

## **Infrastructural Friendly Model of Teaching and Learning for Developing Country**

**Abdalla A. Shaame**

Center of ICT Services  
The State University of Zanzibar  
Zanzibar, Tanzania.  
*abdalla.shaame@gmail.com*

**Haji A. Haji**

Department of Computer Science and IT  
The State University of Zanzibar  
Zanzibar, Tanzania.  
*hajiali10@hotmail.com*

**Mwanajuma S. Mgeni**

Department of Computer Science and IT  
The State University of Zanzibar  
Zanzibar, Tanzania.  
*ajumy.mgeni@gmail.com*

**Omar H. Kombo**

Department of Computer Science and IT  
The State University of Zanzibar  
Zanzibar, Tanzania.  
*omarhaji22@gmail.com*

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**Abstract:** *In recent years, the integration of ICT in pedagogy has become inevitable the educational institution. The educational institutions should find the appropriate model to adopt for the integration of ICT in pedagogy. This study aims to develop an infrastructural friendly model which can be adopted by any educational institutions in developing countries. The study was based on reviewing of relevant literature and the data collected from secondary and primary schools in Tanzania. The finding underlines that the ICT infrastructure in schools is low which needs to be improved before the schools adopt ICT based model in teaching and learning. The main conclusion drawn in this study was that developing countries should prepare friendly environments in school by improving the ICT infrastructure and human resources before adopting ICT in pedagogy. Finally, this research paper recommends that the developing countries' governments, education partners and individuals should provide enough funds to improve ICT infrastructure in schools.*

**Keywords:** *ICT, pedagogy, education institutions, teaching and learning, developing country.*

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### **1. INTRODUCTION**

In recent years, with the rapid development of emerging technology, the integration of Information and Communication Technology (ICT) and pedagogy in teaching and learning cannot be escaped. The educational institution should plan carefully how to integrate ICT in schools. The Schools should adopt the correct student-centered learning approach, by modifying existing approaches or develop new learning strategy to meet the specific school's needs.

The school may find a lot of benefits for the integration of ICT in pedagogy. Such as easy set up and accessible of the teaching and learning materials. Students will be more active in class by introducing them student-centered approach rather than the teacher-centered approach. This approach makes students directly participating in the class, resulting faster understanding of the concepts.

Furthermore, the new pedagogical models need to be explored in school in order to prepare future citizens for long life learners whereby only active learning can be facilitated by ICT [1]. The active learning presupposes that the learner has easy access to information sources such as internet and locally available databases such as an encyclopedia. However, there are ICT related obstacles on which the institutions need to address before adopt a new technology. Insufficient number of computers, teacher's lack of knowledge/skills in ICT and internet accessibility are among the common challenges in schools. The schools do not jump on the technology, but technology embedded issues need to be considered while adopting ICT in education.

The world has been experienced with the several instructional design models to help teachers integrate ICT in pedagogy. The models such as generic model, ASSURE model, and ICARE provides useful guidelines for incorporating ICT in teaching and learning from different perspectives. However, the teachers who are the main actor in this approach are reluctant to apply these models

with different reasons. Lack of resources are the main reasons for teachers and students unwilling to use ICT in pedagogy [2]. Additionally, most of these models are designed to be more suitable in developed countries whereby the teaching and learning environments were further improved.

Once hardware and software are ready available in schools, ICT integration will automatically follow [3]. This paper proposes the infrastructural friendly teaching and learning model which emphasizes the improvement of teaching and learning environment as the first step before integration of ICT and pedagogy began.

The paper is organized as follows. In section one, the introduction of the paper, section two, the constructive learning theory is presented. The discussion of the current situations of teaching learning in Tanzania including findings of this study is described in section three. The infrastructural friendly model of teaching and learning is presented in section four. Followed with the description of the usefulness of the model is presented in section five. In section six the approaches for ICTs integration in schools are presented. The paper concludes with a reflection on the results and previous works.

## 2. CONSTRUCTIVIST LEARNING THEORY

The infrastructural friendly model which this paper is addressing based on Constructivist learning theory. The Constructivist learning theory focuses more on problem solving and thinking skills. The theory emphasizes the learner's ability, to solve real-life and practical problems [4]. Constructivist theory engages students peer learning so that students can learn from each other.

Constructivist learning theory provides theoretical support for the pedagogical and social design of an effective learning environment [5]. The learning environment constructs background for the constructivist theory to deliver long life learner. Whereas, the main aim of the infrastructural friendly model is to deliver long life learners who will compete to this competitive edge.

## 3. CURRENT SITUATION

The data were collected from primary and secondary schools in Tanzania. The data collection technique used was a questionnaire. Because, the questionnaire is easy to use and customizable and the results are manageable to analyse with any computational means. The simple random sampling technique was used for selecting the schools from the large populations of Tanzanian schools. The schools from Unguja, Pemba and Tanga were selected in this survey. Data were collected manually from schools and through Google forms. Finally, all data were analyzed with Google form and the summary drawn.

The majority of participants who participated in this study were teachers, who took about 87.6% compared to students who took 12.4%. This because teacher's inputs are more required in this model whereby the teachers are strong enough to visualize the proper setting of this model.

## 4. FINDINGS

### 4.1. Teaching and Learning Tools

The success of this model is highly depends on the availability of tools for individuals and school. The model emphasized more on the use of laptop to teachers. The study asked whether the digital teaching and learning tools such as laptop, desktop computer and Smartphone are available in schools. Findings show that more than half of the teachers 62.5% do not possess laptop computer to assist them in teaching and learning. To be successful with the developed model, all teachers who don't have laptop computer should either buy second hand computers which are available in affordable price around \$150 in Tanzania. Or they may secure laptop loans from the Bank. In Tanzania the Bank such as the People's Bank of Zanzibar are offering laptop for loans.

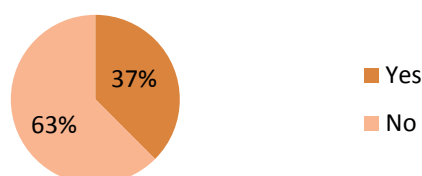


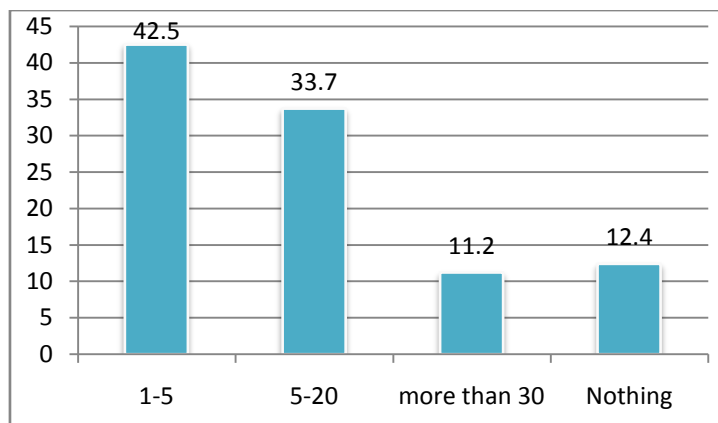
Fig1. Shows the percentage of teachers who possess laptop computers

Furthermore, the study found that the good number of teachers who have a laptop computer about 37.5%, they found that the laptop is very important tools in teaching and learning so that they have secured laptop for themselves.

**4.2. Computer in School**

The study shows that nearly half the schools in Tanzania about 42.7% have only one up to five computers which are used by school administration tasks only. Whereas, 12.4% of the respondent’s schools don’t have any computer. These schools depend on funds from the Ministry of education. Eventually the Ministry of education in Zanzibar and United Republic of Tanzania cannot afford to offer computers to all schools. These schools should find alternative means of getting computers such as through political leaders, developing partners and individuals. Hence, the study shows that nearly half of schools about 44.9% have enough computers which are used in teaching and learning in schools.

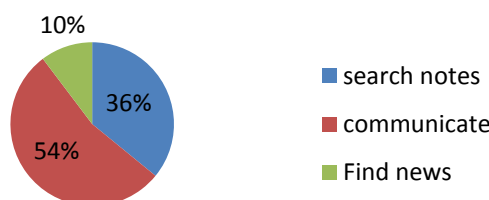
Additionally, the study found that more than half of the studied schools about 57% have a computer room. Thus the students may learn hands-on practice for studying computer courses and able to apply effectively ICT in teaching and learning. These schools may successfully adopt the proposed model. On the other hand, nearly half of the schools in Tanzania about 43% who participate in this survey don’t have a computer room. Therefore, it will be difficult for them to apply the model so that the Ministry of education in Zanzibar, Tanzania Mainland, interested partners and individuals should support the schools to ensure they have a good computing environment so that to be able to apply digital means of teaching and learning.



**Fig2.** Number of computers in schools

The finding from this study is highly equivalent to the study conducted in higher learning institutions in Zanzibar which found the majority of the respondents (61%) were never used mobile phone in teaching and learning [6]. Likewise, this study found that a majority of the respondents about 55.7% were not using mobile phone in teaching and learning. This means that special efforts should be taken to educate teachers and students on the importance of using smart-phone in teaching and learning.

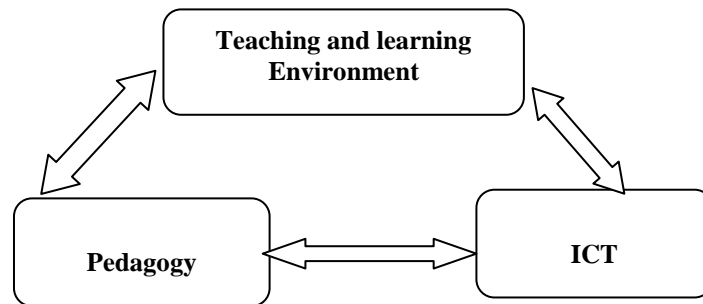
Besides, the study found that 44.3% of the respondents were using mobile phones in teaching and learning. More than half of them about 54% were using their smart-phone to communicate with teachers and/or students. Whereby, 36% of the respondents were using mobile phones for searching notes to the internet. This number is not enough because mobile phone is easy to use and more affordable than a laptop and encourage students more to access the internet [6]. Meanwhile, the study found that only 10% of the respondents were using mobile phones for finding and reading news to the internet.



**Fig3.** Purpose of using a Smartphone for teachers and students

## 5. INFRASTRUCTURAL FRIENDLY MODEL

The infrastructural friendly model of teaching and learning was developed to ensure the proper integration of ICT in pedagogy. This model designed particularly for developing country where the ICT infrastructures are not yet further improved.



**Fig3.** *Infrastructural friendly model of teaching and learning*

### 5.1. Teaching and Learning Environment

Before the integration of ICT in education, the school should improve the ICT infrastructure to create ICT friendly environment. The school ICT tools and infrastructures (such as computers, projectors, networking and internet) need to be improved for the proper integration of ICT in education. The schools via school committee, which comprises the student's parents, and other community members. Additionally, there is a need for the Governments, local and international education partners, to open up their hands to support education activities in schools.

### 5.2. ICT

ICT can be broadly be defined as the tools, facilities, process and equipments that provide the required environment, with the physical infrastructure and the services for the generation, transmission, processing, storing and disseminating of information in all forms including voice, text, data, graphic and video [7]. This implies that ICT has a significant role in improving the teaching and learning in schools. The proper utilization of ICT in education will provide successful benefit to teachers and students in schools..

There are strong evidences that ICT helps school teachers to be more effective in teaching and learning [8][9]. The role of ICT in schools is not only to facilitate education and learning process, but also to engage students to be more active to the lesson. ICT in education offer revolution in modern teaching and learning process in school.

### 5.3. Pedagogy

Pedagogical design should address the student-centered approach rather than a traditional teaching approach where by teacher maintains the classroom. The curriculum design should compromise proper contents and activities based on a particular subject. The pedagogical design must deal with how to use the contents and activities in an effective way in order to scaffold students during the learning process [5]. The most recommended student-centered approach is Problem Based Learning (PBL). PBL encourages students to work together in teams.

PBL encourages self independent and directed study before returning to the group to discuss and refine their acquired knowledge. Thus, each member will be able to provide additional contributions to the topic. Nevertheless, PBL is not about problem solving per se, but rather is uses appropriate problems to increase knowledge and understanding [10].

Each PBL tutorial consists with a group of students, usually six to ten students per group with one tutor who act as facilitator [10]. Each group will elect a representative who will control the group and to ensure each group member will contribute to the topic and be able to present their conclusions to the class. PBL work very fine in small classroom. For larger classroom, more class space and facilitators required to ensure the groups are controlled.

## 6. USEFULNESS OF THE MODEL

The new designed model addresses the use of free and open source software (FOSS) in school. The school will afford to use the software with minimum cost. Many governments and educational

institutions around the world has been adopting FOSS for gaining marvelous advantages from them [11]. Despite of the school will get technical support from volunteers, ICT experts from the university and any individuals who willing to support the school development, but school should employ ICT experts who will support and maintain hardware and software in school. The usefulness of this model involves the following criteria:

### **6.1. Design Web Based Learning Environments**

Moodle is recommended to be learning management software in schools. The Moodle has been experienced and show successful benefit for most of the university and schools around the world. Those academic institutions who are using the Moodle platform regularly seem to get better grades than those who rarely or never use it [12]. Moodle has been adopted by many people and organization around the world because it offers a tightly integrated set of tools to be designed from constructive perspectives. Nevertheless, Moodle has some features like including the capability to embed resources, communication and activities centered on a topic of study, which is not available elsewhere [13]. Now a day Moodle mobile application is available which make it easy for students to access the learning material via their smart phone.

### **6.2. Develop E-Library to Facilitate Knowledge Sharing in Schools**

The world has been changed, the teaching and learning materials need to be accessible in 24/7. The school library needs to be automated and digitize for students to use it while when they are at school or at home. Library system effectively manages the process of acquiring, issuing and making available to all library resources [14]. There are many software which can be used for library automation and digitization. For its reliable, user-friendly and functionality, KOHA and Dspace are the recommended automation and digitization software in schools and universities.

### **6.3. Social Media for Teaching and Learning**

Nowadays, many educational institutions are finding themselves expected to catch up with this world of social media applications [15]. Now social media is no longer used as an entertainment tool and a friend finder stage, instead it is used to simulate highly demanding knowledge to students, teacher, and different professional indifference discipline. The social media platform, such as Google +, Facebook, Wikipedia is now used as a key knowledge sharing bench for students and teachers. Teachers may use social media to communicate with students, to place a topic for discussion and even to upload lecture for students.

### **6.4. Electronic Resources**

Some country, like Korea, spent the large share of academic library budgets on e-resources purchases and e-resource environment improvement for better uses [16]. This data are highly differing with other countries like Tanzania where academic institutions still rely on purchases books instead of e-resources. E-resources and e-journal downloading exhibited relatively high efficiency compares with printed materials. Thus, academic institutions and schools should change their mindset to use e-resources for easy accessibility in teaching and learning.

The school may engage in the use of Google books, Google scholar and open access journal to access e-resources free or with affordable prices.

### **6.5. Free Space for Storing Teaching and Learning Materials (Google Drives)**

Google drive offers free 15GB memory space for teachers and students to store their teaching and learning materials. Furthermore the academic institution may register with Google for education for getting more Google products and access unlimited space for all institutional members. The materials in the Google drive may be accessible even if you are not connected to the internet.

## **7. APPROACHES FOR ICT INTEGRATION IN SCHOOLS**

### **7.1. Improve ICT Infrastructures**

ICT infrastructure is the first thing to consider before school decide to integrate ICT in pedagogy. This including computer accessibility and internet availability. The school should have at least one networked computer lab and WiFi accessibility for those who own laptops and Smartphone. The smart phone should be encouraged to be used by students and teachers in school. Students are aware of mobile technology and they are motivated to use their phones in order to facilitate their learning

[6]. There are many opportunities for students to adopt mobile learning and that encourage them to be self-motivated and increase their engagement with learning behaviour. With the availability of broadband modem around the world, teachers may register for the monthly package with reasonable prices via their Smartphone or laptop computer.

### 7.2. ICT Skills Developments

An ICT skill needs to be improved to school teachers. School headmaster should plan how to increase ICT skill literacy to all teachers. Basic ICT knowledge is essential for teachers. Fortunately, a computer study is mandatory subject for all students who undertaken undergraduate studies at the University. Computer study subject prepares teachers in basic computer theory and computer application such as word processor, spreadsheet, power point presentation and internet. School management may conduct different ICT training to increase computer literacy to teachers.

### 7.3. Pedagogical Knowledge

Pedagogical knowledge is understanding the whole process and practices in teaching and learning. Pedagogical knowledge not only the knowledge that applies to student learning, classroom management, instructional planning and implementation, and student assessment, but also knowledge about techniques or methods used in the classroom, the nature of the learner’s needs and preferences, and strategies for assessing students understanding [17].

Moreover, changing school syllabus will be considered at this stage for making serious change in the education sector. The amending school syllabus is one among the first stage while making revolution in the education system [18]. This will involve Free and Open Source Software (FOSS) courses that students will learn from primary and secondary school.

### 7.4. ICT And Pedagogy Integration

The integration of ICT and pedagogy cannot be escaped if we want to deliver quality education to students. The school should pass through three main stages in ICT and pedagogy integration. These are low-fidelity, medium-fidelity and high-fidelity.

#### 7.4.1. Low-Fidelity

The School may start with the lowest level of using ICT tools in teaching, such as the use of power point presentation, a projector and power presenter. Additionally, teachers may use a whiteboard and a marker pen for more elaboration of the concepts to the students, rather than the use of the blackboard and chalks.

#### 7.4.2. Medium-Fidelity

This is involving the use of flipped classroom whereby the instructor uses video in presenting the topics to students. Teachers may download video through YouTube or may prepare their own videos to reflect with their teaching environment. The software such as atube capture, Jing and Screencast Omatic may be used to download the video, split and merge the video, and even to record the screen and presentation.

In the flipped model, the teaching time is completely restructured from the traditional classroom. The class starts with video to represent the required topic to students. Consequently, the teacher may use real case study to present the topic. Students ask questions about the topic delivered via video or case study. The teacher responded to the questions. The teacher tries to clear up all misconceptions before students sit together in groups. The students sit in groups with hands-on practices and /or directed problem-solving activities [19]. Table 1 shows the comparison between these types.

**Table1.** Comparison of traditional classroom versus Flipped Classroom [Adopted by (Jonathan and Sams, 2012)]

Traditional Classroom		Flipped Classroom	
Activity	Time	Activity	Time
Warm-up activity (Ask questions from previous lesson)	5 min	Warm-up activity (Ask questions from previous lesson)	5min
Lecture new topic	45-55 min	Show video/case study	10 – 15 min
		Questions and Answers time on video/ clear misconcepts	10 – 15 min
Guided and independent practice and/or lab activity	20-30 min	Guided and independent practice and/or lab activity	45 – 55 min

Medium-fidelity we can call it as a blended learning whereby open educational resources (OER) are combined with classroom activities and instruction to provide an overall improvement of an educational outcomes [20]. It is very common practice to some lecturers to the State University of Zanzibar to use blended learning model with OER like Massive Open Online Courses (MOOCs), YouTube materials for accessing a wide range of context.

Therefore, it is suggested that the school should at least use medium-fidelity to make students more active to the lesson.

### 7.4.3. High-Fidelity

This is the highest level of integration of ICT and pedagogy. The teaching is not necessary to be taken to the classroom relatively the course may be conducted online. Teachers may decide which class activity (lectures, group assignment, group activity and class exercise) to be taken in class or off a class. The curriculum and teaching methodology has been converted to ICT paradigm. ICT offers a total teaching role for a course. Students may register the course online, downloading material, do quiz and examination online. To be more effective at this level, the school may have digital contents laboratory for preparing teaching materials and video. The figure 4, provide more elaboration on the role of ICT in teaching.

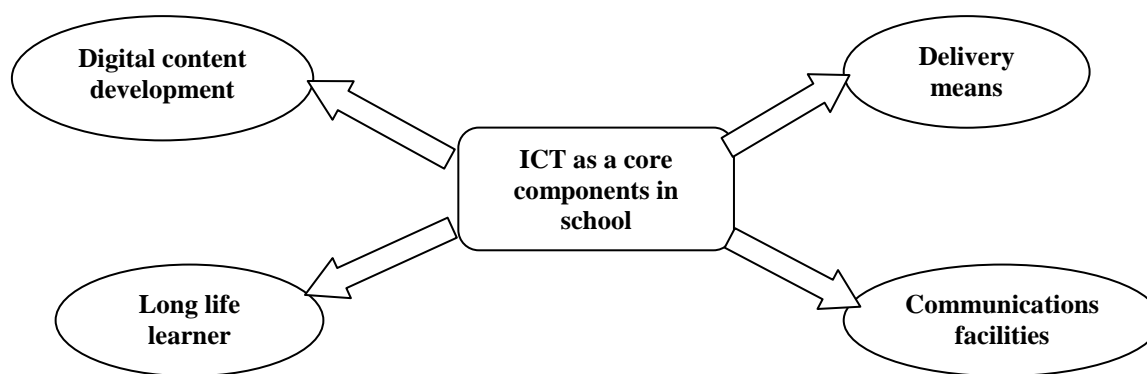


Fig4. Role of ICT in teaching and learning

## 8. CONCLUSION

Although the integration of ICTs in pedagogy cannot be escaped in this modern world of technology. However, for the developing countries should do something for the integration to be successful. Environment friendly to accept the integration of ICTsin pedagogy should be prepared. This model will assist the educational institutions in developing countries in the proper adoption of ICTs in pedagogy.

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