Human Capacity Training Model for Managing ICT Integration in Education

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Abstract

Technology advancement has always had an important impact on industry development and even affected most traditional systems such as education. Incorporation of ICT in education can drive progressive and effective delivery of quality education in schools. However, integrating ICT in education is a complex process and the extent of ICT applications in schools is still extremely varied and in many instances very limited. The purpose of this paper was to analyze the human capacity for managing ICT integration and develop a human capacity ICT training model towards affordable ICT integration in education. The study employed design science research approach. This was used to perform a background research, collect data inform of requirements and design the model. The population for this study was 425 primary schools in one of the County's in the Western region of Kenya. Purposive sampling technique was used in selecting the sample size. The study sampled 30% of the 100 schools which had ICT equipment at the time of data collection. To achieve objectives of the study, questionnaires, guided interviews and observation checklist were used to collect data from the respondents. Quality control was ensured by contacting validity and reliability tests of the instruments. Content and face validity was done by using of a team of experts while reliability was achieved by pretesting and piloting the questionnaire. Inadequate basic ICT skills and knowledge are key challenges to successful integration of ICT in education. There is need for teachers to be trained on technical skills, basic hardware skills and green computing skills to be able to manage ICT equipment as well maintain environmental sustainability during ICT integration in education.

Key words: *Human capacity training model, ICT integration, Affordability*

INTRODUCTION

Technology advancements have most often always had an important impact on industry development, hence affecting even the most traditional systems such as education. Information Communication Technologies (hardware and software) are enabling and facilitating technologies and hence individuals, community groups that have access to them, save time and money and also improve the quality of their work as in [1]. The passion about the use of ICT for development arose with a particular focus on the need to utilize Information Communication Technology in education. The rationale was that, the use of ICTs in education will drive more progressive, effective teaching methods as in [2], [3], [4], [5].

The main reason for integrating ICT in education is to ensure that Kenyan citizens meet the global technological criteria. However, integrating ICT in education is a complex process and the extent of ICT applications in schools is still extremely varied and, in many instances, very limited [6], [7], [8]. The integration of technology in education includes, technological, pedagogical and knowledge management, and in all these respects, technological support is required [9]. It is on this basis that educational facilities are being restructured to bridge the existing technology gap in education [10].

To successfully integrate ICT in education, there is need for proper infrastructural support such as proper hardware, software, networks and Internet access [11]. The Integration plan should therefore reflect the real needs of schools in order to make effective technology deployment. China, while planning for ICT integration in education, focused mainly on improving human resources to meet the demands of the knowledge era [18]. In Rwanda, their education sub-plan included ICT training for primary and secondary teachers [19].

A three-phased approach is suggested that can be employed to the process of systematic planning and implementation of ICT technology in schools [12]. One of the most important factors in the delivery of education today, is ICT technologies [13], but also teachers are of prime importance as to whether the technology is going to be used appropriately and effectively or not [14]. Capacity building of teachers as well as administrators and managers play a major role in enabling the effective use of technology.
In Kenya, particularly, most of the high-end ICT technology training take place in public institutions, but these institutions lose staff to the private sector who offer better salaries [15]. When teachers are well trained, informed and confident in the use of new technologies they can offer any such support during the use of ICT technologies [17], hence reduce on the cost of external support.

Modern developments of innovative technologies have also provided new possibilities to education, but at the same time they have placed more demands on teachers to learn how to use these technologies in their work [16]. ICT technologies should not be viewed as a solution for all educational problems [9], as teachers are equally important in the integration process. Teachers need to acquire new knowledge and skills to use and manage ICT resources in a world of ever changing technology [14].

Today the biggest challenges that governments are facing in providing education is the lack of infrastructure,

maintenance of the infrastructure and a wide range of hardware and software that require ample, ongoing investment and professional support skills [20]. With the integration of ICT in education taking up shape in primary schools, there is need for teachers acquire relevant ICT skills on how to use the technologies to deliver quality education and maintain environmental sustainability in the long run.

STATEMENT OF THE PROBLEM

Governments today are still facing a number of challenges in providing education to its citizens using ICTs. The incorporation of ICT in education can be used by governments across the world to drive progressive and effective education in schools. To actualize ICT integration into primary education, the Government of Kenya, undertook the initiative aiming at providing laptops to all standard one pupils in primary schools in the year 2016. Integrating ICT in education requires establishment of infrastructural facilities, acquisition of hardware and software technologies and their periodic configuration, updating, management and provision of professional support services. Procuring and maintaining a wide range of hardware and software is a major challenge in this era of ever changing technology as it requires substantial, ongoing investment and professional support. Teachers need to be equipped with the relevant skills and knowledge to be able to manage ICT integration in education hence reduce on costs that may be incurred acquiring hardware and provision of professional support hence making ICT integration affordable in primary schools. The purpose of this study was to analyze the human capacity for managing ICT integration in primary schools and develop a human capacity ICT training model towards affordable ICT integration in primary schools.

METHODOLOGY

The study adopted research design science approach. This design was used to perform a background research, collect data inform of requirements and design an artefact. Fig 1: summarizes the steps followed in research design science.

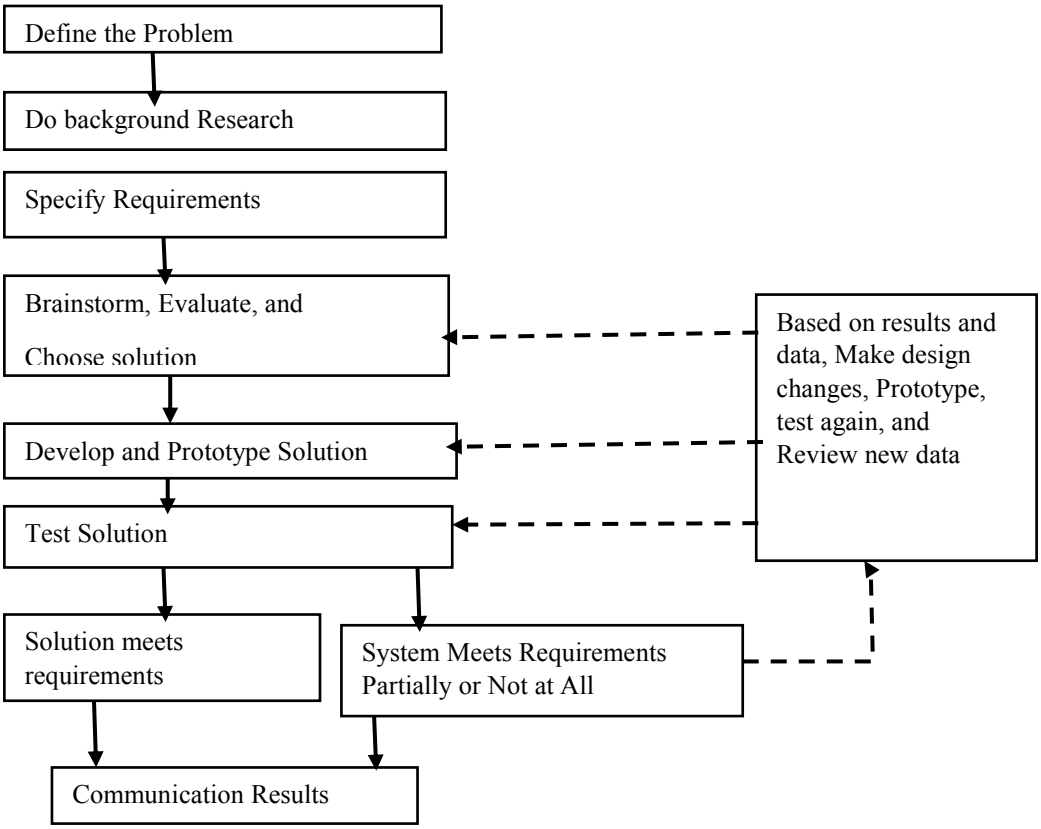

Fig 1: The Design science design model
Source: (Adapted) [21]

The population for this study was 425 primary schools in one of the County's in the Western region of Kenya. This County was a representation of the other Counties for this study because the project was being rolled out in all Counties and the types of equipment supplied to the public primary schools were of the same specifications and also the level of training of teachers was done the same way in all the Counties. The accessible population included only primary schools which had ICT equipment totaling to 100 schools at the time of which data was collected. Purposive sampling technique was used in selecting the sample. It is a non-probability sampling procedure which does not afford any basis for estimating the probability that each item in the population has a chance of being included in the sample [22]. This technique was used to select schools that had ICT infrastructure and teachers who had trained in ICT. The study focused purposively on those schools that had ICT equipment and on those teachers that had been trained on the use of ICT in education. The study sampled 30% of the schools (100), which had ICT equipment, representing 30

schools. Ref [23], asserts that at least 30% of the total population is representative for the study.

To achieve objectives of the study, questionnaires, guided interviews and observation checklist were used to collect data from the respondents. Quality control of the instruments of study was done to establish both instrument and data creditability through: - face and content validity which was done by a team of experts and average value of judgement calculated which .783 was. Reliability of the instruments was established through pretesting and piloting where the Cronbach's alpha of .762 which comprised of 17 items. The tool was hence deemed valid and reliable for use in the study as in [24].

RESULTS

The data collected covered the following aspects: Competency, Training and ICT health and safety issues. The study targeted primary school head teachers and the teachers who had trained in the use of ICT integration in education.

ICT Staff competency

This focused mainly on the ability or competency level of the teachers in the use of ICT technologies. The parameter of interest were based on relevant practical skills required to use the ICT equipment. The focus was on: Setting up a new computer, understanding the licensing requirements, checking network connection, changing monitor display mode and extending the screen, testing printers and printing documents, setting up projectors and troubleshooting a computer system. The respondents were rated on a scale of 1-4: not very competent, moderate level competency, competent and expert. Table 1 gives a summary of the findings.

Table 1: ICT Staff competency level

		Frequency	**Percent (%)**
Valid	Expert	6	6.7
	Competent	26	28.9
	Moderate Level competency	30	33.3
	Not very competent	28	31.1
	Total	**90**	**100.0**

The competency level of the staff in ICT was found to be Moderate Level at 33.3%, Not very competent at 31.1%, Competent were at 28.9% while those at expert level were 6.7%. The study therefore revealed that most teachers were at moderate competent level.

Training

Training is the core building block of human capacity development that can lead to effective and quality delivery of education using ICT technologies. For effective integration of ICT in education, there is a need of adequate training of staff involved to ensure proper use and management of computing resources. Table 2 shows the findings of the study.

Table 2: Length of ICT Training

		Have you been trained in the use ICT	**Total**
		Yes	
How long was the training?	1-5 Days	82	82
	Missing	8	8
Total		**90**	**90**

The table 2 reveals 82 out of 90 teachers sampled were trained in ICT, which is 91.11%. The study also revealed that training was done within one week as in the table. Therefore the duration of time taken for training teachers in the use of ICT equipment and their subsequent integration in education was too short. This was inadequate for teachers to have acquired the relevant skills and knowledge to learn, practice and use in integration of ICT in education and management of the equipment.

The study also sought to collect and analyze data to establish the areas of ICT on which the respondents were trained on. Table 3 give a cross tabulation of the findings.

Table 3: Area trained and use ICT.

		Have you been trained in the use ICT	**Total**
		Yes	
Which area were you trained in?	Basic networking	10	10
	Software upgrade	2	2
	Computer basics	70	70
	Missing	8	8
Total		**90**	**90**

Table 3 reveals that most teachers were trained on the ICT, 10 on basic networking, 2 on software upgrades and 70 on computer basics. Basing on the findings in Table 1 and Table 2, most of the teachers were trained on computer basics and were able to confidently pick it out from the list as having been trained on it. The training had a wide coverage on it than the other areas indicated in the Table 2 as it was touching directly integration of ICT in education.

Further analysis was done to find out whether the respondents had follow up activities on training after the initial one to support them in case of difficulties. The results were summarized on Fig 2: Follow up training.

Fig 2: Follow up Training

Fig 2 reveals that majority of the teachers (97.78%) had no follow up training sessions after the initial one. A follow up training would have formed a platform for the teachers to ask questions about areas they had not understood during the training. The trainers would have also used this forum to find out any problems they were encountering in the process of ICT integration in education.

Availability and adequacy of resources are critical in integration of ICT in education. The research investigated the extent of availability of time, training and support offered to the teachers towards ICT integration in education in primary schools. The findings were as in Table 4

Table 4: Time to develop ICT Skills and Knowledge

		Frequency	**Percent (%)**
Valid	Strongly agree	6	6.7
	Agree	14	15.6
	I don't know	2	2.2
	Disagree	28	31.1
	Strongly disagree	40	44.4
	Total	**90**	**100.0**

Time is a core resource of training. Its availability to trainees can boost the grasp of knowledge and skills. Table 4 reveals that 75.6% of the teachers did not have enough time to train and acquire the relevant skills and knowledge required for ICT integration in education. The training took a shorter period (a week) and hence was not sufficient to enable teachers acquire skills, knowledge to enable apply in ICT integration in education smoothly.

A further analysis was done to find out whether the respondents had sufficient support to acquire ICT skills and knowledge. Data was collected and analyzed as in Table 5.

Table 5: Adequate Support

		Frequency	**Percent (%)**
Valid	Strongly agree	6	6.7
	Agree	12	13.3
	I don't know	8	8.9
	Disagree	44	48.9
	Strongly disagree	20	22.2
	Total	**90**	**100.0**

Professional support is usually handy whenever one falls short of technical knowledge or skills in the course of application. Table 5 reveals that majority of teachers (71.1%) did not receive any support to enable them apply the skills and knowledge in ICT integration in education. They therefore lacked the confidence of using the ICT equipment for fear of getting stack in the process of usage.

ICT Health and safety Issues

The research sought to investigate the ICT health and safety practices in schools to establish how prepared the teachers are to ensure a safe environment for the learners and the surrounding community during ICT integration in education. This arose from the fact that schools are and would be consuming both hardware and software resources which are bound to become defective, obsolete or reach their end-of-life with time hence rendering them useless.

The study looked at human capacity training on: use of anti-glares, care of hardware and software, use of protective keyboard covers, disposal of equipment and effect of e-waste to the environment as in Table 6.

Table 6: ICT Health and Safety Issues

		Frequency	**Percent (%)**
Use of Anti-Glare Screens	Strongly agree	6	6.7
	Agree	10	11.1
	Not sure	4	4.4
	Disagree	20	22.2
	Strongly disagree	50	55.6
	Total	**90**	**100.0**
Care of Hardware and Software	Strongly agree	6	6.7
	Agree	18	20.0
	Not sure	4	4.4
	Disagree	18	20.0
	Strongly disagree	44	48.9
	Total	**90**	**100.0**
Use of protective keyboard covers	Strongly agree	6	6.7
	Agree	18	20.0
	Not sure	4	4.4
	Disagree	18	20.0
	Strongly disagree	44	48.9
	Total	**90**	**100.0**

Safe disposal of ICT equipment	Strongly agree	6	6.7
	Agree	14	15.6
	Not sure	16	17.8
	Disagree	18	20.0
	Strongly disagree	36	40.0
	Total	90	100.0
Effect of e-waste on the environment	Strongly agree	8	8.9
	Agree	8	8.9
	Not sure	12	13.3
	Disagree	20	22.2
	Strongly disagree	42	46.7
	Total	90	100.0

Table 6 reveals that 77.8% of the teachers did not train on the use of anti-glare screens, 68.9% did not train on the care of hardware and software, 68.9% did not train on the use of protective key board covers, 60% did not train on the safe disposal of ICT equipment and 68.9% did not train on the effect of e-waste management. It's clear from the figures that over 60% of the teachers did not train on the ICT health and safety issues and this would make it hard for them to properly manage the ICT equipment. Inadequate skills for proper management can lead to many equipment breaking down and in the process making them expensive in maintenance. Those equipment that cannot be maintained need to be disposed properly and this calls for teachers to have knowledge on the disposal and also effect of e-waste management to keep the environment friendly for the children and the community at large. Spillage of harmful materials from defective or obsolete equipment that has not been properly disposed is dangerous to the environment.

DISCUSSION

Competency in the use of ICT equipment is an ability that can make the integration of ICT in education successfully. The study found a majority of the teachers were at the moderate level competency. With more interaction with the ICT technologies (hardware and software) during training sessions and actual usage in class, can make teachers more competent to a level of expert.

A cross tabulation in Table 2 indicates that the teachers training in the ICT in education mostly takes one week (between 1-5 days). It is supported by 82 out 90 of the total respondents trained. This period is too short to enable the teachers to acquire necessary technical skill and knowledge to sustain ICT integration in education. The analysis in Table 3 further revealed that 70 of the respondents were trained on computer basics. This justifies the (1-5) days training, where most of the training centered on computer basics. This implies that the training is still below the threshold of enabling the teachers to fully integrate ICT in education in primary schools in Kenya as the other areas are very important in the integration process. Fig 2 also revealed that 97.78% of the respondents did not have any follow up training after the initial training. This also raise some concerns since the use of ICT is dynamic and requires ongoing professional support so that teachers can be confident in their usage. There is need to come up with follow up training programmes to enable teachers enhance their knowledge and acquire new skills this era of ever changing technology. Table 3 revealed that, 75.6% of the respondents did not have enough time to train and develop skills and knowledge in ICT. The analysis in Table 5 indicates that 71.1% of the respondents though trained in ICT, the training was not sufficient enough, the support given is not adequate and the time allocated for the training was not adequate to enable them acquire necessary knowledge and skills in ICT for its effective integration in education.

Data was collected and analyzed to find out the use of anti-glare screens on monitors to guard against eye strain to computer and tablet users. The findings in Table 6 revealed that majority of the teachers (77.8%) did not have any training on the use of anti-glare screens which is a health and safety issue when using ICT equipment. This implies that there is need to train teacher on the use of anti-glare to protect their eyes and those of learners against damage due to long exposure on the screen. On the care of ICT equipment (Hardware, software and peripherals), Table 6 revealed that, over 68.9% did not train on the care of hardware and software to prolong the lifespan of the equipment. This implies that there is need for training teachers on the care of hardware and software measure as this determine the lifetime of hardware and software. Key board covers protect keyboards against dust, moisture and spillage of liquids that might interfere with the electrical circuit hence the operation of the device. Table 6 revealed that 68.9% of the teachers did not train on the use of protective keyboard covers, a component that enables users to interact with the computer. Hardware equipment with time of use, may become defective due to failures, obsolete due to changes in technology or reach their end-of-life after long usage. In such cases it may become necessary for them to be removed and be disposed-off safely. Data was collected to establish the level of training on the disposal of such equipment in primary schools. Table 6 revealed that majority of the teachers (68.9%) were not aware of the effect of e-waste on the environment. The lack of awareness implies that they were not trained on and do not know how to keep the environment friendly during the period of use of ICT equipment.

ICT human capacity training model

Basing on the findings of the study, Factor analysis was preferred to identify the factors that were relevant to the development of the human capacity training model. The Kaiser-Meyer-Olkin (KMO) value as in [25] was established first as in Table 7.

Table 7: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.601
Bartlett's Test of Sphericity	Approx. Chi-Square	1930.874
	Df	528
	Sig.	.000

Table 7 reveals that the KMO value is 0.601 and the Bartletts test of Sphericity value is 0.00. These values are within the acceptable range and hence the sample is adequate for exploratory analysis as in Table 8. Principal component analysis was done to find how the factors load on the components as in table 8.

Table 8: Principal Component Analysis

Component Matrix[a]										
	Component									
	1	2	3	4	5	6	7	8	9	10
Levels of competency			-.678							
Set up a new computer										
Check set up of existing computer system	.575									
Set up projector for use	.711									
Trouble shoot a computer	.539									
Has had enough time to develop ICT skills and knowledge			.707							
Has had enough training			.709							
Trained on use of anti-glare glass on monitors	.714									
Trained on care of hardware, software	.800									
Trained on use of protective Keyboard covers	.828									
Trained on safe disposal of equipment	.835									
Trained on the best practices when using ICT equipment	.790									
Trained on safe and responsible use of electronic communication e.g. email	.730									
Trained on effect of e-waste on the environment	.795									

The factors that load on various component were established after factor analysis as in Table 7. A total of three (3) components were found from the analysis. Ten (10) factors load on component 1 with loadings of .575, .711, .539, .714, .800, .828, .835, .790, .730 and .795. The factors loading weight on component 3 are -.678, .707 and .709. Factor rotation was then done to reduce the number of factors in which the variables under the study have higher loadings and identify the specific factors that load on the components and also determine their respective weights. This was done to make the interpretation easier as shown in Table 8.

Table 8: Factor Rotation

Factors	**Loading**		
	1	**3**	**5**
Use of anti-glare glass on monitors	.869		
Care of hardware and software	.834		
Use of protective Keyboard covers	.880		
Safe disposal of equipment	.787		
Best practices when using ICT equipment	.752		
Effect of e-waste on the environment	.856		
Set up a new computer		.812	
Check set up of existing computer system		.791	
Enough time to develop ICT skills and knowledge			.940
Enough training			.902

When factor rotation was done, five components were generated with their respective the factor loadings as in Table 8. The variables: Trained on use of anti-glare glass on monitors with a factor loading of (.869), care of hardware and software (.834), use of protective Keyboard covers (.880), safe disposal of equipment (.787), and best practices when using ICT equipment (.752) and trained on effect of e-waste on the environment (.856) load together to form component 1. All these variables have a common factor of green computing and as such were renamed Green Computing. The variable set up a new computer with a factor loading of (.812) and check set up of existing computer system (.791) load together to form component 3. It is observed that these variables have a common shared element of hardware skills and were therefore renamed as Hardware skills. The variables had enough time to develop ICT skills and knowledge with a factor loading of (.940) and had enough training (.902) load together form component 5. It is observed that these variables have a shared element of technical training skills and were renamed as Technical Training skills. The human capacity training model was developed by integrating the components found in the study. Components one (1) , three (3) and five (5) has key components of Training i.e. component one (1) address

training related to Green computing, component three (3) addresses training in basic hardware skills and component five (5) addresses training in technical skills as in Fig 3.

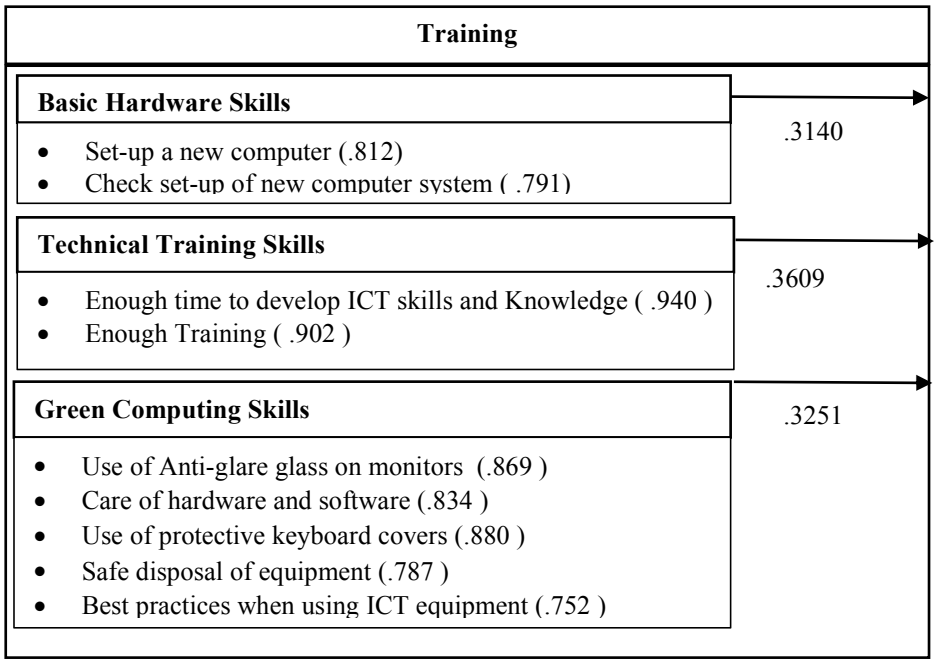

Fig 3: Human capacity training model

The human capacity training model Fig 3, is composed three sub-models: Basic hardware skills with a weight of (.31420, Green computing skills (.3251) and Technical training skills (.3609). The basic hardware skills core to the use of ICT equipment and are required by every teacher for effective integration of ICT into education. The technical training sub-model is composed of technical skills and knowledge that require enough time for their development. Training in ICT integration should therefore be given enough time for the teachers to acquire the knowledge and also time to practice the skills so develop confidence in their usage. The green computing skills are essential for ICT health and safety issues. Knowledge in this area helps teachers to know how to keep the children and themselves save by putting appropriate measures in place such use of anti-glare screens, keeping the environment safe by proper disposal of ICT equipment that is defective, obsolete or having reached its end of life. Knowledge in green computing will also enable teachers manage the equipment well so that they stay longer and serve the purpose they are meant for. In the model, technical skills and knowledge have the highest weight as they cut across the basic and green computing skills. For one to acquire skills and knowledge in any area, he/she should undergo training and this normally consumes time as a resource. This implies that for proper and effective human capacity development for ICT, enough time must be set aside to enable both learn and practice to acquire the knowledge and skills needed for successful ICT integration in education.

CONCLUSION

Information and Communication Technology (ICT) integration in education is a process that requires careful and systematic planning for its success. The staff who are the pillar of whether the use of technology will succeed or not, need to be considered during its implementation. Training is the key to imparting relevant skills and knowledge for teachers to successfully integrate ICT in education and well as being cognizant of environmental sustainability. They need to be properly equipped with relevant skills and knowledge to use to use, manage and maintain the technology hence making it affordable in the long run. The training should be centered on teacher's acquisition of technical, basic hardware and green computing skills and knowledge that are essential for the utilization of ICT technologies in education. Green computing skills are required for them to manage the ICT equipment. These skills and knowledge will ensure that defective, obsolete and equipment that have reached their end-of-life are safely disposed off to avoid a being a health hazard to the environment and hence endangering children and the society. A clean environment free from dangerous chemicals is save to live and work in. Training of teachers in use and management of ICT should be given higher priority for its effective and efficient Integration towards delivering progressive and quality education in primary schools.

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