess Content Modification

Participant's Name:	Topic selected:	Date:

Aspect(s)	**Evaluation of Expectations**		
	0	**1**	**2**
New content slides	No new content slides have been added	One new slide has been added	More than one new slide has been added
New examples	No new examples added	One contextual example has been added	More than one contextual example has been added
Slide Content modification	No content has been modified	One slide content has been modified	More than one slide content has been modified
Content deletion	No content has been deleted	Some part of the text has been modified	Examples and contextual data have been deleted

Appendix G: Checklist for Participant Details on Activity 1

No	Aspect	Responses
1	Diversity of teachers teaching at different levels	
2	Schools that have a working computer lab	
3	Schools that have access to the Internet	
4	Most occurring subjects by teachers	1. 2. 3.
5	Two major motivational reasons for teachers to join the workshop	1. 2.
6	Usefulness of the data given above	

Appendix H: Checklist to determine an Effective Peer Instruction (PI) Question

An effective PI question should have the following features:

No	Features of an effective PI question	
1	Uses a simple language	
2	Is not ambiguous	
3	It focuses on understanding of concepts	
4	It addresses common misconceptions students have in the topic	

Appendix I: IRB Approval from the Indian Institute of Technology Bombay

IRCC, Office of the Dean R&D, IIT Bombay

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

Institutional Review Board (IRB)

July 30, 2021

To
Prof. Sridhar Iyer
Department of Computer Science and Engineering
IIT Bombay

Ref: Proposal No. IITB-IRB/2021/038

Sub: Review of the above-mentioned project proposal submitted on 10.07.2021

Dear Professor,

Thank you for submitting your proposal to the IITB Institutional Review Board (IRB) for review. The IRB has reviewed the proposal submitted by you and the following proposal is approved:

Proposal number	: **IITB-IRB/2021/038 version 01**
Title	: **Improving the Effectiveness of Secondary Trainers in a cascaded in-service School Teacher Professional Development Programme on ICT Integration in Tanzania**

The IRB approval is for the ethical conduct of the study. The study is approved for the entire duration and a closure report should be submitted within 2 months of the completion of the study.

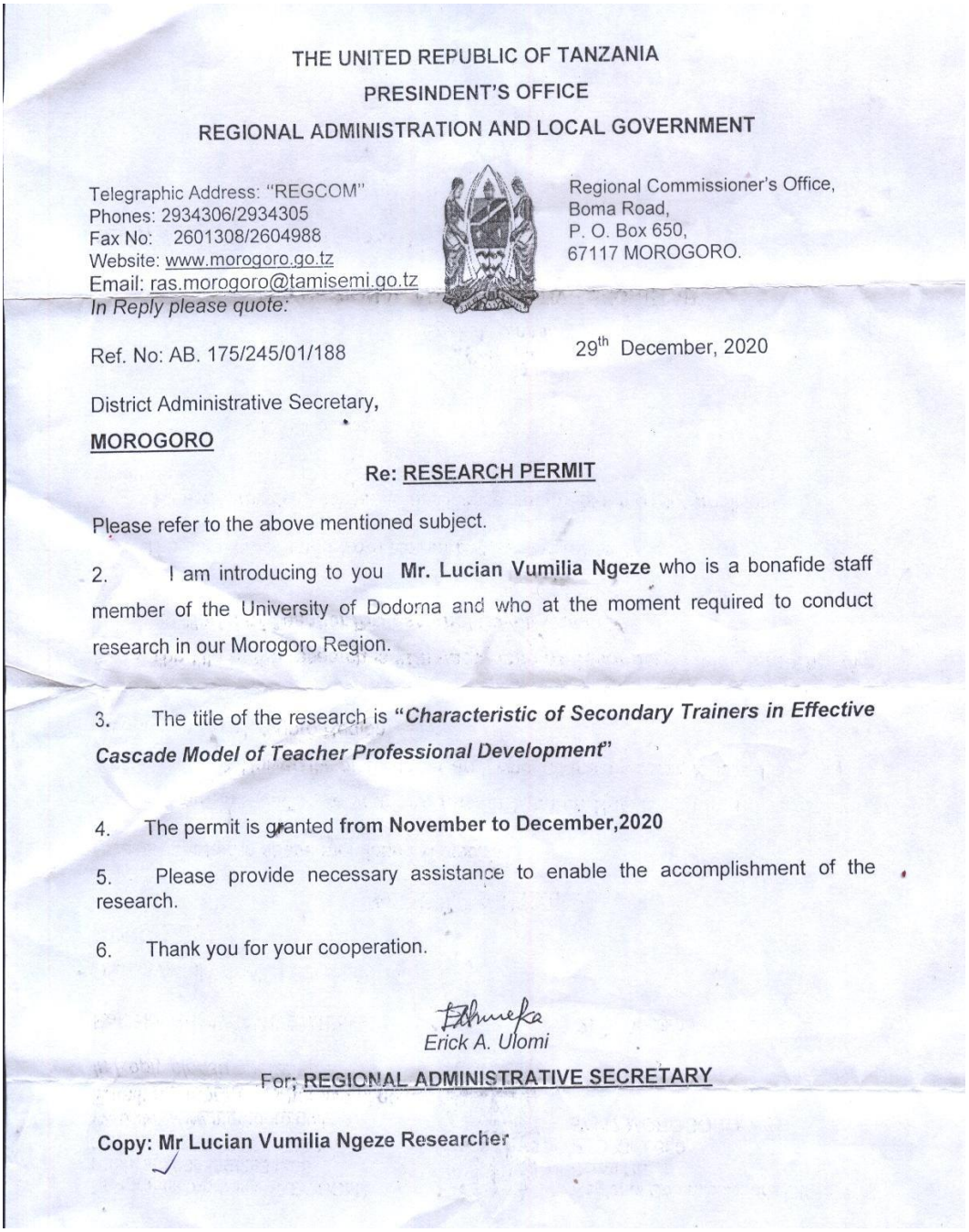
Further, it is also confirmed that neither you, nor any of the study team members have participated in the decision-making process of the committee.

In case there are any changes in the proposed work (which is not limited to scope, dates, participants and methodology etc.), please communicate to IRB within 15 days of such a change.

Thank you.
With Best wishes from IRB for your study,

For Prof.Virendra Sethi
Chairperson IITB-IRB

Appendix J: Research Permit from the Regional Education Office, Morogoro



THE UNITED REPUBLIC OF TANZANIA

PRESINDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

Telegraphic Address: "REGCOM"
Phones: 2934306/2934305
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Website: www.morogoro.go.tz
Email: ras.morogoro@tamisemi.go.tz
In Reply please quote:

Regional Commissioner's Office,
Boma Road,
P. O. Box 650,
67117 MOROGORO.

Ref. No: AB. 175/245/01/188

29th December, 2020

District Administrative Secretary,

MOROGORO

Re: RESEARCH PERMIT

Please refer to the above mentioned subject.

2. I am introducing to you **Mr. Lucian Vumilia Ngeze** who is a bonafide staff member of the University of Dodoma and who at the moment required to conduct research in our Morogoro Region.

3. The title of the research is **"*Characteristic of Secondary Trainers in Effective Cascade Model of Teacher Professional Development*"**

4. The permit is granted **from November to December,2020**

5. Please provide necessary assistance to enable the accomplishment of the research.

6. Thank you for your cooperation.

Erick A. Ulomi

For; **REGIONAL ADMINISTRATIVE SECRETARY**

Copy: Mr Lucian Vumilia Ngeze Researcher

Appendix K: Informed Consent

STUDY CONSENT FORM

Workshop Title: Training School Teachers on ICT Integration

August 2020, Forest Hill Secondary School, Morogoro, Tanzania

I am **Lucian V. Ngeze**, a third year PhD student at the Indian Institute of Technology Bombay (IIT Bombay), in India. As part of my research work, I am conducting a study to train teachers on how to become effective teacher trainers.

The study aims to train teachers to become teacher trainers. Teachers will be trained on the skills and competencies that are required to become master teacher trainers. This will help the researcher determine the effectiveness of the training.

During the study, the research assistants will be taking pictures and video of important sessions. Some of these videos or photos may be used at some point during the research process. However, will we not use these pictures and videos for any other purposes and nor will we disclose any revealing information like your name, your school or any other affiliation without your consent.

- *I have read and understood the statements above, and I provide consent to use the videos and pictures taken during this workshop for the researcher's work.*
- *I understand I have been asked to take part in the research project work by the researcher specified above. I have had the project explained to me, and I have read the introduction shared above.*

Intention	*YES*	*NO*
I will participate in all the sessions and duration of this workshop.	✓	
At any time, I can be interviewed or audio-recorded by the researcher	✓	
I agree to take photos and videos of the sessions I am participating in for the purpose of the research work	✓	
Upon completion of the training and upon returning to my school, I will be able to share with other teachers what I have gained.	✓	

My name is: Ashura M. Barongo

Signature: _____ Date: 31/08/2020

Appendix L: Implementing A2IT2 model-based Cascade workshop in Other Domains

Workshop name: *Implementation of CBC for teaching Biology in Secondary Schools in Zanzibar, Tanzania*

Duration: *6 days* (Monday through Saturday)

1. Activity 1: 15 minutes|| Pair work [ATTAIN PHASE]
   (i) In pairs, find out and discuss the difference between content-based curriculum and competence-based curriculum.
   (ii) Note you points in your notebooks
   (iii)Present two differences to the rest of the participants
2. Lecture 1 (by MT): 10 minutes
   (i) Explain the meaning of CBC
   (ii) Highlight the focus of CBC
3. Activity 2: 60 minutes: Group work [ALIGN PHASE]
   (i) In a group of 3-4 members, think of one 40-minutes topic from Form III class
   (ii) Think of two competencies that you want to develop
   (iii)Set up competence-based activities to achieve the two stated competencies
   (iv)State the assessment methods to determine achievement of the competencies
   (v) Present the two competencies developed and the activities developed to the rest of the participants
   (vi)Comment on the presentations from other groups
4. Discussion (MT to lead the discussion with the class as they respond to the following two questions): 20 minutes
   (i) Question 1: How is a good learning objective stated? Recall the presentations (10 minutes)
   (ii) Question 2: What are features of competence-based activities? (10 minutes)
5. Lecture 2 (by MT): 30 minutes
   (i) Clarify on SMART learning objectives and how they are created with examples
   (ii) With two examples, discuss the features of competence-based activities.

(iii) Explain the formation of competence-based assessment methods (questions, assignments, etc.)

(iv) Explain the concept of constructive alignment

6. Activity 3: Refine your group work
   (i) Refine your competencies, learning activities and Assessment methods
   (ii) Note your refinements in your notebooks
7. Activity 4|| 30 minutes|| Group work [INTEGRATE PHASE]
   (iii) In the same group, think of the following:
      a. what ICT tool can be used to in the activities;
      b. where can it be used as an advantage to enhance the learning to achieve the intended learning objectives; and
      c. when is it appropriate to be used.
   (iv) Introduce the technology tools in your lesson plan by clearly stating what participants will do.
   (v) Share with the rest of the participants
8. Lecture 3 (by MT): 30 minutes
   (i) Technology affordances in teaching and learning
   (ii) Technology integration in teaching and learning (when and how)
   (iii) Give examples of technology solutions (eg. Animation, simulation) to teach a complex concept.
   (iv) Give example of how technology can help in learning of complex concepts. Eg. How a human blood circulation animation can help in learning about the Blood circulation system
9. Activity 5|| 20 minutes|| Refine your technology integration plan
   (i) Refine your technology integration in the lesson
   (ii) Ensure technology is used appropriately and in the right way to achieve the LOs.
10. Activity 6||Group Work || 60 minutes
   (i) In the same group, create a 60 minutes lesson plan. Include the two learning objectives. Include the learning activities you created. Integrate technology at the appropriate location in the lesson. Include the assessment methods.

(ii) Present your completed technology-enhanced lesson plan to the rest of the participants

(iii) Receive feedback from the participants and the MT.

11. Continue Training on the Rest of the Workshop Content
12. Activity 7|| Group Work|| 40 minutes [TEACH PHASE]
    (i) In the same group, develop a PowerPoint presentation from the developed technology-enhanced lesson plan
    (ii) Include all the important components to achieve the intended competencies.
13. Activity 8 ||Microteaching presentations ||20 minutes per group
    (i) Each group to take a microteaching session with the rest of the participants. (participants now become 'students')
    (ii) Each group to receive feedback from the rest of the participants
    (iii) MT to provide feedback of the microteaching sessions presented
14. Activity 9: Discussion led by MT|| Features of a good trainer|| 15 minutes
    (i) Question 1: Can anyone train? [7 minutes]
    (ii) Question 2: What are important skills that a trainer needs? [8 minutes]
    (iii) Summarize the points for each question
15. Lecture 4 (by MT) || Facilitation Skills
    (i) Setting and facilitating an activity
    (ii) Opening and running a training session
    (iii) Communication skills
    (iv) Engaging all participants
    (v) Adult learning principles
    (vi) Training evaluation
16. Based on some criteria, select and engage some participants as trainers during a Pilot training [TRAIN PHASE]
    (i) A pilot training is used for ensuring validity, reliability and practicability of the full training implementation
    (ii) During the pilot training, select trainers who meet criteria to conduct a full teacher training.

17. Full training of all the targeted participants [TRAIN PHASE]
    (i) Training to be managed by the Resource Trainers
    (ii) Training evaluation to be managed by Resource Trainers

Appendix M: Sample Technology-enhanced Lesson Plan

Developed by Teacher Ahadi and his Group Members

LESSON PLAN

DATE	CLASS	TIME DDURATION	NUMBER OF STUENTS	
28-06-2019	FORM ONE "A"	10:40-11:20	REGISTERED	PRESENT
			45	43

Competence: The students to demonstrate an ability to distinguish odd, even and prime numbers

General Objectives: By the end of the lesson every students should be able to perform computation on numbers

Main Topic: NUMBER

Sub Topic: NATURAL NAUMBERS AND WHOLE NUMBERS

Specific Objectives: By the end of 40 minutes each student should be able to

i) Identify even, odd and prime numbers
ii) list all even and odd numbers between 1 to 30

T/L Strategies: Groups discussion and presentation

T/L Materials: number chart and number cards

Reference: TIE (2010): Basic mathematics for secondary school. Book one. Tanzania institute of education

LESSON DEVELOPMENT

Stage	Time	Teaching Activities	Learning Activities	Assessment
Introduction	04	Asking students in groups of 5 students to recall about natural numbers	In groups students use the previous learned concepts to discuss natural number s and	Observing the response of learner on stating characteristics of natural

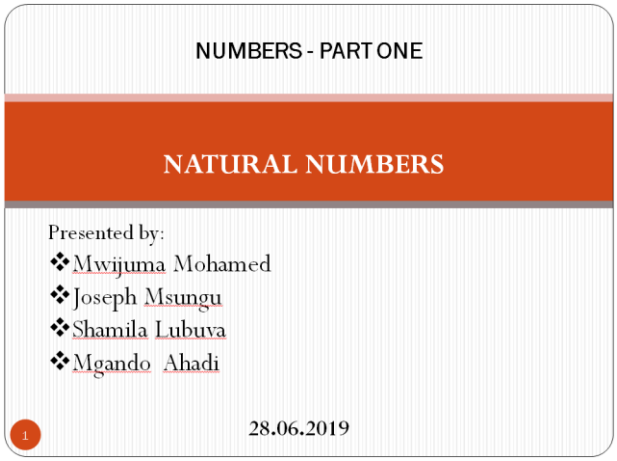
			present to the class	numbers in their presentation
New Knowledge	12	Asking student to group themselves in small group of 5 to identify odd, even and prime based on division concept	In small groups of 5 student to: i. list number 1 to 10 ii. categorize number which are divisible by 2 and not iii. dividing number 1 to 10 by other numbers And the present the lesson	Passing the through the groups checking how the discussion is conducted and assist them if necessary in order for student to be able to list even, odd and prime numbers Such as Even numbers: 2,4,6……. Odd numbers: 1,3,5….. Prime numbers: 2,3,5,7,11……
Reinforcement	15	Setting up questions on mentimeter so as students to identify odd, even and prime number between 1 to 30 based on division Example List all even, odd and prime numbers from 1 to 30	By responding to mentimeter question students to list • even numbers from 1 to 30 • odd number from 1 to 30 • prime numbers from 1 to 30 use mentimeter to submit the response	Through response from mentimeter will give the picture of all 9 groups
Reflection	03	Asking students in pair to discuss the relevance of the lesson in their lives	Student in pair to relate the use of even, odd and prime numbers in their daily life	Checking on the correctness of their answers and assist/correct if necessary
Consolidation	06	To summarize the lesson student to answer QN. Which of the following is not the group of prime numbers a) 2,3,7and 11 b) 2,5,9 and 17 23, 31 and 37	Students in groups to respond to mentimeter questions	Responding toward any reaction/challenges if necessary

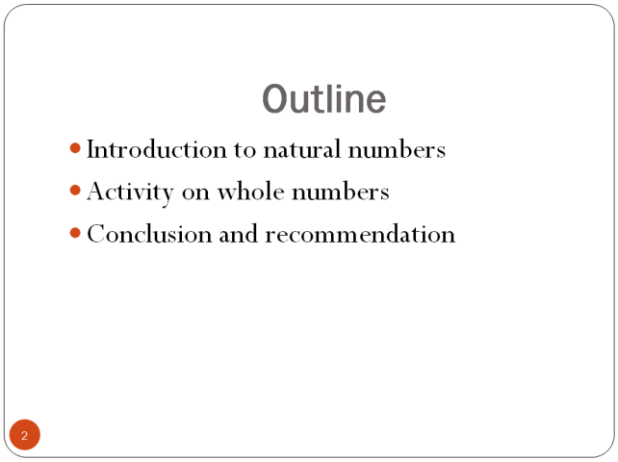
STUDENTS'S EVALUATION: *The lesson went smooth as planned most of students participated the lesson about 95%.*

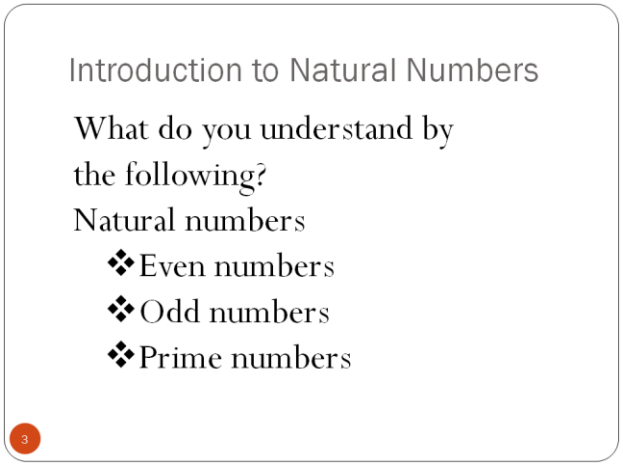
TECHER'S EVALUATION: *08 out of 09 groups respond correctly to the questions, this shows that 87% of the student did correct.*

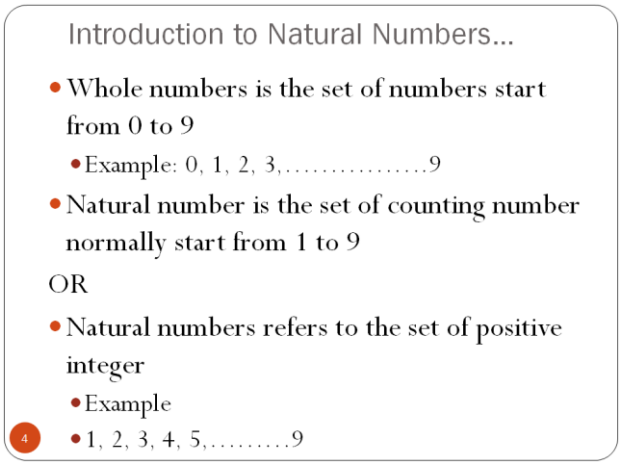
REMARKS: *To proceed with the next lesson while the remaining 13% will be given more task in remedial time.*

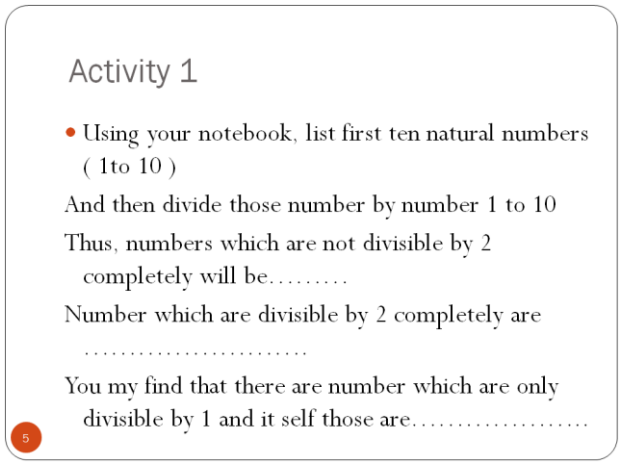
Appendix N: Sample Microteaching PowerPoint Presentation for the selected lesson

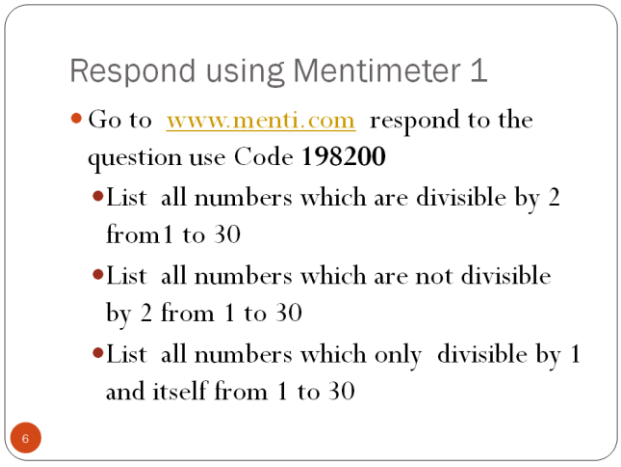


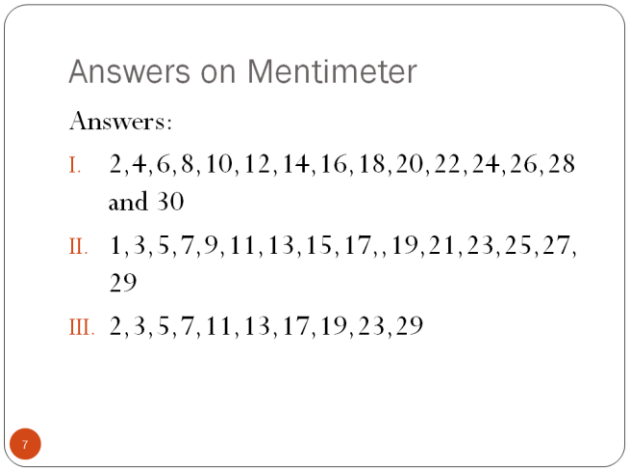


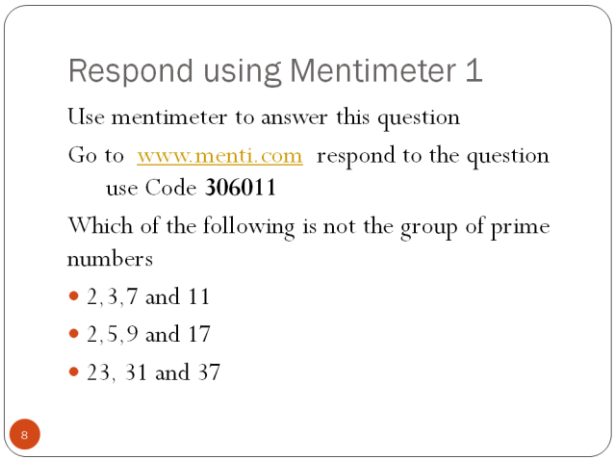












Appendix O: Experiences of secondary Trainers from the Cascade Model Training

Dear teacher,
I am Lucian Ngeze, from UDOM and a researcher on ICT in Teaching and learning. I am doing a study about the different teacher professional development models that can work in Tanzania. These will help policy makers to create frameworks that will work for training teachers in Tanzania.

Since you participated in the national ICT programme for Secondary School Teachers that run in 3 cycles (Cycle 1, Cycle 2 and Cycle 3), you might remember that we used CASCADE MODEL to ensure that Cycle 2 and Cycle 3 can be completed and that other teachers can be trained by participants of Cycle 1.

Please share what you remember about the programme.

1a) Your full name: ……

1b) Your sex. [Select the correct choice] M F

1c) Your Region: ……..

1d) Subjects you teach: …….

1e) Your Teaching Experience [Select the correct choice]

1-3 years 4-10 years 11-15 years 16-20 years More than 20 years

1f) Your Age range [Select the correct choice]

25-34 years 35-44 years 45-54 years 55-60 years

1g) Your active phone number (preferably one with WhatsApp): …….

1h) In which cycle did you participate in? [You can select more than one]

- □ Cycle 1 Cycle 2 Cycle 3

1i) What was your Training Centre? [Select the correct choice]

- □ Kilakala Sec School
- □ Dodoma sec School
- □ Pamba Sec School
- □ Lugalo Sec School

1j) After Cycle 1, how many teachers did you train when you returned to your school?

1k) My sessions for training teachers [Select the correct choice]

- □ I did not manage to train teachers
- □ I trained teachers in my school only
- □ I trained teachers in my school and other schools

2. What general DIFFICULTIES did you face when starting to prepare to train others?

3. What challenges did you face when you were going through the given handouts (PowerPoint presentations)?

4. Did you face any challenges with the trainers of Cycle 1? Mention them if any

5. What DIFFICULTIES did you face After CYCLE 1 when you were supposed to start training other teachers Yes No

6. Complete this statement: After CYCLE 1 was over, when I returned back to my school, I found it very difficult to train other teachers because:

7. What do you think needs to be done to all teachers who participated in CYCLE 1 to be able to train other teachers effectively?

8. Which skills do you think if you were trained in that, you would manage to do the training effectively?

9. What can you say about the competence of facilitators of CYCLE 1 or CYCLE 2 to help you train other teachers?

10. Which other MODULES you think if they were added, they would help you to train other teachers effectively?

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