Integrating Information and Communication Technology (ICT) in Teaching Metalwork Shop Practice Colleges in Nigeria

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ABSTRACT

This paper attempts lay framework for ICT integration to the teaching and learning of Metalwork shop practice in technical colleges as a result of the rapid technological innovations which require students to develop multiple skills to function in workplaces. One way to gaining skills for todays' competitive society is through a modern learner-centred ICT. This paper considers the need to integrate ICT into the teaching and learning process under the concept of ICT, the meaning of metalwork shop practice, benefit of ICT integration in teaching MSP. The research used the Four-D Model which follows syntax of define, design, develop and disseminate. The study also discusses the two stages of the approaches of ICT integration and teaching and learning models and the principles of ICT integration in school. It was recommended that Cross River State government should establish ICT laboratory in each of the technical colleges, equip them properly, train teachers on the use of ICT resources in teaching and provide steady electricity for the successful operation of the resources

Keywords
ICT, Metalwork Shop Practice, Teaching

Introduction

The advent of Information and Communication Technology (ICT) has influenced the design of modern machine, tools and equipment from the traditional manually operated type to digital type resulting to the need for changes in subjects' contents as well as teaching methods of courses in virtually every level of education. According to Gachago and Mafute (2007) most developed countries have exploited the potentials of ICT to transform their educational landscape at the tertiary, secondary and even primary school levels particularly the instructional process. While developed countries have since embraced ICT and lunch their countries into greatness, most educational institutions in parts of the world have just begun introducing the integration of computer technology into their teaching process and others yet to key into this global network.

Information and Communication Technology (ICT) is the science of the utilization of computer equipment, subsystems, software and firmware for the automatic analysis, acquisition, storage, manipulation, management, movement, transformation, control, display, interchange, transmission and retrieval of data (quantitative and qualitative information) to most appropriately meet human needs (Adewole, Ogunlisi & Bajulaiye, 2013). ICT is a technology that supports activities involving information. Such activities include gathering, processing, storing and presenting data. These definitions imply that ICT will be used, applied, and integrated into activities of working and learning based on conceptual understanding and methods of informatics Cox, Preston, & Cox (1999). ICT has so revolutionized all spheres of human endeavour so much so that its effective use or otherwise has become a yardstick for measuring the failure and success of a system. The growth of a nation is currently defined largely in terms of the ratio of its citizens who efficiently and effectively utilize ICT in most productively meeting human needs. This further to explain why ICT has become a potent factor in distinguishing between the developed and developing societies globally (Kpolovie, 2012).

The national vision 20:2020 document of Nigeria indicates the role of ICT in respect of several sectors and offers specific examples as to how ICT can propel development of the national socio-economic sub-sector with respect to agriculture, oil and gas, health, education, finance, governance, infrastructure support, knowledge-based economy, labour employment and productivity, and research and development Federal Government of Nigeria, FGN (2003).

To fully integrate ICT into the socio-economic development, Nigeria must first be transformed into a knowledgebase economy through education by the use of ICT in her teaching and learning process. Integrating ICT into the classroom will help to broaden and deepen students' knowledge in their respective discipline as well as expose their difficulties in conceptualization, and engage them actively in the learning process (Kiboss, Ndirangu & Wekesa, 2004). The purpose of using technology in teaching is to eradicate technophobia among students and give better value and impact their performance competencies. Louw, Muller and Tredoux (2008) argue that ICT holds much promise for use in curriculum delivery. It also has the means to aid in the preparation of learners by developing cognitive skills, critical thinking skills, information access, evaluation and synthesizing skills (Cawthera, 2000).

Today, ICT has become, within a very short time, one of the basic building blocks of modern society. Many countries now regard knowledge of ICT and mastering its basic skills and concepts as part of the core of education, alongside reading, writing and numeracy. There have been plans by United Nations Educational, Scientific and Cultural Organization (UNESCO) to see that both developed and developing, have access to the best educational facilities necessary to prepare young people to play full roles in modern society and to contribute to a knowledge nation. Because of the fundamental importance of ICT in the task of schools today, UNESCO had also published books on the need for ICT integration in schools as her practical means of helping member states. These books have two key purposes. The first is to specify a curriculum in ICT for secondary schools that are in line with current international trends. The second purpose is to outline a programme of professional development for teachers necessary to implement the specified ICT curriculum successfully. This effect and many others ought to have yielded a positive result. The finding that teacher's expertise and lack of knowledge to evaluate the use and role of ICT in teaching is worrisome. These factors hindering teachers' readiness and confidence in using ICT support (Talla, Talla, Toyobo, Adika & Adeyinka (2014). Moreso, researchers have identified several other problems in the use of ICT in teaching linked to staff attitude and training staff in the use of ICT, access and ICT skill in general among others.

Literature Review

Concept of Information and Communication Technology (ICT)

Information and Communication Technologies (ICT) refers to technologies that provide access to information. It is similar to information Technology (IT) but focuses primarily on communication technologies through the internet, wireless networks, cell phones, and other communication mediums. Olakulehin (2009) defined it as a range of technologies that are applied in the process of collecting, storing, editing, retrieving and transfer of information in various forms. The Federal Ministry of Education of Nigeria (2010) sees ICT as encompassing all equipment and tools inclusive of traditional technologies of radio, video and television to the newer technologies of computers, hardware, firmware etc as well as the methods, practices, processes, procedures, concepts and principles that come into play in the conduct of the information and communication activities.

To Ogunsola (2005) ICT is viewed as a cluster of associated technologies defined by their functional usage in information access and communication of which one embodiment is the internet. Nweze (2010) describe ICT as computer-based tools used by people to work with information and communication processing needs of an organization. It includes covers computer hardware, software, the network and other digital devices like video, audio, camera, camera and so on which convert information (text, sound, motion among others) into digital form. UNESCO (2002a) defined it as the tools and processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means including hardware, software and telecommunications in the forms of personal computers, scanners, digital cameras, phones, faxes, modems, CD and DVD players and recorders, digitized video, radio and TV programmes, database programmes and multimedia programme.

ICT just like Education is not amenable to any single generally accepted definition. It means different thing to different people depending on their perception. However, to Olakulehi (2001) and Derbyshire (2003) Information and Communication Technology are tools within the school environment include use for school administration and management, teaching and learning of ICT related skills for enhancing the presentation of classroom work, teaching/learning respective tasks, teaching/learning intellectual, thinking and problem-solving skills, stimulating creativity and imagination for research by teachers and students and as communication tool by teachers and students. From these definitions, it holds that ICT is all-embracing involving hardware, software, procedure and peopleware.

The metalwork shop practice (MSP)?

Metalwork shop practice (MSP) is defined as the range of technical activities involving sheet-metal, blacksmith, foundry and welding that takes place in in a metalwork station (workshop). Technical colleges are expected to have a functional shop for conducting metalworking processes. Hajra (2001) defines metalworking processes as the manipulation of metals to create individual parts, assemblies, or large-scale structures. MSP covers a wide range of work involving the building of large ships, aircraft and bridges to precise engine parts and jewellery. Therefore, mechanical graduates are required to possess a correspondingly wide range of knowledge in tools, machine and equipment operation to be self-reliant and as a basis for an introduction to materials and process engineering in terms of a synthesis of activities and learning experiences for those who may want to further their studies in technology.

Technology plays a critical role in the economic development of every nation by solving teething problems and creating solutions that are new and innovative which requires collaboration and communication with equipment. It is a role that involves technical skills and curiosity of how to connect pieces of knowledge to find solutions and communicate a focus on value creation. This is very important because the main thrust of the metalwork is founded in hand-on and physical activities and besides designed to develop extensively the affective and cognitive areas by it integrative, inductive and holistic curriculum nature which gives it sound educational validity and application concerning all pupils, independent of academic abilities.

The general aims of the course are to make an essential contribution to general educational development, link observation and action with ingenuity and creativity and with problem-solving and higher-level responses, develop work-related disciplines, provide insights into engineering technology at a variety of levels, provide a basis for career decision-making and further studies. More so, the knowledge of metalwork can also help students to be able to explain the use of different tools, equipment, machinery and techniques of manufacturing, which ultimately facilitate the shaping of these materials into various usable forms.

Benefit of integrating ICT in teaching

The integration of ICT in teaching technology-related trades is imperative. The emergence of new technologies is a pointer to a new paradigm of teaching and learning. Colleges' access to ICT poses some challenges to the teaching and learning of the trade. Variety of computer applications have been developed and used in teaching technology and research has often been employed to direct educational software design and development towards teaching. Today, numerous computer applications are available, aiming to stimulate students' active and offering the opportunity to work under conditions that are extremely difficult, costly or time-consuming to be created in the classroom or even the workshop. The use of such ICT applications has developed a new research field in metalwork education. ICT offers a great variety of opportunities for modelling concepts and processes (Murphy, 2003) and (Osborne, 2003). IT provides a bridge between students' prior knowledge and the learning of new metalwork concepts, helping students develop scientific understanding through an active reformulation of their misconceptions (Wetzel, 2001).

Today a wide variety of educational software is available for teachers and students helping them to create, select and apply appropriate technical resources and modern engineering-related ICT tools including prediction of modelling to complex engineering activities with an understanding of the limitations. Integrating ICT into the teaching of metalwork will help broaden and deepen the students' knowledge as well as to expose students' difficulties in the conceptualization, and engage them actively in the learning process (Kiboss, Ndirangu & Wekesa, 2004).

Research Method

The study adopted Research and Development (R&D) approach towards ICT integration model. According to Putra (2012), method of research and development is the research that deliberately, systematically, aimed to formulate the findings, repairing, development, producing and testing the effectiveness of products, models, strategies in the way of a particular procedure, service, superior, new, effective, efficient and meaning. The subjects to be tested on are the Senior Technical (ST-1, 2 & 3) metalwork trade learning class of technical college main avenue, Calabar Metropolis, Nigeria. Development of the model used was a 4-D model of four stages namely define, design, develop and disseminate (Thiagarajan, Semmel & Semmel, 1974) for the approaches to ICT integration and stage of teaching and learning with and through ICT. However, at this preliminary study, stages were limited to the design of the models.

Designing of approaches to ICT integration and teaching and learning with ICT

Basically, approaches, teaching and learning with ICT if well manage could give a very positive effect for technical students, especially in developing their core (practical) skills and competencies (Yan, Yinghong, Lui, Whiteside & Tsey, 2018). However, in this stage the first step was to define the main concepts of the model design study to be integrated into the subject matter and set a course that will be the subject of research. Then the redesign ICT approaches, learning and teaching models were carried out. At this stage, the initial framework of the ICT integration generated model is based on **a continuum of approaches to ICT development** that relates to the growth of ICT for its specific environment. The teaching and learning with ICT model was designed to find the interconnection and interrelatedness of learning activities in the educational system. The design of approaches of ICT integration, teaching and learning metalwork shop practice model produced syntax than can be applied in the knowledge process is the same as other technical trades (UNESCO, 2002a; Kpolovie, 2012; Newby, Stepich, Lehman & Russel, 2006). The broad approaches through which educational systems proceed in their adoption and use of ICT consist of (i) Emerging (ii) Applying (iii) Infusing and (iv) Transforming. Also, the four stages of how teachers and students use ICT in the classroom are (i) Discovering ICT tools (ii) Learning how to use ICT tools (iii) Understanding how to use ICT tools and (iv) Specializing in the use of ICT tools.

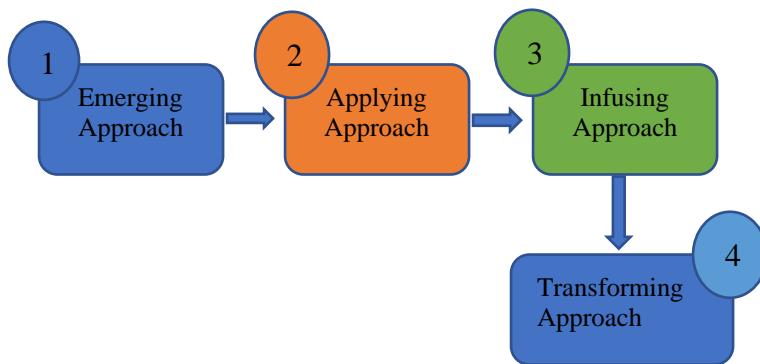## A continuum of approaches to ICT development

Figure 1: Model depicting a continuum of approaches to ICT integration

Based on the framework of above, the model conceives ICT development as a continuum along which an educational system can pinpoint the approach that relates to the growth of ICT for its specific subject matter and environment as described below:

Syntax 1: **The emerging approach**

The emerging approach is seen as the initial phase of ICT integration in the education system. At this phase, schools simply commence the acquisition of computers and other related technologies. The equipment acquired may or may not be used for core educational activities. They may just be acquired sometimes to boost the image of the school. In other words, these facilities are not integrated into classroom activities for students to learn from.

Syntax 2: **The applying approach**

The applying approach in this continuum model directly follows the emerging approach. This phase is characterized by the use of ICT for administrative purposes. Schools use the acquired ICT facilities mainly for its management and administration. Students' records are processed using these facilities. The management of the schools uses ICTs for the production of a various document for the effective administration of the schools.

Syntax 3: **The infusing approach**

The infusing approach is the third phase of the continuum model. The major characteristic of this phase is the use of ICT in the classroom. At this stage, the schools have started integrated ICT into the teaching and learning process. New approaches to teaching are beginning to emerge in these schools.

Syntax 4: **The transforming approach**

The transforming approach is the fourth phase of the continuum model. It is characterized by the heavy infiltration of ICT in the life and fabric of the education system. It is manifested by schools that are under major reforms by using ICT as the primary change agent. Reforms in these schools are driven by ICT and sound pedagogical principles that can work with the technology.

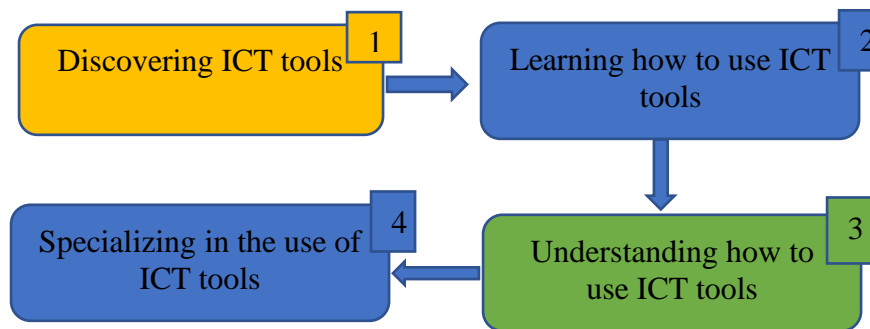## Stage of teaching and learning with ICT

Figure 2: Model stage of teaching and learning with ICT

This model conceives teaching and learning as interconnected and interrelated activities in the educational system in four stages as described as follows:

Syntax 1: **The discovering ICT tools stage**

The discovering stage is the first stage of teaching and learning with and through a model. At this stage, the teacher and learners are in the process of discovering the ICT tools, their functions and uses. Colleges at this stage emphasize training in computer skills and general computer literacy. The target at this stage is to have the teachers and students develop the basic ICT skills to manipulate the newly acquired equipment.

Syntax 2: **The learning how to use ICT tools stage**

The learning how to use ICT tools state of teaching and learning with and through ICT model follows the discovering stage. At this stage, the teacher and the students have gone beyond the basic skills of learning how to use these skills and tools in their various subject areas. Schools at this stage are beginning to apply ICT in the various discipline and specializations.

Syntax 3: **The understanding of how and when to use ICT tools stage**

The understanding of how and when to use ICT stage of the teaching and learning with and through ICT model is the third stage. At this stage, teachers and students have come to understand how and when to use ICT tools to achieve a particular purpose. The skills developed at this stage include the ability to evaluate ICT tools and select the most appropriate tools for a given project or a particular task.

Syntax 4: **Specializing in the use of ICT tools stage**

Specializing in the use of ICT tools stage is the fourth and last stage of the model. This stage involves the schools establishing specific ICT subject areas in the curriculum and helping students to specialize in these subjects. At this stage, the school provide vocational and professional education in ICT to the students to enable them to become a specialist.

Principles of ICT Integration

The process of integrating ICT in education is complex and follows several clear underlying principles. Tchameni (2006) came up with six broad principles of ICT integration in education. These principles, according to Tchameni, present the main skills required in a teaching and learning environment. The six major principles or skills constitute the six major objectives of integration of ICT education. Therefore, the teacher needs to develop and apply these principles or skills or capability to effectively integrate ICT in education. These principles are:

1. Exercise a critical mind and perception regarding the advantages and disadvantages and limitation of ICT in education and learning.
2. Take stock of and assess the potential of ICTs and networks about skills development in the learning programme.
3. Identify and communicate with the aid of various relevant multimedia tools
4. Effectively use ICTs for research, interpretation and communication of information for problem-solving.
5. Effectively use ICTs to develop continuous exchange and learning networks in the specific field of education and the teaching profession.
6. Help students to take ownership of ICTs for learning activities and assess the students' use of ICTs for as well as make a critical appraisal of data collected on the networks.

First principle

Under the first principle, there are five other principles which cover five competencies that teachers must have about the exercise of a critical mind and perception regarding the advantages and limitations of ICT in education and learning. These five competencies are:

1. The principle of vigilance and careful assessment of the impact of ICT on their students and their work
2. The principle of alertness to social inequality or exclusion resulting from an inability to access resources.
3. The principle that ICTs are not of themselves generators of innovative educational change
4. The principle that ICTs serve the behaviourist. Cognitive, constructive and instructive approaches equally well.
5. The principle that ICT should facilitate learning integration and transfer, make learning more meaningful and help students develop their talents, imaginations, resourcefulness, creativity and the like.

Second principle

The second principle subsumes six other principles which represent competencies related o taking stock of and assessing the potential of ICT and networks about skills development in education. The six competencies which teachers must have to effectively integrate ICT in education are:

1. Exploring several educational sites to identify appropriate resources.
2. Maintaining an activity bank to help students with their learning and to support other educational practices
3. Assessing resources not designed for educational purposes and adapting them for the competencies targeted in the study program.
4. Analyze educational software programmes carefully to see how they transmit content in the learning process and in problem-solving to see to what extent they leave traces of how the learner want through the process of making decisions, the operations carried out and the resultant effect.
5. Determining instructional needs and equipment requirements and eliminating attractive items but of little or no educational value.
6. Assess the value of these tools and to select those which help to develop intellectual skills and relationships in the learning programme

Third principle

The third principle encapsulates six other principles related to identifying and communicating with the aid of various relevant multimedia tools. These principles which are competencies that must be obtained by teachers for effective ICT integration are:

1. Collaboration, teamwork, joint action, and utilization of the collective intelligence of individuals located at a distance
2. Use of thematic networks, research, peer, email, discussion groups, databanks, images and sound
3. Selection of interactive resources and audiences with whom to communicate depending on specific issues
4. Guiding student-directed interactive learning
5. Helping student target, formulate and refine their questions so that ICT information searches are relevant, meaningful and suitable
6. Careful precision in terms of the language used

Fourth principles

The fourth principles cover four other principles related to the effective use of ICTs for research, interpretation, communication of information and problem-solving. These principles which represent competencies for teachers for effective ICT integration include:

1. Targeting of information, and critical analysis and conversion or transformation of useful resources into learning objects for educational activities.
2. Tracking of students' progress and interrupting their work as needed
3. Raising awareness of internet navigation and providing guidance, example: point out pitfalls
4. Getting students back on track through suggestions questions, and tips to help students develop critical search strategies.

Fifth principle

The fifth principle for ICT integration in education represents three other principles which relate to the effective use of ICTs to develop continuous exchange and learning networks in the specific field of education and the learning networks in the specific field of education and the teaching profession. These three principles or competencies are:

1. The necessity of establishing selection criteria for professional development resources
2. The use of collaborative peers' network to help train new graduates as well as colleagues
3. Building networks of teachers who share the same expertise

Sixth principle

The sixth principle of ICT integration in education subsumes five other principles which are related to assisting students to take ownership of using ICTs for their learning activities and assessing their use of ICTs as well as making a critical appraisal of data collected on the networks. These principles representing major competencies for ICT integration are:

1. Developing basic and essential ICT competencies, with an emphasis on computer literacy: introduction to ICT functions and tools (familiarity with common software such as word, excel, power-point, among

others) and basic operations (downloading, saving, and filing educational materials, compiling and organizing information).
2. Choosing the appropriate tools for a given task, integrating several tools to solve actual problems, and using them on an everyday basis critically and productively to serve as a model for the students.
3. Using a diversity of ICT software to teach, learn, communicate and solve problems in different subjects and adopting expressed critical stance towards these technologies.
4. Developing projects and the accompanying document (example; worksheet, digital portfolio)
5. Integrate various aspects of the course and extend the meaning of the information beyond the classroom
6. Evaluating the learning achieved through specific questions, effective work processes (example; integrated online self-evaluative learning, access to glossaries and extra class notes at internet-accessible hypertext sites among others.

Conclusion

Technical students are taught trades subjects without ICTs and are expected upon graduation to work in industries where knowledge of ICTs is required. Also, technical teachers still rely on the traditional teaching methods which are teacher-centred, task-centred and memory-based in teaching technical trades instead of the learner-centred ICT approach which encourages collaborative, creative and evaluative learning which are invoke the world over. Though, the integration of ICT is a complex and rigorous process that requires a systematic approach and specific knowledge and skills. The approaches must be well planned, implemented and evaluated often to determine the level of attainment of the educational goals. Acquiring computer and other resources alone to accomplish the aim of ICT integration in teaching and learning. Competence in handling ICT gadget and resources are key to the success of ICT usage in schools. The dimensions and components of the complex process of the evolving field of ICT integration in teaching and learning must be understood as well as paying attention to the essential component. For successful integration of ICT integration in technical colleges, the state government must invest heavily in ensuring that all levels of the four basic requirements are met in term of ICT provision and implementation.

The way forward

1. Cross River State government should establish an ICT laboratory in each of the technical colleges and equip them properly.
2. Teachers should be trained on the use of ICT resources in teaching and be made to use the knowledge in teaching students
3. Cross River State government should provide steady electricity and provide technical support staff to guide teachers and students on how to operate the facilities.

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