Creating an Online Tool for Assessing the Readiness of Teacher Training Colleges in

Developing Countries to Implement the UNESCO ICT Competency Framework for Teachers: A

Design and Development Study

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Abstract

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human life today. School curricula is continually being revised to take advantage of the

opportunities that ICTs offer to improve teaching and learning. Using the tool development type

of design and development research, this study translates the UNESCO ICT Competency

Framework for Teachers (UNESCO ICT-CFT) into an online survey that is capable of detecting

if computer labs of teacher training colleges in developing countries have the capability to be

used to train teachers to exhibit the UNESCO ICT competencies. By employing design and

development techniques of expert review and field tests, an online tool was developed that was

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training teachers on the UNESCO ICT-CFT. This report provides a detailed account of the tool

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General Audience Abstract

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Dedication

To My Parents: Emmanuel S. Y. Djimah & Regina A. Mensah

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To God be the Glory.

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Chapter One – Introduction and Need for Study

Information and Communications Technology and Developing Countries

Information and Communications Technology (ICT) plays a very important role in the world today. In developing countries, ICTs are prominently described as a key component of the agenda to improve the wellbeing of its citizenry. Educators and students are encouraged to use ICTs in their teaching and learning. Governments of developing countries and donor agencies have initiated programs in some of these countries that seek to improve the use of ICT. This study produced a tool that may be used to complement the implementation of one such initiative – the UNESCO ICT Competency Framework for Teachers.

Information and Communications Technology. Information and Communications Technology has been variously defined and continues to evolve and expand. Near the beginning of the 21st century, Toomey (2001) explained that ICT:

> …generally relates to those technologies that are used for accessing, gathering, manipulating and presenting or communicating information. The technologies could include hardware (e.g. computers and other devices); software applications; and connectivity (e.g. access to the Internet, local networking infrastructure, videoconferencing). What is most significant about ICT is the increasing convergence of computer-based, multimedia and communications technologies and the rapid rate of change that characterizes both the technologies and their use. (para. 2)

Around this same time, The International ICT Literacy Panel (2002) defined ICT literacy as 'using digital technology, communications tools and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society' (p. 2).

Later in the same decade, Unwin (2009) described the conceptual framework of ICTs and stated that although ICTs are primarily defined as computers and the internet, there are also other definitions that place more emphasis on the different types of technologies. Unwin (2009) further asserted that ICTs should be seen as encompassing three main "interconnected processes: the capture of information, its storage, and the ways in which people access and share it". Three years later, Zuppo (2012) pointed out that defining ICTs in a global world had become challenging, due in part to the many different connotations given to the term (p. 14). Although the acronym ICT (or ICTs) has continuously referred to Information and Communications Technology, by 2012, ICTs were being defined in close association with the purposes for which they were used. Whilst in developing countries, ICTs were closely related to socioeconomic development (Zuppo, 2012, p. 15), the Organization for Economic Co-operation and Development (OECD) still related ICT to an entire economic sector (2001, p. 3).

Despite evolving definitions, governments the world over have attached great importance to ICT. ICTs are not only seen as a catalyst for development, but have also led to drastic changes in many aspects of human endeavor, including government, health, construction, and communication. According to a study by Dimelis and Papaioannou (2010), there was a significant growth in the productivity of 42 developing and developed countries, and such growth could be directly linked to ICT use.

Developing Countries (DC). The term 'developing countries' is one that conveys different meanings depending on the system of measurement and the intent for which the classification is made. According to Sanford and Sandhu (2003), a country's level of development can be assessed using different indices including "per capita income; economic and social structure, social conditions and lastly, the prevailing level of economic and political

freedom". The United Nations Statistical Yearbook (2011) further states that there is no acceptable agreement in the UN system with regards to the term "developed" and "developing".

Developing Countries (DCs), in an effort to accelerate development and to alleviate poverty, have vigorously embraced the touted potential of ICTs in this regard. Policies have been established in many DCs to integrate ICTs in the education sector (Kozma, 2008). In DCs, however, the focus for these new policies has largely remained on the provision of ICT tools (such as computers and computer labs, projectors, Smart Boards, Internet access, etc.). In the education sector, ICT has prominently featured in all forms of restructuring. Teachers are required to integrate ICTs in their lessons, and to provide environments that would allow students to improve their ICT skills and knowledge.

UNESCO's ICT Competency Framework for Teachers

Technology has played a significant part in human development. In this so-called information age, technology has taken an even more profound grasp, and has permeated all aspects of human life. Teachers play an important role in the development of a country, and this role is essential, especially in the deployment and adoption of a new phenomenon. It is essential that teachers be trained, not only to use technology effectively, but also to find innovative ways to integrate such technologies in their instruction. In an effort to facilitate such ICT integration, the United Nations Educational, Scientific and Cultural Organization (UNESCO) teamed up with Intel, Cisco, Microsoft, Virginia Polytechnic Institute and State University (Virginia Tech) and the International Society for Technology in Education (ISTE) to produce an ICT Competency Standards for Teachers (ICT-CST) in 2008. In 2011, UNESCO published an updated version of the ICT Competency Standards for Teachers' document. This version was referred to as the ICT Competency Framework for Teachers (ICT-CFT).

The UNESCO ICT-CFT employs a three-pronged approach of technology literacy, knowledge deepening and knowledge creation. The framework also identifies the six aspects of a teacher's work as: understanding ICT in education; curriculum and assessment; pedagogy; ICT; organization and administration; and finally, teacher professional learning.

The framework provides details on how ICT can be integrated into teacher education, taking into consideration the three approaches and the six aspects of a teacher's work. According to UNESCO (2011), this newer version of the framework is intended as an updated version of the 2008 document, and the 'framework has been enriched on the basis of feedback from subject matter experts and users worldwide, and enhanced with the inclusion of example syllabi and exam specifications for Technology Literacy and Knowledge Deepening' (p. 1). The primary focus of the UNESCO framework is to provide a guide that would allow member states to readily recognize what is needed to provide an education for pre-service teachers. This would ultimately help train teachers to adequately use ICT to teach and produce a workforce ready to harness the power of ICT for rapid economic development.

Statement of the Problem

DCs are burdened with the need to continue to provide basic amenities such as electricity, water, shelter, roads and education. To provide such basic facilities, governments of DCs have looked at the successes of developed countries, and have modeled their development agenda along the success stories of the developed world. International bodies and donor agencies such as the UN and USAID have demonstrated a willingness to help DCs but such help is usually tied to the fulfillment of conditions prescribed by these agencies and bodies. It is not uncommon to see DCs therefore try to implement the policies prescribed by the donor agencies and bodies.

The UNESCO ICT-CFT is one such policy that most DCs welcome, especially because of the view that ICTs will help accelerate development.

Although the UNESCO ICT-CFT has been in existence for over six years, a search of countries in the developing world that have adapted the document for use did not show a wide adoption rate. Countries (e.g. Guyana, Tanzania, Nigeria) that have made efforts to implement the UNESCO ICT-CFT place emphasis on provision of infrastructure (such as computers, networks and Internet) and computer literacy training (Hooker, Mwiyeria &Verma, 2011a, 2011b; Moore, 2012), usually at the expense of ICT integration in the teachers' work. It is unclear if the infrastructure built by these countries provide the required hardware and software needed to achieve the stated objectives of the UNESCO ICT-CFT.

The UNESCO framework suggests that countries adapt the document to suit the conditions of the implementing country (UNESCO, 2008a, p. 12). This is important because DCs are at different levels of development. Within countries, the schools that will implement the framework are also not equally resourced. This situation is especially exacerbated when relatively new technologies (such as computers, networks, mobile devices, etc.) come into play. These differences in resource availability within countries notwithstanding, the majority of pre-service teachers write the same qualifying examination.

In order for pre-service teachers of DCs to meet the suggested ICT competency outlined by the UNESCO document, the syllabi and examinations of teacher training colleges in DCs may have to be revised. A part of such a revision may also include determining what resources (hardware, software, and infrastructure) are required to fully implement the standards. To do this, the UNESCO ICT-CFT objectives have to be transformed to show clearly, the behaviors and performances required, and to also attach specific examples of resources that may be used to

potentially achieve these objectives. This way, potential implementing institutions will have a readily available way to determine if they have, at least, the minimum resources needed to achieve desired UNESCO ICT-CFT objectives.

If DCs are to implement the UNESCO framework, it is essential to provide the schools a way to determine if the resources they have in their computer labs can be used to teach and assess pre-service teachers on the UNESCO ICT-CFT objectives.

The focus of this dissertation is to produce an online tool that provides a means to determine the resources (hardware, software, and infrastructure) that could be present at training and examination centers, an environment that is ideal for the attainment of the prescribed UNESCO ICT-CFT. This guide will be used to determine the readiness of computer labs and classrooms to be used to teach and assess pre-service teachers' ICT competencies. DC countries can also use this guide to evaluate computer labs and determine any additional appropriate resources needed.

Need for Study

UNESCO's ICT-CFT was produced with the purpose to train a 21st century workforce capable of production that meets the needs of the populace. Adoption and use of the ICT-CFT, especially in developing countries, has the potential to accelerate development and alleviate poverty. Since its production, however, adoption, adaptation and use of the ICT-CFT have been slow, at best. A tool for assessing the readiness of computer labs of teacher training institutions to implement the UNESCO ICT-CFT should not only raise the awareness of the existence of the UNESCO ICT-CFT, but could also provide a basis for better planning (in terms of resource procurement) and implementation of the UNESCO ICT-CFT.

Purpose of the Study

The purpose of this study is to provide an electronic tool for detecting the level and nature of readiness of teacher preparation computer labs in DCs to implement the UNESCO ICT-CFT. Such a tool should not only provide governments of DCs with a readily available way to assess the readiness of computer labs in teacher training institutions, but it should also provide information that will be helpful as governments determine what steps may be taken to make the computer labs ready. As DCs continue to invest their scarce resources in ICT, it is essential that such investments (particularly for educational purposes) are focused on the needs of the countries. Without a contextualized needs assessment tool, most DCs might be swayed into investing in technologies that may not contribute to the achievement of the objectives specified in the UNESCO ICT-CFT.

Fulfilling this purpose is complicated by the fact that UNESCO's ICT-CFT objectives do not specify the conditions under which the objectives may be attained. Mager (1962) makes it clear that any meaningful performance objective must, among others, state the conditions under which the behavior must be performed. In order to produce teachers who can exhibit the competencies as stated by the objectives, it is necessary to identify the conditions, and hence the tools that are required.

The resulting tool produced from this study will be beneficial to governments of DCs that are currently using or are preparing to use the UNESCO ICT-CFT. These DCs could evaluate their computer labs and procure resources that will help them fully implement the UNESCO ICT-CFT. NGOs and donor agencies could use the tool to assess potential beneficiary countries and to make sound decisions on allocation of resources. The tool could also provide UNESCO with an additional resource that could accompany the framework, providing more direction to

countries that intend to implement the framework. Lastly, this adds to the literature base of many fields of research, including design and development in instructional design, ICTs, teacher preparation, and in general, studies on developing countries.

Translating the Standards

According to Mager (1962), achievement of meaningful performance objectives requires that the objective clearly states; a) the expected behavior, b) conditions under which the behavior must be performed, and c) criterion for assessing the behavior (p. 12). A key component of the UNESCO ICT-CFT framework is a list of 21 objectives under the ICT module, specifying the behaviors that pre-service teachers should exhibit to show their ability to integrate ICTs in their classrooms. Although implied, the objectives do not expressly state the required conditions (Note: In this study, the terms 'conditions' and 'resources' are used interchangeably to mean 'hardware, software and infrastructure) that must exist in order for the objectives to be attained. A part of this study (Chapter Four) translated the UNESCO ICT-CFT, such that conditions are aligned with standard indicators provided by the document. Mager (1962) asserts that if objectives are to successfully communicate intent, 'it is important to further define the terminal behavior by stating the conditions that will be imposed on the learner'. Such conditions will include the resources that must be available to the learner, at the time the intended behavior is expected to be exhibited.   Translating the UNESCO ICT-CFT objectives into contextually ready environments involved an analysis of the stated objective, a determination of the underlying assumed conditions, and a write up of what these conditions demand, in terms of physical resources that must be present. This study, however, did not discuss Mager's third element – the criterion for assessing the behavior expected.

Research Questions

1. What will an online tool for assessing computer lab readiness to adopt the UNESCO

   ICT-CFT for teachers in developing countries look like?

2. How will the tool be operationalized to assess training centers?

Organization of the Study

This study is organized into six chapters. Chapter One discusses the background to the

study and includes definitions for ICT and how ICT relates to developing countries. Also

included in Chapter One is a brief overview of the development of UNESCO's ICT-CFT, the

problem statement, need and purpose of the study, a section on translating the UNESCO ICT-

CFT into an operational form and research questions. Chapter Two is a review of literature for

the study. A review of the UNESCO ICT-CFT, ICT skills assessment, performance objectives,

instructional design components and factors that influence adoption and implementation in

diffusion and innovations are made. Chapter Three presents the research design and

methodology and provides detailed information on the tool development, expert review selection

procedure, participant selection and processes for gathering data. Chapter Four discusses the

design and development of the center readiness assessment tool. It includes an account of the

processes for analysis and breakdown of the UNESCO ICT-CFT objectives, expert review

processes, determination of related features of hardware, software and infrastructure that could

be used to achieve the objectives, formulation of questions to determine center readiness, and the

determination of appropriate feedback responses. Chapter Five reports on results of field test of

the online tool. A tool performance report, inventory of resources at participants' computer labs,

report on reactions to tool questions, and an account of feedback to participants are some of the

sub-topics in Chapter Five. Chapter Six summarizes the study, discusses the results and lessons

learned from the study, and advances suggestions on tool use and improvement.

Chapter Two – Review of Literature

Introduction

The objective of this study is to produce an online tool that could detect the readiness of schools and computer labs in developing countries to produce and assess pre-service teachers who have the required ICT competency as specified by the UNESCO ICT-CFT. A review of literature addressed the following areas:

    1.   History of UNESCO's ICT-CFT

    2.   ICTs Competency/Skills Assessment

    3.   The 21 ICT Objectives of UNESCO's ICT-CFT

    4.   Diffusion of Innovations

History of UNESCO's ICT-CFT

The United Nations Educational, Scientific and Cultural Organization (UNESCO) made up of 195 Member Nations and 8 associate members has as its goal 'to contribute to the building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information' (UNESCO, n.d.a para. 3). In line with the stated goal, UNESCO has been at the forefront of championing a developmental agenda through education, science and culture. This is especially evident in developing countries. Of particular relevance, the education sector of UNESCO includes in its mission to 'provide international leadership to create learning societies with educational opportunities for all populations' and 'provide expertise and foster partnerships to strengthen national educational leadership and the capacity of countries to offer quality education for all' (UNESCO, n.d.b. para. 1).

In furtherance of the objectives of its education sector, UNESCO teamed up with Intel, Cisco, Microsoft, Virginia Polytechnic Institute and State University (Virginia Tech) and the International Society for Technology in Education (ISTE) to produce an ICT Competency Standards for Teachers (ICT-CST). According to UNESCO (2008a):

The objectives of the ICT Competency Standards for Teachers project are:

- To constitute a common set of guidelines that professional development providers can use to identify, develop or evaluate learning materials or teacher training programs in the use of ICT in teaching and learning.

- To provide a basic set of qualifications that allows teachers to integrate ICT into their teaching and learning, to advance student learning, and to improve other professional duties.

- To extend teachers' professional development so as to advance their skills in pedagogy, collaboration, leadership and innovative school development using ICT.

- To harmonize different views and vocabulary regarding the uses of ICT in teacher education. (p. 5)

According to UNESCO (2008a) the policy is intended to be a part of the broader agenda of 'educational reform and sustainable development' (p. 6). The ICT-CST project has three main components (and hence three separate documents) that are geared towards 'addressing the underlying policy framework', 'examining the components of educational reform and developing a matrix for teacher,' and providing a detailed description of the specific skills to be acquired by teachers within each skill set/module'. The project also includes a phase for the 'establishment

of a UNESCO mechanism to endorse training programs for compliance with the UNESCO

standards' (p. 2).

It is interesting to note that before the preparation and dissemination of the ICT-CST

project and its resultant framework documents, UNESCO had previously produced similar

documents aimed at encouraging ICT use in teacher education. For example, in 2002, UNESCO

produced a detailed planning guide that proposed 'a framework for ICTs in teacher education,

describing the essential conditions that must be met for successful technology integration and

providing guidelines for the development of a strategic planning process' (UNESCO, 2002 p. 3).

UNESCO (2002) suggested that advancements in ICT at the time had put pressure on

governments and educational institutions to produce teachers who were adept at using these new

technologies in their teaching activities.   The goal of the planning guide was therefore to

'provide a guide to help teacher educators, administrators and policy-makers infuse, integrate, or

embed ICTs into teacher education' (p. 11).

In 2011, UNESCO published an updated version of the ICT Competency Standards for

Teachers document. This version was referred to as the ICT Competency Framework for

Teachers (ICT-CFT). According to UNESCO (2011), this version of the framework is intended

as an updated version of the 2008 document, and that the 'framework has been enriched on the

basis of feedback from subject matter experts and users worldwide, and enhanced with the

inclusion of example syllabi and exam specifications for Technology Literacy and Knowledge

Deepening' (p. 1).

In conclusion, UNESCO suggests that governments could (and are encouraged to)

evaluate their educational polices, and based on their current and future economic needs, select

components of the ICT-CST framework that align with their goals and use them to train and

evaluate their teachers.

Use of the UNESCO ICT-CFT. There is no doubt that governments all over the world

have experienced (or seen) the potential of ICT in all spheres of life. Countless debates and

publications litter academia about the role of ICTs (e.g. Clark, 1983; Kozma, 1991) in learning

and education. These debates, however, have not slowed down the rate of infusion of ICTs in

education. Governments, Non-Governmental Organizations (NGOs), Corporations, Bretton

Woods institutions (IMF, World Bank, etc.) and even United Nations agencies have all

advocated for, and at some point, actively promoted policies and strategies that are aimed at

bringing ICTs to the fore of education. As such, many countries have some form of ICT

standards, and teachers are trained and assessed by the dictates of these standards. In the

following section, I have selected cases in four countries and the European Union (EU) to

illustrate the use and effect of the UNESCO ICT-CFT.

UNESCO ICT-CST in the United States. In the United States of America, the National

Council for the Accreditation of Teacher Education (NCATE) is the accrediting institution that

recognizes and approves teacher-training programs in universities and colleges. NCATE is made

up of teachers, teacher educators, content specialists and local and state policy makers. The US

Department of Education and the Council for Higher Education Accreditation recognize NCATE

as a professional accreditation body for teacher preparation (NCATE, n.d. para. 6). For over 20

years, NCATE has relied on the International Society for Technology in Education (ISTE) to

provide the ICT competency standards by which teachers are assessed. ISTE produced the

National Educational Technology Standards (NETS), which 'are the standards for learning,

teaching, and leading …' (ISTE, 2012, para. 2). The NETS for teachers (NETS.T) has been in

effect since 2002. These standards provide the specific competencies that teacher education

programs and teachers are required to have in order to be accepted as accredited programs and

certified teachers respectively.

In comparing the UNESCO ICT-CST and the NETS.T standards, it can be deduced that

these standards bear some similarities. For example, the ICT-CST standards advocates three

broad approaches of 'Technology Literacy', 'Knowledge Deepening' and 'Knowledge Creation'.

Based on a country's economic/social conditions, the various ministries could adapt the

framework and produce syllabi that either concentrate on one approach, or combines all three

approaches to take advantage of the benefits of ICT in economic development. Ultimately, the

aim is to produce teachers who have the skills and knowledge to produce a workforce that has

the necessary "21st century skills in support of social and economic development" (UNESCO,

2008a). Likewise, the NETS.T lists performance indicators that are also aimed at producing

skilled teachers who have the knowledge and ability to produce 21st Century workforce. The

NETS.T states the following:

All teachers should meet the following standards and performance indicators. Teachers:

1. Facilitate and Inspire Student Learning and Creativity

2. Design and Develop Digital-Age Learning Experiences and Assessments

3. Model Digital-Age Work and Learning

4. Promote and Model Digital Citizenship and Responsibility

5. Engage in Professional Growth and Leadership (ISTE, 2008.)

The document provides further elaboration of these indicators that point to the same

ideals identified in the UNESCO ICT-CST document. Although not stated explicitly, a careful

study of the NETS.T document shows clearly that the three approaches identified by the

UNESCO ICT-CST document (technology literacy, knowledge deepening, and knowledge creation) are all embedded in the five broad indicators of the NETS.T.

It must be stated that the NETS.T standards were first created in 2001, and that it was not until 2008 that UNESCO drew on the expertise of ISTE and other partners to create the ICT-CST document. Since the NETS.T document predates the UNESCO document, it cannot be said that the NETS.T draws from the UNESCO document. It can be concluded that aspects of the UNESCO framework are similar to that of the NETS.T document.

UNESCO ICT-CFT in Guyana. Guyana (located in the North of South America) only recently adopted the UNESCO ICT framework policy to train its teachers. In 2007, only 48.6% of Guyana's teachers were fully trained and qualified (Moore, 2012). In an effort to train more teachers, the Ministry of Education in Guyana (including the University of Guyana, The Cyril Potter College of Education and other affiliates), together with the Commonwealth of Learning (COL), Microsoft, and UNESCO developed an ICT Professional Development Strategy for Teachers. This plan, which uses the UNESCO ICT-CST as the main guiding framework is designed to "equip all Ministry of Education Officials, teacher development management and staff, school principals and teachers with the skills to use ICT effectively to support high-quality teaching and learning in Guyanese schools" (Moore, 2012). With specific reference to teachers, the Guyana ICT Professional Development Strategy provides two main ways for ICT integration. Firstly, pre-service teachers pursing either a 2-year advanced diploma in education or a 4-year Bachelor of Education degree were required to take a number of courses in ICT literacy and ICT integration. Secondly, the strategy provided for continuing professional development for both newly trained and in-service teachers to improve their ICT skills/ICT Integration.

The Guyana ICT Professional Development Framework is modeled on the UNESCO ICT-CFT standards. The development framework provides programs that are not only designed to increase technology literacy, but also to enhance knowledge deepening. Short courses, such as one that discusses the role of an ICT coordinator, go beyond the knowledge of how to use computers and are designed to help the teachers and other educators perform beyond ICT literacy. According to Moore (2012) the UNESCO ICT-CFT was initially used to spread awareness of the potential of ICT in the Ministry of Education and also among lecturers of student teachers. This way, when it came to the review of the school curriculum, the stakeholders were already aware and more receptive, and thereby were able to include ICT in the curricula.

UNESCO ICT-CFT in Tanzania. Tanzania (located on the borders of the Indian Ocean on the eastern shore of Africa), much like Guyana has only just implemented a pilot program of incorporating ICT into teacher education. Known as the Teacher Development for 21st Century (TDev21), the program was implemented by the Tanzanian Ministry of Education and Vocational Training (MOEVT) and was supported by the World Bank and the Global e-Schools Communities Initiative (GESCI). According to the draft report, the broader objective of the program was to "build teacher capacity in Sub Saharan Africa for effective use of technology, particularly ICTs in education" (Hooker et al, 2011a). Specifically, the idea was to redesign and implement the UNESCO ICT-CFT.

Before the implementation of the pilot program, the Government of Tanzania had in 2005 collaborated with the Swedish Government and had started a project to introduce ICT in all government teachers' colleges. With the help of the Swedish International Development Corporation Agency (SIDA), the project was designed to help improve the quality of pre-service

and in-service teachers (MoEVT, 2007). This program was also designed as an intervention to help address the shortfall in trained teachers at the secondary school level, where in some regions teacher/student ratios were as high as 1:80 (Hooker et al, 2011a).

According to Hooker et al (2011a), the pilot implementation of the ICT-CFT for Tanzania was carried out in three main stages. First, needs assessment situational analysis was performed that involved scanning ICT teacher training policies at both the pre-service and in-service levels, conducting stakeholder analysis to determine national counterparts, and also identifying which teacher training institutions to partner for the pilot implementation. This phase of the pilot study involved both a 'desk review' (review of existing literature for work in Tanzania and other parts of the world) and also a field study that involved interviews, focus group discussions, surveys and questionnaires to help ascertain the status of ICT infrastructure and use.

The second stage of the stage for the pilot implementation of the UNESCO ICT-CFT for Tanzania involved the "contextualization of the Global ICT-CFT Framework" (Hooker et al 2011a). This stage of the pilot process involved review of other frameworks around the world (such as the UNESCO ICT- CFT, the ISTE NETS-T, the Australia ICT Competency Framework for Teachers, the Dutch ICT Knowledge Base, the Teachers Competencies and Qualifications Framework for EU Countries, etc.), and the production of a new "emergent" level framework, that was mainly carved out of the aforementioned frameworks.

To implement the policy, a workshop was organized to train "master trainers" who were expected to 'adapt and mainstream the standards at the national level' (Hooker et al, 2011a). The workshop involved 33 participants from over 10 colleges, secondary schools and other designated persons from the Tanzania MoEVT.

The final stage of the Tanzania ICT-CFT was devoted to Capacity Building for the Deployment of ICT-CFT. According to Hooker et al (2011a), the main focus at this stage was to ensure that national facilitators were familiar with the objectives and content of the ICT-CFT for Tanzania, that digital content was generated to be used by such facilitators, and that avenues for assessment and certification for pre-service and in-service teachers were adequately explored.

The implementation of the pilot project resulted in improvements in ICT in schools in Tanzania. The majority of improvements, however, seem to be infrastructural in nature. For example, of the six achievements listed in the Hooker et al report (pg.17), only one of them involved actual training of personnel (training of 80 tutor technicians). The rest of the achievements listed infrastructure development (such as Installation of 1250 networked clients, and installation of internet connectivity for 34 colleges).

UNESCO ICT-CFT in Nigeria. Another country that has embarked on developing an ICT competency standard for teachers is Nigeria. Nigeria, located in the West of Africa, is a prominent country both in West Africa and the entire African continent. This is partly due to its large population, currently estimated at over 170 million (CIA Factbook), and also due to its rich crude oil resource. Most projects, initiatives, and development agenda in Nigeria ultimately spill into other African nations.

Nigeria's ICT-CFT initiative is modeled like the project in Tanzania (discussed above). According to Hooker et al (2011b), the reasons for adopting the UNESCO ICT-CFT are two-fold: the UNESCO ICT-CFT resulted from consultations with experts around the world with government support, and also that it is global in nature, and flexible enough for countries to adapt as necessary.

As is characteristic of many African nations, Nigeria has over the years undergone several educational reforms and there have been a series of program and initiative policies. For example, several instruments and polices such as The National Vision (2020), The Seven-Point Agenda, Roadmap for Education Sector, the National Information Technology Policy, and the National Information Technology Education Framework have all at some point mentioned the Integration of ICT into school curricula, and hence the need to produce competent teachers who have certain ICT competencies (Hooker et al. 2011b). These policy documents have resulted in an attempt to train teachers in ICT.   The pilot project in Nigeria has therefore concentrated on harmonizing the already existing initiatives, and revising them to incorporate certain aspects of the UNESCO ICT-CFT that have not been properly highlighted.

UNESCO ICT-CFT at the European Union. Under the auspices of the European Union's (EU) Lifelong Learning Program, a new framework referred to as eTQF Teacher ICT Competency Framework was developed. The Teachers Competencies and Qualification Framework (eTQF) was designed for use by the members of the European Union to help "schools' principals, education managers and education authorities to support the development of teachers' competency in the use of ICT in education" (eTQF, 2012). The eTQF is based on the UNESCO ICT-CFT and is comprised of four broad thematic areas: ICT, Pedagogy, Curriculum and Assessment, and Teacher Development. These themes are intended to help teachers assess themselves and ensure that they are adequately prepared to teach. To this end, the eTQF also has an online self-assessment tool that allows teachers to assess their skills, and based on their results, the self-assessment provides further information for the teachers to seek help or further training if needed.

The eTQF is different from the cases in Tanzania and Nigeria to the extent that even though it borrows from the UNESCO ICT-CFT, it is purely designed to help in-service teachers, whereas that of Nigeria and Tanzania is for both pre-service and in-service teachers.

As expressed earlier, most country data I surveyed indicate that they have some type of ICT related program for teachers. Many countries however, have their own ICT Policies and frameworks, which predates the 2008 UNESCO-CFT. As such, these countries have relied more on their own developed documents. In countries where they have embraced the UNESCO-CFT, they only seem to have done so recently, and are now piloting or reshaping their own documents to take advantage of the UNESCO-CFT.

Relationship between UNESCO ICT-CFT and Country Standards. The majority of countries surveyed fall into two main categories when it comes to ICT integration into teacher education. These are countries that already have well-established competency standards and therefore do not use the UNESCO ICT-CFT, and countries that are currently adopting or revamping their ICT competency standards to take advantage of the ideas expressed in the UNESCO ICT-CFT document.

Countries that have well established competency standard frameworks are mainly developed countries such as the United States, Australia, and other countries in Europe. As mentioned earlier, the United States of America has, for over 10 years now, already had some form of technology integration into teacher education. This has mainly been spearheaded by ISTE. Although brief, the NETS for teachers is closely related to the UNESCO Framework. The broad approaches of technology literacy, knowledge deepening, and knowledge creation advocated for by the UNESCO-CFT align with the NETS-T. This is especially evident in the areas of knowledge deepening and knowledge creation. The NETS-T for example states that

"teachers will use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments" (ISTE, 2008, p. 1). Likewise, the knowledge deepening aspect of the UNESCO-CFT highlights that teachers should be able to use technology to help students think creatively to solve complex problems, understand policy and also apply their knowledge to real world problems. The only slight difference I found is that the NETS-T does not deal in detail with the technology literacy. However, teachers cannot attain the other sections of the NETS-T if they do not have adequate technology literacy skills.

In countries where the ICT Competency frameworks have just been established or are being piloted, they seem to conform to the UNESCO framework. The UNESCO ICT-CFT is used as a guide upon which the national frameworks are established. Most of these countries, like Nigeria and Tanzania, already have some ICT policies in place. However, these are mainly infrastructural in nature. The policies have concentrated on the provision of ICT equipment to schools. The new reforms therefore, tend to use the UNESCO framework and hence their national curricula and standards conform to the UNESCO-CFT.

The Guyana ICT professional Development Strategy for Teachers, for example, is designed to ensure that teachers gain knowledge in all three areas of the UNESCO ICT-CFT framework. The 2-year advanced diploma in education and the 4-year Bachelor of Education degree incorporate courses that ensure that graduates have attained technology literacy and knowledge deepening skills. Again, the strategy also incorporates continuing professional development courses that are specifically designed for qualified practicing teachers, school principals, ICT coordinators, and maintenance staff, all targeted at the knowledge deepening aspect of the UNESCO ICT-CFT framework.

The UNESCO-CFT framework was designed as a guide to help countries develop their own ICT Competency Framework for teachers. The pilot implementation of the contextualized UNESCO-CFT project in Tanzania did not cover any national exams. According to Hooker et al (2011b), the teachers instead would be expected to produce e-portfolios and artifacts that would demonstrate their learning and skills in ICT.

In Guyana, the professional development strategy for teachers, carved out of the UNESCO ICT-CFT incorporates the ICT skills into the existing teacher education programs. There is no specified examination set out for teachers for only ICT. Teachers take courses as part of their degree programs, and may be examined per the usual rules determined by the training institutions.

In conclusion, UNESCO has been able to produce a comprehensive document that, when utilized, could help many countries strengthen their workforce, through the provision of relevant education. Although the UNESCO document has been in existence since 2008, and has seen a revision (with the inclusion of a sample syllabus and examination scheme), many countries have not taken advantage of this resource. In countries where the UNESCO ICT-CFT has been used, this is only at a pilot stage, or at best at its infancy. For UNESCO's effort to have the much-needed global impact, it may be important for UNESCO to embark on a vigorous campaign, and seek to demonstrate to both developing and developed countries, the mutual benefits that may be derived from adopting a uniform plan for training teachers, especially in this age, where technology is bringing the world together more than ever before.

ICT Competency/Skills Assessment

Assessment of ICT skills in education around the world, and particularly in Africa have been largely dominated by organizations (such as ETS, and Certiport) that provide different

forms and levels of certifications for individuals. These assessments are usually proctored examinations that one registers for, buys study materials for, and prepares to take the examination on appointed dates. Upon successful completion, one is issued a certificate that can then be provided as a testament to one's skill set. The following sections highlight some of the well-known examinations and standards, and show how they are used to assess ICT skills and knowledge.

iSkills by Educational Testing Service (ETS). The Educational Testing Service (ETS) is one of the world's leading non-profit organizations committed to advancing 'quality and equity in education for people worldwide by creating assessments based on rigorous research' (ETS, 2013a). The ETS estimates that it "develops, administers and scores more than 50 million tests annually in more than 180 countries, at over 9000 locations worldwide" (ETS, 2013a). Katz and Macklin (2007) report that in 2001 ETS convened an International ICT Literacy Panel and commissioned the committee to determine the relationship with the growing use of ICT and how it affects literacy (p. 4). As a result of the committee's observations and recommendations, and in keeping with ETS' business model, ETS set in motion an agenda to produce an assessment tool that could be used by educational institutions and business entities to test the skill level of potential students and employees. The process involved producing a number of publications (e.g. ETS, 2005; Gregorian, 2002; Katz, 2005). The resultant assessment (which is administered by ETS) is an "outcomes-based assessment that measures the ability to think critically in a digital environment through a range of real-world tasks" (ETS, 2013b, para. 1).

According to ETS (2013b), the test includes sections that measure the ability to navigate, understand, and critically evaluate information. The test also delivers information to help access student evaluation and placement and curriculum development. The ETS (2013b) further states

that the *i*Skills assessment test is designed to be taken by college students to help institutions "evaluate students' level of critical thinking skills in a digital environment".

The *i*Skills assessment by ETS is positioned as a comprehensive assessment tool that goes beyond a mere display of computer literacy. Katz et al (as cited in Macklin, 2007, para. 8) indicate that the *i*Skills test not only measures knowledge of technology but also the ability to use critical thinking skills to solve problems in a technological environment.

IC3 by Certiport. Certiport is a US based firm that was established in 1997 with the goal of providing "performance-based certification exams and practice test solutions for academic institutions, workforce and corporate technology markets" (Certiport, n.d.a, para. 2). Certiport provides these certification examinations across different software makers and their respective software. Examples of such certifications include Microsoft Office Certification Program, the Adobe Certified Associate Certification Program, and the Internet and Computing Core Certification (IC^3). According to Certiport (n.d.a), over 2 million certification examinations are administered each year around the world (para. 4).

Certiport's IC^3 has been positioned as the entry-level certification that assesses basic ICT skills and knowledge. Key to this certification is the demonstration of Internet skills. Certiport indicates that the IC^3 certification assures students, job seekers, and employers of the "foundation of knowledge needed for success". The key assessment areas of the IC^3 certification are computing fundamentals, key applications and living online (Certiport, n.d.b, para. 7).

International Computer Driving License by ECDL Foundation. The European Computer Driving License (ECDL) was established in 1996 with the aim to raising digital literacy throughout Europe. Due to its popularity, countries outside of Europe became interested and so in 1999, the International Computer Driving License (ICDL) was established to

administer a similar certification worldwide (ECDL, 2013, para. 3). Further, the ECDL (2013)

asserts that over the past decade it has successfully operated over 24,000 test centers in 148

countries and has thus far issued over 11 million ICT proficiency certificates in 41 languages

(para. 9). In the United Sates, the ICDL certification program is made up of modules designed to

provide the skills that will produce a "proficient end user of a computer and common computer

applications" (ICDL, 2013, para. 1). Testing for ICDL certification is administered only at

approved ICDL centers which are usually located in schools, universities, public bodies,

government departments, and private centers.   According to ICDL (2013), certificates are

awarded only after demonstration of skills and knowledge in ICTs through the sitting of exams at

approved test centers.

NETS by International Society for Technology in Education (ISTE). The National

Educational Technology Standards (NETS) were developed by ISTE and provides the standards

for assessing learning, teaching and leading in the digital age. The NETS provides broad

standards of ICT literacy for different groups including Teachers (NETS-T), Students (NETS-S),

and Administrators (NETS-A) (ISTE, 2012, para. 2). Assessments of these standards are done

by the executing agencies. For example, the NETS-T is assessed through a process whereby the

National Council for the Accreditation of Teacher Education (NCATE) approves teacher

education programs that have NETS-T standards included in its curricula.

These assessment agencies are very dominant and continue to set the standards by which

ICT skills are measured. Schools and business organizations rely on the assessments provided

by these specialized examinations units.

The 21 ICT Objectives of UNESCO's ICT-CFT. The UNESCO ICT-CFT has three

main components: technology literacy, knowledge deepening and knowledge creation. The

framework also identifies six aspects of a teacher's work as understanding ICT in education,

curriculum and assessment, pedagogy, ICT, organization and administration and finally teacher

professional learning. The ICT aspect of a teacher's work lists 21 main competencies that a

teacher must exhibit. Table 1 lists the objectives and an explanation of what the teacher is

expected to do.

Table 1: ICT objectives of UNESCO ICT-CFT

A	Technology Literacy Approach [1]Teachers should be able to:	Description of Activities
1	Describe and demonstrate the use of common hardware.	Discuss and demonstrate the basic operation of various hardware technologies, such as desktop computers, laptops, printers, scanners, and hand-held devices.
2	Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Discuss and demonstrate the basic tasks of word processors, demonstrate how they are used in instruction. Have participants create a text document in which they carry out these basic word processing tasks to generating a text document.
3	Describe and demonstrate the purpose and basic features of presentation software and other digital resources.	Discuss the purpose of presentation software and demonstrate its general features and function. Have participants create a presentation on a topic of their choice using digital resources.
4	Describe the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.	Discuss the purpose of graphics software and demonstrate the creation of a graphics display. Have participants create and share a graphic display.
5	Describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website.	Discuss the purpose and structure of the Internet and the World Wide Web and participants' experiences with these. Demonstrate the use of a browser; have participants use a browser to access popular websites.
6	Use a search engine.	Demonstrate the use of a search engine; discuss and demonstrate simple keyword searches; have participants search for websites on their favorite topics and discuss the keyword strategies they used with the group for discussion.
7	Create an email account and use it for a sustained series of email correspondence.	Demonstrate the creation and use of an email account; have participants create an email account and create and send a series of email messages.
8	Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.	Demonstrate a variety of tutorial and drill and practice packages in the subject which the participants teach and describe how such packages support the acquisition of subject matter knowledge. Have participants analyze specific packages in their subject area and describe how they support the acquisition of specific subject matter knowledge.
9	Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	Have participants search websites and catalogs to identify appropriate software for specified learning objectives or standards and analyze these packages for accuracy and curriculum alignment. Have participants discuss the criteria they used for analyzing and evaluating the software.
10	Use networked record keeping software to take attendance, submit grades, and maintain student records.	Discuss the purposes and advantages of a networked recording keeping system, demonstrate the use of such a system, and have participants enter record keeping data for their class.
11	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.	Discuss the purposes and advantages of various communication and collaboration technologies; and have participants use these technologies to communicate and collaborate with others in the group.
B	Knowledge Deepening Approach	
12	Operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.	Demonstrate the use of a variety of software packages in the subject domain; have participants explore and demonstrate these packages.
13	Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.	Have participants search websites and catalogues to identify appropriate software for project-based learning in their subject field. Have participants develop evaluation criteria and rubrics and justify their selections based on effectiveness for the intended purpose.
14	Use an authoring environment or tools to design online materials.	Demonstrate the use of an authoring environment or tools. Have participants work in groups to design an online unit of a course of study.
15	Use a network and appropriate software to manage, monitor, and assess progress of various student projects.	Demonstrate the use of networked project software that allows the teacher to manage, monitor, and assess student project work; have participants enter project data for their students' work.
16	Use ICT to communicate and collaborate with students,	Discuss the use of online communication and collaboration environments by teachers

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[1] Refers to newly trained teachers from teacher training colleges

	peers, parents, and the larger community in order to nurture student learning.	to support student learning; have participants keep a log, share printouts, and demonstrate examples of their online interactions, in this regard.
17	Use the network to support student collaboration within and beyond the classroom.	Discuss the use of online communication and collaboration environments by students to support their collaborative project work and learning; have participants keep a log, share printouts, and demonstrate examples of student online interactions.
18	Use search engines, online databases, and email to find people and resources for collaborative projects.	Discuss the use of search engines, online databases, and email to find people and resources for collaborative projects; have participants conduct searches related to a project for their course; engage in an online collaborative project; have participants reflect on their experiences, share with others, and discuss them.
C	Knowledge Creation	
19	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.	Demonstrate a variety of software packages and digital production resources and describe how they support and advance students' innovation and knowledge creation practices. Have participants analyze specific examples of use of these resources in their subject area and describe how they support student innovation and knowledge creation. Have participants use and evaluate these tools in a unit that they design.
20	Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.	Demonstrate a variety of virtual and knowledge building environments and describe how they support student learning communities. Have participants analyze specific examples of use of these resources in their subject area and describe how they support student learning communities. Have participants use and demonstrate the effectiveness of these tools in a unit that they design.
21	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.	Demonstrate a variety of planning and thinking tools and describe how they support students' creation and planning of their own learning activities. Have participants analyze specific examples of use of these resources in their subject area and describe how they support the development of students' self-regulated learning. Have participants use and evaluate these tools in a unit that they design.

Source: Reproduced with Permission from UNESCO (Appendix K)

Diffusion of Innovations

The main purpose of the UNESCO ICT-CFT is to provide teachers with new skills and knowledge that will improve teaching and learning. Inherent in this purpose is the introduction of new tools and ideas (i.e. ICT). Rogers (2003) has described "the process in which an innovation is communicated through certain channels over time among the members of a social system" as diffusion (p. 6). Often, such communication involves the introduction of a new idea and/or tool. Rogers (2003) describes the four main elements in diffusion of innovations as (a) the innovation, (b) communication channels, (c) time, and (d) social system. Diffusion of innovations can occur at the individual level and at the organizational level. More often, educational policy and implementation decisions are taken at an organizational level (i.e. the governmental body responsible for education) rather than by individual actors in the field. The UNESCO ICT-CFT was produced with the rationale that governments will adapt and implement them at the governmental (organizational) level.

With respect to diffusion of innovations in organizations, Rogers (2003) states that there are three main types of innovation-decisions:

Optional innovation-decisions, where adoption or rejection of an innovation are made by individuals without regard to the decisions of the others in the organization.

Collective innovation-decisions, where adoption or rejection of an innovation are made by consensus among the individuals in the organization.

Authority innovation-decisions, where adoption or rejection of an innovation are made by a few individuals who have power to make such decisions (Rogers, 2003, p. 402)

Rogers (2003) also refers to *contingent innovation-decisions, a* hybrid-type of innovation-decision where "choices to adopt or reject can be made only after a prior innovation-decision" (p. 402). Early research in organizational innovativeness restricted itself to individuals in the organization. According to Rogers (2003), these types of research usually obtained data mainly from top executives, who were deemed to be the champions of innovation, which may not necessarily be the case.

Rogers (2003) explains that there are five main stages in the innovation process in organizations. The first two stages of agenda setting and matching are described as the initiation activities, whilst the next three stages of redefining/restructuring, clarifying," and routinizing are referred to as the implementation stages. The UNESCO ICT-CFT proposes for governments to set in motion the initiation activities, and for the teacher training centers to operationalize the framework in the implementation stages as described by Rogers (2003).

Just as the introduction of an innovation does not guarantee adoption, the adoption of an innovation does not guarantee that the innovation will be implemented. Rogers (2003) defines rate of adoption as "the relative speed with which an innovation is adopted by members of a social system" (p. 221). According to Rogers (2003), there are five main variables that determine the rate of adoption of any innovation. These variables are: I) perceived attributes of innovations, II) type of innovation-decision, III) communication channels, IV) nature of social system, and V) extent of change agents' promotion efforts. The rate at which an innovation is adopted is determined by a combination of both level of presence of these variables and also how they relate and interact with each other.

Chapter Three – Research Methodology

Introduction

This chapter discusses the research methodology used for the study. Based on Richey and Klein's (2007) product and tool research, this study employed Gustafson and Branch's (2002) instructional design model to analyze, design, develop, and evaluate an online tool for determining if computer labs of teacher preparation colleges can be used to teach and assess pre-service teachers' competency on the ICT section of UNESCO's Information and Communication Technology – Competency Framework for Teachers.

Research Design

Design and Development Research. Richey and Klein (2007) have defined design and development research as:

> the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional products and tools and new or enhanced models that govern their development (p. 1).

Design and development research is categorized into two main areas: model research and product and tool research. This study focused on the creation of instructional products and tools. Richey and Klein (2007) describe product and tool research as a type of design and development research "conducted during the design and development of a product or tool" (p. 9). Instructional designers, amongst other things, develop tools that are used for either instructional or non-instructional purposes. Richey and Klein (2007) describe the phenomena in recent years where instructional designers have focused on tools for non-instructional purposes, which is the case in this study. An important component of tool development research is the documentation of all processes leading to the production of an instructional or non-instructional tool (Richey &

Klein, 2007). The outcomes of tool and product research are usually context specific in the sense

that the tool developed is usually the result of the study of a specific project. However, such a

tool can be utilized in other projects or regions that may have similar contexts. According to

Richey and Klein (2007), product and tool development research tends to rely on "case study

methodologies and evaluation techniques" (p. 54).

Richey and Klein further provide techniques for addressing research design concerns in

the areas of validity, causal inferences, generalization and interpretation and the anticipation of

problems. Table 2 shows how this study addressed the research concerns expressed by Richey

and Klein (2007)

Table 2: Techniques to address research design concerns

Research Design Concern	Recommended techniques used to address concern	How Study Addressed Concern
Validity	Use experts with differing areas of specialization for tool review	3 expert reviewers with broad knowledge of performance objectives, ICT in Education and Education in the Developing regions reviewed the objective breakdown
	Have participants verify reports of tool use	Participants in the test of the tool confirmed their status as tutors in ICT in Colleges of Education
	Select designers with varying levels of expertise to test tool	Participants were selected from different schools in different socio/economic regions, and had varying years of teaching experience.
Causal Inferences	Determine tool's practicality	The online tool was stripped of any design elements that could have extended its load time, to accommodate for varying internet speeds.
	Determine tool's effectiveness	Survey questions were reviewed to ensure that they

		were unambiguous.
Generalization and Interpretation	Recognize "real world" constraints on tool use	In this study, participants were directly contacted and asked to use the tool. This may not be as simple in real world situations.
	Plan for tool's independent use	The tool can check if any lab could be used to teach/asses UNESCO ICT CFT.
Anticipating problems	Consider cultural norms when analyzing student data	In analyses, consideration is given to the fact that this is a field test, and that not every aspect of the tool would work seamlessly.

Richey and Klein (2007) conclude that design and development research can expand the work and reach of instructional design by providing more research work outside the traditional ID confines of teaching and learning, providing practical solutions to potentially pressing workplace problems and more importantly serving "as an important link between theory and practice" (p. 14).

ADDIE Model. Instructional designers rely heavily on models to develop instruction and tools. According to Gustafson & Branch (2002) models are "simple representations of more complex forms, processes and functions of physical phenomena or ideas" (p. 1). One of the very popular models in instructional design is the ADDIE model. Gustafson & Branch (2002) indicate that the elements of the ADDIE model (analyze, design develop, implement and evaluate) "each inform the other as development takes place and revision continues throughout the process…" To this end, they developed a conceptual display that illustrates the iterative nature of instructional development and in more specific terms, the ADDIE model.

Although the ADDIE model is very popular, the origins of the model, and its author(s) remains murky, at best. Molenda (2003) asserts that the ADDIE model is "merely a colloquial

term used to describe a systematic approach to instructional development virtually synonymous with instructional systems development" (p. 35). This study adopts the conceptualization depicted by Gustafson & Branch, and follows its iterative nature to develop the context sensitive framework. The study, however does not include the implementation aspect of the ADDIE model. In the following sections, specific activities pertaining to the study, and in accordance with the ADDIE model (as envisioned by Gustafson & Branch, 2002), are discussed.

Phase 1 – Analysis, Design and Development

  Analysis and Design – Objective Breakdown. In Instructional Design, "analysis" includes determining if there is a gap between a stated performance objective and actual performance (Gustafson & Branch 2002, p. 19). Further, Gustafson and Branch (2002) describe "design" to "include writing objectives in measureable terms" (p. 19).

  The UNESCO ICT-CFT is a comprehensive document that seeks to contribute to the development of a 21st century workforce by providing a framework suggesting the competencies that teachers must exhibit after their training. A careful review of the objectives and related material in the document revealed two correctible problems that are addressed in this study. First, in many cases, multiple performance indicators or behaviors are contained in a single objective. Second, where provided, only one example of a resource is given as a guide to what resources are needed.

  Mager (1962) established the importance of performance objectives and has shown the specific elements that should be present in a well-constructed performance objective. In order to clearly state a terminal behavior that is free of ambiguity, the conditions that should be present for the behavior to manifest adequately should also be stated. Dick et al. (2009) further explain

"condition" as a "description of the tools and resources that will be available to the learner when performing the skill" (p. 115).

In this study, a researcher analysis of the ICT objectives defined by the UNESCO ICT-CFT was made. The researcher analysis was based on Mager's approach to performance objectives and was aimed at identifying the unique knowledge, skills, and behaviors intended by the objective. The researcher analysis also involved parsing the UNESCO ICT-CFT objectives, with the goal of identifying any combinations of performances within a single objective, and separating them. This analysis was conducted twice to ensure that the researcher did not overlook any multiple behaviors in a single objective, and that the changes made do not change the intention of UNESCO. Table 3 shows examples of the first and second revisions to the ICT sections of two UNESCO ICT-CFT objectives.

Table 3: Researcher Revisions to UNESCO ICT-CFT Objectives

UNESCO Objectives		First Revision of UNESCO Objectives		Second Revision of UNESCO Objectives
Describe and demonstrate the use of common hardware.	1a	Discuss the use of common hardware	1.1	Describe the use of common hardware
	1b	Demonstrate the use of common hardware	1.2	Demonstrate the use of common hardware
Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	2a	Discuss the basic tasks of word processors such as entry, editing text and printing	2.1	Describe the basic tasks of word processors such as text entry, editing text, formatting text and printing.
	2b	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.	2.2	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.
	2c	Describe the uses of word processors, such as text entry, editing text, formatting text, and printing.		
	2d	Demonstrate the uses of word processors, such as text entry, editing text, formatting text, and printing.		

The revised objectives were then shared with a team of expert reviewers for comment and suggestions.

Analysis and Design - Expert Review. The breakdown of the objectives was provided to expert reviewers for review. As indicated in Table 3, a key component of design and development research is to ensure validity. Three expert reviewers were selected to provide a review of the UNESCO objective breakdown. The experts were selected based on their qualifications, experience, and current professional activities. Table 4 shows a brief background on the selected experts.

Table 4: Profile of Expert Reviewers

Name	Institution	Expertise
Dr. Mapopa Sanga	Southwestern Oklahoma State University	Instructional design, teacher education, online learning
Dr. Joseph Mukuni	Virginia Tech	Career and technical education, teacher preparation, managing technical and vocational resources in Africa
Dr. Samuel Adu Gyamfi	University of Education, Winneba	Instructional design, educational technology, teacher preparation,

Expert Reviewers' Evaluation Rubric. An electronic, researcher-designed rubric was provided to the experts. The primary focus of the rubric was to seek the reviewers' assessment of how well the UNESCO objectives were further expanded to clearly state observable performance objectives and to remove multiple behaviors/skills expressed in a single objective. To this end, the online survey tool showed both the UNESCO objective and the researcher breakdown of the objectives. The experts reviewed these objectives breakdowns and, where inconsistencies or omissions were found, the expert reviewers provided suggestions for correction. All revisions suggested by the expert reviewers were incorporated into the final objectives breakdowns.

Development. This stage of the study focused on the development of an online tool for checking if the computer labs of selected participants had adequate resources to teach and assess pre-service teachers' competency on the UNESCO ICT-CFT.

To determine what resources might be used to teach or assess the objectives, an initial matrix was designed showing the following:

a)   A column that lists the objectives as stated in the UNESCO ICT-CFT

b)   A column showing the revised objectives

c)   A column that describes the generic features of resources that should be present in order for the objective to be taught/assessed

d)   A column showing examples of resources that possess the features described in the third column. These example resources were derived from the breakdown of the UNESCO ICT-CFT objectives.

Table 5: Objective and Example Devices

UNESCO ICT-CFT Objective	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Describe the basic tasks and uses of word processors such as text entry, editing text, formatting text and printing.	Ability to show word processing procedures, such as text entry, editing text, formatting text and printing.	Pictures, videos, computers, smartphones, tablet, printer, word processing software, desktop computer
	Demonstrate the uses of word processors such as text entry, editing text, formatting text and printing	Ability to accept text input, format text and print text	Desktop Computer, Laptop, Tablet, Printer, Smart Phone, Word Processing Software

Appendix E is a table presenting all 21 UNESCO ICT-CFT objectives and the corresponding columns as described above. As part of the study, detailed descriptions of all stages of the development of the tool are documented in Chapter Four.

Phase 2 – Evaluation

The evaluation stage of the study involves an analysis of the field test of the tool.

Field Test. The tool was distributed to 12 prospective participants. Each prospective participant was located in a different teacher training college within Ghana. Seven of the 12 prospective participants responded to the survey.

Setting and Participant Selection. Richey and Klein (2007) stress the importance of the setting of a study. Participants' working conditions – resources, equipment and facilities – is as equal a consideration in design and development research as is the selection of participants chosen for the study (p. 84). As discussed earlier in Chapter One, DCs have peculiar resource constraints that warrant special consideration when it comes to the availability and use of technological resources.   For this stage of the study, 12 prospective participants who are ICT teachers and use the computer labs in their teacher training institutions in Ghana were selected. Purposeful sampling procedures were employed to ensure that the sample represented the variety of resource availability at teacher training institutions in Ghana (Richey & Klein, 2007. p. 89). The 12 colleges of education were selected from 6 administrative regions in Ghana because they reflect the conditions under which the UNESCO objectives will be taught and assessed. The rationale for selecting the potential participants to test the tool stems from the fact that these are the people who will be tasked to teach and assess the objectives in real situations. Also of significant importance is that these participants are experts in the field, and their use of the tool to provide the resources they would use to teach/assess the students also provides additional validity to the resources provided in the tool.

Data Collection Procedures. In all, 12 potential participants (in 12 different Colleges of Education in Ghana) were selected and asked to use the tool to determine their centers' readiness to implement the UNESCO ICT-CFT.

A purposive sampling procedure was used to select the potential participants. This sampling procedure was adopted to ensure that potential participants and institutions represented different geographic and economic regions of Ghana. Two of the institutions were located in the regional capitals of the regions (which are usually urban and have relatively higher socio-economic development), six were located in district capitals and four were located in rural areas. Prospective participants in these institutions were contacted by email to solicit their participation in the study. An Institutional Review Board (IRB) approved invitation letter was sent to the prospective participants, and follow-up calls were made to ensure that the participants were aware of what was required of them. 7 of the 12 participants (58%) completed the survey. Three participants (25%) began using the survey but for unknown reasons, did not complete it. Two participants (17%) did not answer the survey. The seven participants represented seven different institutions; two were located in the regional capitals, four in district capitals and one in a rural area. The estimated time for completing the survey was 90 minutes. As part of the use of the tool, participants had the opportunity to comment on the tool as well.

Phase 3 – Analysis of Field Test

Upon completion of the field test, an initial analysis of the results of the field test of the tool was made. The purpose of the initial analysis was to determine if the responses the participants provided were relevant, adequate, and appropriate. A subsequent analysis of the feedback provided to participants by the tool was also made to identify instances where the tool provided appropriate feedback, and also instances where the feedback that the tool provided to the participants was incorrect.

A discussion of the analysis in Chapter Six details the challenges and/or suggestions resulting from the use of the tool and also contains a proposal enumerating how the challenges and suggestions could be addressed in a future review/expansion of the assessment tool.

Chapter Four – Design and Development of the UNESCO ICT-CFT

Center Readiness Tool

Introduction

Richey & Klein (2007) have emphasized the importance of documenting all the processes leading to the production of non-instructional tools. This study focused on the design of a non-instructional tool to determine the capability of computer labs in teacher training colleges to be used to teach and assess students on the UNESCO ICT-CFT. This chapter describes the processes involved in the creation of the tool.

Tool Development Process

Step 1: Researcher Analysis and Breakdown of UNESCO ICT-CFT Objectives. As part of the UNESCO Information and Communication Technology-Competency Framework for Teachers, there are 21 ICT objectives that describe core ICT knowledge, skills and performances that all pre-service teachers are expected to exhibit. As can be seen in the Objective 1 below, some of the objectives contained multiple performances.

"Teachers should be able to **describe** and **demonstrate** the use of common hardware".

In the first step of the creation of the tool, the researcher analyzed all 21 UNESCO ICT-CFT objectives and where necessary, revised the objectives. For the purpose of this study, the restated performance objectives focused on removing any instances of multiple performances or behaviors within a single objective. In instances where these multiple performances were identified, the original objective was broken down into two or more revised objectives. This iterative process was applied to all 21 objectives. Table 6 shows two examples of revisions made by the researcher to the original UNESCO ICT-CFT objectives prior to the expert review.

Table 6: Revising the UNESCO ICT-CFT Objectives

UNESCO Objective 2	
Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	
Researcher Revision 1	**Reason for Change**
Discuss the basic tasks of word processors such as entry, editing text and printing	This change was made to separate multiple behaviors and to expand on the what may be done.
Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.	
Describe the uses of word processors, such as text entry, editing text, formatting text, and printing.	
Demonstrate the uses of word processors, such as text entry, editing text, formatting text, and printing.	
Researcher Revision 2	**Reason for Change**
Describe the basic tasks and uses of word processors such as text entry, editing text, formatting text and printing.	A second review was made to simplify the first revision and to also use the 'verbs' that were used in the original UNESCO document
Demonstrate the uses of word processors such as text entry, editing text, formatting text and printing	
UNESCO Objective 9	
Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	
Researcher Revision 1	**Reason for Change**
Select relevant off-the-shelf educational software packages and web resources	The change separated the three different behaviors required in the original objective. Also, the 'action verb' in the objective was changed from 'locate' to 'select'.
Evaluate off-the-shelf educational packages and web resources for their accuracy and alignment with curriculum standards	
Match off-the-shelf educational packages and web resources to the needs of specific students	

In Table 6 above, the researcher separated the two skills (describe and demonstrate) outlined in Objective 2 and created four separate objectives. The rationale for making the change was to include more detail in what may be taught and assessed. A second review was made to simplify the objective and to revert to the original verbs used (describe and

demonstrate). In UNESCO Objective 9, the researcher also revised the objective to show the

different skills required. Three separate objectives were created. Also, the researcher used

"select" instead of "locate" to make the objective clearer. This procedure was followed to revise

18 of the original 21 ICT objectives (Appendix D). Three of the objectives did not have more

than one skill/behavior embedded within them and therefore did not need any further breakdown.

Step 2: Expert Review of Researcher's Objective Breakdowns. The final stage of

revising the objectives involved input from expert reviewers. Three expert reviewers were

recruited to examine the objective breakdowns proposed by the researcher, and to recommend

changes where necessary. An online survey instrument (Appendix F) was created that listed all

the objectives and the researcher's breakdowns. This survey was made available to the expert

reviewers, who then examined the breakdowns and provided comments and recommendations

for modifications. There were two types of changes suggested by the expert reviewers. One

type of change involved further breakdowns of some of the objectives to avoid multiple

behaviors in a single objective. The second type of change suggested the researcher revert to a

word that was used in the original UNESCO objective. Below are examples of the two

suggested modifications.

Table 7: Revisions Recommended by Expert Reviewer

UNESCO Objective 8 – Revision involving further breakdown	
Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.	
Researcher Revisions	**Expert Reviewer Revision**
• Describe the function and purpose of tutorial and drill and practice software • Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects	• Describe the function of tutorial and drill and practice software • Describe the purpose of tutorial and drill and practice software • Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.

In Objective 8, an expert reviewer recommended a distinction be made between "function" and "purpose". This resulted in the further breakdown of the UNESCO Objective into three separate objectives. These changes were to further ensure that multiple behavioral and skill requirements were not bundled into a single objective. The expert reviewers recommended similar changes to three other objectives breakdowns. After completion, the objectives did not contain multiple performances.

Table 8: Revisions Recommended by Expert Reviewer

UNESCO Objective 9 – Revision involving reverting to original wording	
Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	
Researcher Revisions to Objective	**Expert Reviewer Revision**
• Select relevant off-the-shelf educational software packages and web resources • Evaluate off-the-shelf educational packages and web resources for their accuracy and alignment with curriculum standards • Match off-the-shelf educational packages and web resources to the needs of specific students	• Locate relevant off-the-shelf educational software packages and web resources • Evaluate off-the-shelf educational packages and web resources for their accuracy and alignment with curriculum standards • Match off-the-shelf educational packages and web resources to the needs of specific students

In Objective 9, an expert reviewer recommended that an original word (locate) that was used by the UNESCO document should be maintained instead of the word (select) that the researcher had used. This type of modification affected only one objective (Table 8). The researcher accepted the recommendation. Ultimately, all feedback from the expert reviewers were analyzed and included in the revisions to the objectives.

Step 3: Determination of Related Features, Hardware, Software and Infrastructure. The next phase of producing the electronic tool involved determining the features of hardware, software and infrastructure that could be used to teach and assess the competency of pre-service teachers. The conditions, or resources, essential in order to teach

and/or assess an objective are an important part of performance objectives. In this study, the

conditions were limited to the following relevant and appropriate resources: hardware, software,

and infrastructure. As part of the study, the potential conditions needed to teach/assess pre-

service teachers' competency on the UNESCO objectives were generated from the revised

objectives by describing the features of, and resources (hardware, software, and infrastructure)

that may be used. For each of the revised objectives, the researcher created a matrix that

described relevant features known for teaching and assessing the objectives. Based on the

needed features, a preliminary list of possible hardware, software, and infrastructure with the

necessary capabilities was produced. Table 9 is an extract of the matrix showing the features and

examples of resources that may be used. A complete table is presented in Appendix E.

Table 9: Matrix showing features and example devices from revised objectives

UNESCO ICT-CFT Objective	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Describe the basic tasks and uses of word processors such as text entry, editing text, formatting text and printing.	Ability to show word processing procedures, such as text entry, editing text, formatting text, and printing.	Pictures, videos, computers, smartphones, tablet, printer, word processing software, desktop computer
	Demonstrate the uses of word processors such as text entry, editing text, formatting text and printing	Ability to accept text input, format text, and print text	Desktop Computer, Laptop, Tablet, Printer, Smart Phone, Word Processing Software
Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	Locate relevant off-the-shelf educational software packages and web resources	Ability to connect to the internet, availability of internet access	Desktop Computer, Laptop Computer, Tablet, Smartphone, Internet access,
	Evaluate off-the-shelf educational packages and web resources for their accuracy and alignment with curriculum standards.	Availability of a platform for presenting and comparing items	Computer, Smartphone, Tablet, Internet Access, presentation software
	Match off-the-shelf educational packages and web resources to the needs of specific students	Availability of student academic records, software for teaching and learning, availability of software that can be tailored to specific student needs	Learning Management System, brainstorming software, computers, internet access,

This process for determining the relevant hardware, software, and infrastructure, however could not be exhaustive, given that the participating computer labs might use some hardware, software, and infrastructure that the researcher may not have considered. It was important that the tool allowed participants to add additional items that reflected resources available to them in their actual setting as they attempted to indicate what resources they would use to teach/assess the UNESCO objectives. To address this concern, the tool was designed to permit the following actions.

- As part of Part I of the survey tool, participants were asked to select, from an initial list, the hardware, software, and infrastructure available in their computer labs (See Figure 1).

Figure 1: A partial image of Part I of the online tool showing initial inventory of resources

From the list below, please select all the resources available in your main lab (best equipped).

Hardware Resource	Main Lab
Desktop Computer	☐
Laptop Computer	☐
Tablet	☐
Smartphone	☐

- In cases where some items were not listed in Part I of the tool, participants had the opportunity to add their own "Other" items to this initial list (Fig. 2), by clicking on an 'add' button

Figure 2: Partial image of Part I of Online Tool Showing option for Participants to add Resources

Teleconference Equipment	☐
Large-Scale Printers	☐
Duplicating Machines	☐
Optical R/W Drives (e.g DVD, CD, etc)	☐
Other (Please specify) [+] [-]	[ ]
Software Resource	
Word Processing Software (e.g. MS Word, Pages, OpenOffice)	☐

- In Parts II and III of the survey where participants selected what resources they may actually use to teach/assess students' competencies, participants could add more resources. Figure 3 below is an example of this feature in Part II of the online tool. This feature allowed for participants to include items that became apparent to them, after reading the objectives, but were not included in the initial list.

Figure 3: Partial image of the Online Tool Showing option for Participants to Add Resources in Part Two

Question 1

To **describe** common ICT hardware, which of the following equipment would you use to teach students? Select all that apply.

☐ I do not have the resources to teach this topic

Hardware	Software	Infrastructure
☐ Desktop Computer	☐ Word Processing Software (e.g. MS Word, Pages, OpenOffice)	☐ Internet Access
☐ Laptop Computer		Other (Please specify) [+] [-]
Other (Please specify) [+] [-]	☐ Presentation Software (e.g. PowerPoint, Keynote, etc)	[ ]
[ ]	Other (Please specify) [+] [-]	
	[ ]	

- Irrespective of where the participants added these new items, the items immediately became available as options that participants could select, in subsequent questions.

Step 4: Translation of Conditions and Example Devices into Survey Questions. To determine if the computer labs of colleges of education had adequate resources to serve as

centers for teaching and assessing students on the UNESCO ICT-CFT competencies, the revised

UNESCO objectives and their contextually derived hardware, software and infrastructure were

transformed into questions to be answered by the participants. Each UNESCO ICT-CFT

objective had its own set of questions, and the number of questions under each objective was

based on the breakdown of the objective, and how many unique sets of skills and/or

competencies were required. Parts II and III of the survey addressed questions pertaining to

teaching and assessment respectively.

The initial design of the survey questions grouped teaching and assessment questions

under each UNESCO objective. The rationale for this approach was to allow participants to

complete both teaching and assessment evaluations of their centers for one objective, before

moving on to the next objective. Figure 4 shows the initial layout of the survey questions

Figure 4: First Iteration of Survey Questions
To **describe** common ICT hardware, which of the following equipment would you have
available to:

Teach students:		**Assess students' competency:**	
Lab 1			
a) Desktop Computer	☐	a) Desktop Computer	☐
b) Laptop Computer	☐	b) Laptop Computer	☐
c) Smartphone	☐	c) Smartphone	☐
d) Tablet	☐	d) Tablet	☐
e) Printer	☐	e) Printer	☐
f) Scanner	☐	f) Scanner	☐
g) Interactive Board	☐	g) Interactive Board	☐
h) Projector	☐	h) Projector	☐
i) Other (Please specify)....	☐	i) Other (Please specify)....	☐

After generating a complete survey using this layout, it became apparent to the researcher

that there was a risk involved in this approach. Presenting the tool this way could potentially

lead to participants struggling with having to switch between thinking about 'teaching' and

'assessment' for each question (32 questions) and there was a high probability of mixing the two

up. To minimize this risk, the survey questions and instrument were revised to provide the

opportunity for the participants to respond to questions as they related to their teaching and then

to respond to questions as they related to assessment. Also, an inventory section was included at

the beginning of the tool. The inventory section of the tool provided a way for participants to

select and/or provide an inventory of all hardware, software, and infrastructure available in their

respective computer labs. The inventory items that were provided at the beginning of the tool by

the participants were then provided as options that could be selected for potential use in

teaching/assessing. Finally, the answer options for the tools were grouped under hardware,

software and infrastructure. This grouping of the answer options was intended to increase the

probability for participants to select all available, yet appropriate, resources. Figure 5 below

shows an example of a revised survey question.

Figure 5: Example of Revised Tool Question and Response Structure in the Teach Section of the Survey

Question 9

In **describing** the Internet and the World Wide Web, their uses and how a browser
works to your students, indicate which of the following you would use: Select all
that apply.

Hardware		Software		Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	☐	a) Internet Access	☐
b) Laptop Computer	☐			b) Other	
c) Smartphone	☐				
d) Tablet	☐				
e) Projector	☐				
f) Other					

Step 5: Determination of Feedback Responses. The final stage of the preparation of

the tool involved an attempt to determine appropriate feedback responses. The purpose of this

study is to provide an electronic tool for detecting the level and nature of readiness of teacher

preparation computer labs in DCs to implement the UNESCO ICT-CFT. Based on the responses

to the survey questions, the tool ideally would provide accurate feedback indicating if the

computer labs have the capability to be used to teach and assess students on the original

UNESCO competencies. For each objective, the researcher created potential feedback items,

and these were paired to different combinations of potential responses from users of the tool, in

an attempt to provide relevant and accurate feedback. In the initial feedback attempts, the

researcher identified hardware, software, and infrastructure that could be used to successfully

teach/assess each objective. These hardware, software and infrastructure were then matched

with researcher prepared feedback, and if appropriate combinations of resources were selected

by the participants, the tool would trigger one of the feedback options to be displayed. In order

to avoid distraction, it was decided to provide the feedback at the end of the survey. Table 10

below shows the sample feedback options for an objective and the reasons for omitting a

feedback.

Table 10: Sample Feedback

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
Describe and demonstrate the use of common hardware.	a. Based on your responses, when teaching, you have the resource that can be used to describe and demonstrate the use of common hardware. b. Based on your responses, when teaching, you have the resource that can be used to describe the use of common hardware, but not to demonstrate the use of common hardware. c. Based on your responses, when teaching, you do not have the resource to describe and	a. Based on your responses, when teaching, you have the resource to demonstrate the use of common hardware but not to describe the use of common hardware in main lab.	If the resources for demonstration are available, the same resources can be used to describe common hardware	Although demonstrating the use of common hardware requires the presence of the appropriate resources, describing common hardware can be done without the actual hardware being present.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	demonstrate the use of common hardware.			

In the second and third columns of Table 10 above, four feedback responses were

generated for UNESCO Objective 1. The original UNESCO objective had two performances

(describe and demonstrate) in it. Given the number of distinct performances required in this

objective, there were four possible responses. Only three were included in the tool as potential

responses. As indicated in the Table 10, for Objective 1 (as is the case with other objectives), it

was logical to conclude that having the resource to demonstrate an activity meant that the

capability to describe an activity was existent.

Conclusion

Designing a tool that could be able to accept input from participants, assess the responses

and provide appropriate feedback required a lot of preparation, and several iterations of the tool

elements such as design, technological constraints, environment where the tool will be used, and

adopting a design flexible enough to be modified where needed. The steps outlined in this

chapter helped to produce a tool that was able to be used in real world settings.

Chapter Five – Results of Field Test

This chapter presents a report of the field test of the online tool for determining the readiness of computer labs to be used to teach and assess the ICT competencies of pre-service teachers.

Report of Field Test

In all, 12 potential participants (in 12 different Colleges of Education in Ghana) initially indicated their willingness to participate in the study. A purposive sampling procedure was used to select the potential participants. This sampling procedure was adopted in an effort to ensure that participants and their institutions represented the different geographic and economic regions of Ghana. The 12 institutions were located in six different administrative regions of Ghana. Two of the institutions were located in the regional capitals (which are usually urban and have relatively higher socio-economic development); eight were located in district capitals, and two were located in rural areas. Potential participants in these institutions were contacted by email to solicit for their participation in the study. An IRB approved invitation letter was sent to the potential participants, and follow-up calls were made, to ensure that the participants were aware of what was required of them. 7 of the 12 participants (58%) completed the survey. Three participants (25%) began using the survey but for unknown reasons, did not complete it. Two participants (17%) did not answer the survey. Of the seven participants (representing seven different institutions), two were located in the regional capitals, four in district capitals and one in a rural area. The estimated time for completing the survey was 90 minutes. As part of the use of the tool, participants had the opportunity to comment on the tool as well.

Tool Performance in Field Test. In general, the tool was able to work as was anticipated. Data from every participant was accurately collected and stored on a server. All

seven participants were able to click on the link to the tool (provided to them in the invitation email) and were immediately able to access the tool. None of the participants indicated that they had difficulty accessing the tool. Of concern to the participants, however, was the fact that the tool did not offer the participants an opportunity to go back and make changes to answers they had provided, without having to restart the survey. Another concern that participants had was the inability to save progress made in answering the survey, and come back at a later time to complete it.

Inventory of Hardware, Software and Infrastructure Resources at Computer Labs. The first part of the survey collected data on the resources available at each institution. Participants selected from a researcher-provided list, the resources that they have. They also had the option to add additional resources to the researcher-provided list. Some participants added to the initial researcher-provided list that was presented in the tool. As discussed in Chapter Four, the researcher presented a list of hardware, software, and infrastructure resources that the computer labs may have. To ensure that the participants could provide all the resources in their respective computer labs, the tool was designed in a way that allowed the participants to add their inventory in Part I of the survey. In subsequent questions, the additions that were made then appeared as options that the participants could select as the device for teaching or assessing a competency. Table 11 shows participants and the inventory of resources they selected and/or added.

Table 11: *Inventory of Resources at Participating Colleges*

Resources	Institutions						
	1	2	3	4	5	6	7
Hardware (List provided by researcher)							
Desktop Computer	√	√	√	√	√	√	√
Laptop Computer	√		√	√	√	√	

	Institutions						
Resources	1	2	3	4	5	6	7
Tablet							
Smartphone					√	√	
Cellphone						√	
Printer	√	√	√	√	√		√
Scanner	√			√	√		
Interactive Board					√		
Projector	√	√	√	√	√	√	√
Digital Camera							√
Teleconference Equipment							
Large-Scale Printer							
Duplicating Machine							
Optical R/W Drives	√		√	√	√		√
Input, Output and Storage Devices			√				
Software							
Word Processing	√	√	√	√	√	√	√
Presentation	√	√	√	√	√	√	√
Spreadsheet	√	√	√	√	√	√	√
Graphics	√					√	√
Database	√		√	√		√	√
Drawing	√		√	√		√	√
Authoring							
Drill and Practice	√	√	√	√	√	√	√
Internet Browser	√	√	√	√	√	√	√
Off-the-Shelf Educational		√					
Collaborative Tools							√
Multimedia Production		√	√	√	√		
Virtual Meeting		√					
Brainstorming							
Web Production							√
Infrastructure							
Internet Access		√	√	√	√	√	√
Learning Management Software							
Local Network		√	√	√	√		

Resources	Institutions						
	1	2	3	4	5	6	7
Website Hosting Services							
Participant Added Items							
Hardware							
Personal Laptop	√						
Router Switch		√					
Input, Output and Storage Devices			√				
Projector Screen					√		
Software							
IMO		√					
MS Project		√					
GN3		√					
Parallel Space		√					
Dreamweaver				√			
Wikis				√			
Infrastructure							
MTN Modem (Internet)	√						
www.altavista.com	√						
www.hotmail.com	√						
www.google.com	√						
Email		√					

The participants' responses demonstrated the online tool was able to detect and capture

the differences in resource availability in the seven institutions analyzed. In general, the majority

of the responses indicated that the computer labs were equipped with commonly available

equipment. For example, it can be observed from Table 11 above that 100% of the participants

whose responses were analyzed had Desktop Computers. The same observation can be made for

other resources such as Projectors, Word Processing Software, Internet access, etc. There were

some resources that were absent (e.g. Large Scale Printers, Teleconference Equipment,

Brainstorming software, etc.) in all the institutions. Three of the participants added resources

that the researcher did not include in the initial list. These included items such as Router Switch (Participant 2), Projector Screen (Participant 5) and MTN Modem (Participant 1). Of note to this researcher is that although the PEW Research Center (2015) shows that about 83% of Ghanaians have access to mobile devices (cell phone and smart phone) participants in only two of the seven institutions surveyed (28.6%) indicated that they have access to mobile devices (cellphone and smartphones) in their computer labs. None of the computer labs had access to a tablet. Another important finding is that none of the computer labs had access to a Learning Management System.

Responses to Questions on Teaching/Assessing students' UNESCO Standards. All 7 Participants (100%) whose responses were analyzed completed the survey by answering all questions. For each question, participants indicated what resources they would use to teach pre-service teachers a competency and what resources they would use to assess the competency of pre-service teachers.

The participants' responses demonstrated that the online tool was able to detect and capture the differences among institutions regarding resources that would be used to teach students, or assess students' competency, with respect to specific objectives. Table 12 below shows the institutions and the number of items selected for teaching and assessing students' competency on UNESCO ICT-CFT Objective 1. These questions were generated from the breakdown of UNESCO ICT-CFT Objective 1 (ICT Objectives).

Key: **T**   =   **TEACH**
      A   =   **ASSESS**
      a   =   **Has resource and will use**
      b   =   **Has resource but will NOT use**
      blank   =   **Does NOT have resource**
      No Color   =   **Participant provided resource**

Table 12: Participants Response on resources to be used in teaching/assessing students' competency

Activity	INSTITUTION													
	1		2		3		4		5		6		7	
	T	A	T	A	T	A	T	A	T	A	T	A	T	A

Question 1 T: To **describe** common ICT hardware, which of the following equipment would you use to teach students?
A: Which of the following would you use to assess students' competency to **describe** common ICT hardware?

Activity	1 T	1 A	2 T	2 A	3 T	3 A	4 T	4 A	5 T	5 A	6 T	6 A	7 T	7 A
Researcher-provided List														
Hardware														
Desktop Computer	a	a	a	a	a	a	a	a	a	a	a	a	a	a
Laptop Computer	a	a					b	b	a	a	a	a		
Smartphone									a	a	a	b		
Printer	a	b	a	b	a	a	a	b	a	a			b	a
Scanner	a	b					a	b	a	a				
Interactive Board									a	a				
Projector	a	b	a	b	a	a	a	a	a	a	a	a	a	a
Digital Camera													b	b
Optical R/W Drives	a	b			a	a	a	b	b	b			a	b
Software														
Word Processing	a	b	b	b	a	b	a	a	a	b	b	b	b	b
Presentation	a	b	a	b	a	b	a	b	a	b	b	a	a	a
Spreadsheet	a	b	b	a	a	b	a	b	b	b	b	b	b	b
Graphics	a	b									b	b	a	a
Database	a	b			a	b	a	b			b	b	b	b
Drawing	a	b			a	b	a	b			b	b	b	b
Drill and Practice	a	a	b	b	a	b	a	b	b	b	b	b	b	b
Internet Browser	b	b	a	b	b	b	a	b	b	b	a	a	a	b
Off-the-Shelf Educational			b	b										
Multimedia Production			b	b	b	b	b	b	b	b				
Virtual Meeting			b	b										
Web Production													b	b
Infrastructure														
Internet Access	a	a	a	b	a	a	a	a	a	a	a	a	b	b
Local Network					a	b	a	b	b	a				
*Participant Added Items														
Hardware														
Personal Laptop	a	b												
Router Switch			a	b										

	INSTITUTION													
	1		2		3		4		5		6		7	
Activity	T	A	T	A	T	A	T	A	T	A	T	A	T	A
Input, Output and Storage Devices					b	a								
Projector Screen									a	a				
Software														
Infrastructure														
MTN Modem (Internet)	a	b												
Question 2: **T:** To **demonstrate** the use of common ICT hardware, which of the following would you use to teach students? **A:** Which of the following would you have to assess students' competency to **demonstrate** the use of common ICT hardware?														
Researcher-provided List														
Hardware														
Desktop Computer	a	a	a	a	a	a	a	a	a	a	a	a	a	a
Laptop Computer	a	a			a	a	b	b	a	a	a	a		
Smartphone									a	a	a	a		
Cellphone											b	b		
Printer	b	b	b	b	b	b	b	b	b	b			b	b
Scanner	b	b							b	b				
Interactive Board									a	a				
Projector	b	b	a	a	a	a	a	a	a	a	a	a	a	a
Digital Camera											b	b		
Optical R/W Drives	b	b			b	b	b	a	b	b			b	b
Software														
Word Processing	b	b	b	b	b	b	b	a	a	b	b	b	b	b
Presentation	b	b	b	a	b	b	a	a	a	b	b	a	b	a
Spreadsheet	b	b	b	b	b	b	b	a	b	b	b	b	b	b
Graphics	b	b									b	b	a	b
Database	b	b			b	b	b	a			b	b	b	b
Drawing	b	b			b	b	b	a			b	b	b	b
Drill and Practice	b	b	b	b	b	b	b	a	b	b	b	b	b	b
Internet Browser	a	a	a	a	b	a	b	a	a	a	a	a	a	a
Off-the-Shelf Educational			a	b										
Collaborative Tools													b	a
Multimedia Production			b	b	b	b	b	b	b	b				

	INSTITUTION												
	1		2		3		4		5		6		7	
Activity	T	A	T	A	T	A	T	A	T	A	T	A	T	A
Virtual Meeting			a	b										
Web Production													b	a
Infrastructure														
Internet Access	b	b	a	a	a	a	a	a	a	a	a	a	b	b
Local Network			b	b	b	b	b	a	b	a				
*Participant Added Items														
Hardware														
Personal Laptop	a	a												
Router Switch			a	b										
Input, Output and Storage Devices					b	a								
Projector Screen									a	a				
Software														
Dreamweaver							b	a						
Wikis							b	a						
Infrastructure														
MTN Modem (Internet)	a	a												
Email			b	a										

Based on the data compiled in Table 12 it was observed that participants did not always use the same resources to teach and/or assess students' competency. Even within the same institution, they did not necessarily use the same resources to teach and assess students. In Question One, for example, whilst Participant One indicated that she would use almost all (15 out of 16) of the resources available to her (with the exception of internet browser) to describe common ICT hardware to her students, she would use only four resources (desktop, laptop, drill and practice software, and internet access) to assess students' competency to describe common ICT hardware. Of the 12 resources that Participant Six recorded as available in the computer lab, six of them would be used to teach students and assess students' competency. On Question Two,

both Participants Four and Five indicated that they have Optical R/W drives available in their computer labs. However, whilst Participant Four indicated that the resource would be used to assess students' competency to demonstrate the basic tasks and uses of common hardware, Participant Five would not use the resource to teach or assess students' competency. This pattern of differences in the use of resources to teach and assess students' competency was captured by the tool in all the objectives. Also evident in the data compiled in Table 12 above is the ability of the tool to capture not only the resources that the participants provided themselves but also its what objectives and activities (teach or assess) the participant-provided resources would be used for. For example, in Question Two, the tool captured that Participant Two had access to a "router switch" that she intended to use to teach students on "demonstrating common ICT hardware", but that it would not be used to assess the students' competency on the same topic. This showed that the tool was able to collect relevant information from the participants, and was able to examine the inputs from each participant.

Feedback to Participants. Although not part of the initial purpose, an attempt was made to provide accurate and immediate feedback to the participants of the study. The online tool was configured to provide accurate feedback based on the responses from the participants. All seven participants who answered the survey received feedback for their responses.

Below is an example of a question and the feedback provided.

UNESCO Objective 1: Describe and demonstrate the basic tasks and use of common hardware.

To determine if computer labs have the capability to teach the UNESCO objective stated above, 2 questions were asked:

Survey Tool Questions:

Figure 6: Question One in Part II of the Survey

Question 1

To **describe** common ICT hardware, which of the following equipment would you use to teach students? Select all that apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

The first question (Fig. 6) concentrated on the part of the objective dealing with the verb "describe". In Part I of the survey, the participants selected or added to the hardware, software, and infrastructure they have at their institution. In each question, the relevant inventory they selected were populated into the answer options and the participants selected which ones they would use. However, because Objective One contained two distinct performances, the feedback logic did not rely only on the responses given in Question One, but that of Question 2 as well, in an attempt to provide an appropriate feedback.

Figure 7: Question Two of Part II of Survey Tool

Question 2

To **demonstrate** basic tasks and uses of common ICT hardware, which of the following would you use to teach students? Select all that apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

The second question (Fig. 7) in this instance, solicited for information on what the participants would use to demonstrate ICT hardware.

Participant 1 Response

Participant 1 provided the following as resources available in their institution that would be used to describe and demonstrate the basic tasks and uses of common ICT Hardware.

Figure 8: Response from Participant 1 on Objective One

Q_1	Q_2
Desktop Computer	Desktop Computer
Laptop Computer	Laptop Computer
Printer	Internet Browser
Scanner	
Projector	Others(My personal laptop
Optical R/W Drives (e.g	and an MTN MODEM
DVD, CD, etc)	My personal laptop with an
Word Processing Software	MTN MODEM for Internet
(e.g. MS Word, Pages,	connection)
OpenOffice)	
Presentation Software (e.g.	
PowerPoint, Keynote, etc)	
Spreadsheet Software (e.g.	
Excel)	
Graphics Software (e.g.	
Illustrator, Photoshop)	
Database Software (e.g.	
Access)	
Drawing Software (e.g. Paint)	
Drill and Practice Software	
(e.g. Typing Tutorial)	
Internet Browser	
Others(My personal laptop	
and an MTN MODEM	
My personal laptop with an	
MTN MODEM for Internet	
connection)	

Based on the responses provided by Participant 1 (Fig. 8), the following feedback was

given:

Figure 9: Feedback to Participant 1 on Teaching Objective 1

Objective 1 : Describe and demonstrate the use of common hardware.

Teach students:	
Result: Based on your responses, when teaching, you have the technology that can be used to describe and demonstrate the use of common hardware.	

From Figure 9, it can be observed that the tool analyzed the responses provided by the

participant in both Questions 1 and 2, and provided a response that addressed both of the two

distinct performances mentioned in Objective 1. This pattern is replicated in all 21 objectives.

Each of the seven participants were presented with a report at the end of the survey showing each

objective and a feedback as to their labs' capability to be used to teach/assess the original

UNESCO ICT-CFT objectives. In order to minimize feedback error, the researcher did not activate a feature in the tool that would automatically provide a positive feedback to participants who chose "other" as their primary option to teach/assess an objective, without selecting one of the designated "positive response" feedback options. Appendix J shows the complete feedback presented to one of the participants.

In conclusion, participants were able to use the tool in field tests, and the tool was able to use the data collected to provide feedback as to the potential of the computer labs to be used by participants to teach/assess students' competency on the ICT objectives of the UNESCO ICT-CFT.

Chapter Six – Discussion

Chapter Six is a discussion of the importance of the expert review as well as a discussion on the field test of the tool. The chapter concludes by providing a summary of the research, the potential contributions of the study, and next steps for future development of the tool.

Expert Reviewer Comments

Three expert reviewers were recruited to examine the breakdown of the UNESCO ICT objectives, and to provide suggestions to improve the breakdown, where necessary. As indicated earlier, the intent of the objectives breakdowns was not to ensure that revised objectives reflected all key components of a good performance objective. Rather, the breakdown of the objectives was done to clearly define the skills that were to be performed. Two of the expert reviewers concluded that the objectives breakdowns were adequate for the purpose of the study. One reviewer, however, suggested changes to be made. Of the 21 objectives, the expert reviewer recommended changes to five of them. These suggestions mainly involved a further breakdown of the objectives, and in one instance, a reversion to the original UNESCO verb.

The review by experts, and the subsequent acceptance of their recommended changes, ensured the validity of the breakdown of the objectives. The review and revisions also ensured that the final list of revised performances ultimately generated responses that were accurately aligned with the initial UNESCO competencies. It also demonstrated that the study design included the use of expert reviewers, which is a key tenet of tool development in design and development research (Richey & Klein, 2007).

Field Test of Survey Tool

Participants were able to access the survey tool from the link provided in the invitation email. Because the database created for this study operated without any problems, the researcher

was able to determine the number of attempts by the participants and their rates of completion. The tool was designed to be completed at a single sitting and in a specific sequence. However, most of the field test participants followed a different approach. Most started answering the survey, stopped working on the survey at some stage, and came back to it. In such instances, the survey records were treated as new entries, and required the participants to start over again.

Table 13 shows the number of times that participants restarted the survey and at what stage they stopped working on the tool.

Table 13: Participant Attempts and Percentage Completion of Tool

Participant	Attempt 1	Attempt 2	Attempt 3	Attempt 4
1	0% Complete	49% Complete	40% Complete	100% Complete
2	0% Complete	0% Complete	40% Complete	100% Complete
3	35% Complete	0% Complete	100% Complete	-
4	5% Complete	5% Complete	100% Complete	-
5	30% Complete	100% Complete	-	-
6	100% Complete	-	-	-
7	100% Complete	-	-	-

As shown in Table 13 above, only two of the seven participants completed the survey at the first try. The remaining five participants tried between two and four times before completing the survey. Participant 2 commented on this, and indicated that the tool would be improved if it allowed participants to go back to previously answered questions. This is an important observation, one that could be incorporated in a future update of the tool.

The first part of the tool used a researcher provided list of resources to collect information on the resources available to participants in the computer labs of the colleges of education. This feature allowed each participant to configure an inventory list to align with resources available in his or her computer labs. This feature of the tool was very useful as it allowed the researcher to determine if this method of collecting data could be used to detect and, if desired, compare the differences between what resources the various participants and labs

have, and more importantly, what resources the participants have the option to use to teach/assess the original UNESCO ICT-CFT objectives. The feature was also useful to participants, as they were able to describe their resources once, rather than having to repeat relevant components of the inventory for each of the 64 questions in the survey.

The tool's feature allowing participants to add to the researcher-provided list was used by five participants to add a total of 15 resources to their lists in Part I of the survey. These included resources such as Projector Screen, IMO (a mobile voice-over-IP app) and a Router Switch. The tool was also able to identify participants who did not include some researcher-provided resources in their inventories. There were eight resources included in the researcher-provided list that none of the participants indicated they had available in their computer labs. These included Large-Scale Printer, Duplicating Machine, Brainstorming Software, and a Learning Management System (LMS).

Although participants also had the option to add more resources in Parts II and III of the tool, none of the participants used that feature of the tool. All the resources that participants provided were added in Part I of the survey.

The tool was designed to be used in regions where Internet speeds are slow. With this in mind, the tool had no graphics and images. This was done to ensure that load times of the pages of the tool were kept at a minimum. In field tests, participants were able to access the tool without any connection issues. This shows that it is helpful when designing online survey tools for use in areas where Internet speeds are slow to take into consideration the load time of the online tool, as participants are less likely to encounter connection issues if the pages are designed to load quickly.

Feedback to Participants

As reported in Chapter Five, the feedback that was provided to the participants was controlled by a set of computer coded scripts. These logical scripts were programmed to provide specific feedback depending on which options (of hardware, software and, infrastructure) were selected by the participants. In most cases, the tool provided an appropriate response. However, in instances where the participants selected resources other than what was initially presented in the tool's scripts, the feedback was not always accurate. In the example below, the feedback provided to the participant was inaccurate.

UNESCO Objective 7: Use a search engine

To determine if computer labs have the capability to teach the UNESCO objective stated above, the following question was asked:

Survey Tool Question:

Figure 10: Question 11 from Part II of the Survey

Question 11

Which of the following will you use, if you were to teach your students how to use a search engine? Select all that apply.

Hardware		Software		Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	☐	a) Internet Access	☐
b) Laptop Computer	☐			b) Other	☐
c) Smartphone	☐				
d) Tablet	☐				
e) Projector	☐				
f) Other	☐				

Tool Script

Selections that were included in the tool's scripts included items "a – d" in Hardware, item "a" in Software, and item "a" in Infrastructure. At least one item from each category had to be included in the response to Question 11 in order to receive positive feedback from the tool.

Participant 1 Response

Participant 1 provided the following (Fig. 11) as equipment available in their institution that would be used teach students how to use a search engine:

Figure 11: Resources Selected by Participant to Question 11

Q_11
Desktop Computer Laptop Computer Word Processing Software (e.g. MS Word, Pages, OpenOffice) Internet Browser Others(My personal laptop with an MTN MODEM for Internet connection)

Based on the responses shown in Figure 11, the tool provided the following feedback to Participant 1

Figure 12: Feedback Provided to Participant 1 on Objective 6

Objective 6 : Use a search engine.

Teach students:
Result: Based on your responses, when teaching, you do not have the technology to use a search engine.

This feedback was inaccurate because the responses provided by the participant prove that his computer lab has the capability to be used to teach students how to use a search engine. The inaccurate feedback resulted because the tool did not treat the entry in the "other" infrastructure category as an automatic positive response. This result occurred because the researcher decided not to incorporate a feature that would allow for a positive feedback to "other" response answers into the initial field test. This meant that if the participant did not select at least one of the pre-determined needed resources from each category as being present, the tool

automatically provided feedback that indicated that the objective cannot be met using the technology in the lab. In this particular case, the participant had access to the internet (via his personal laptop) but because he did not choose "internet access" (one of the designated "positive feedback trigger answer"), the participant did not receive the accurate feedback.

Summary

The purpose of this study was to provide an electronic tool for detecting the level and nature of readiness of teacher preparation computer labs in DCs to implement the UNESCO ICT-CFT. The design, development and field tests of the tool was based on Richey and Klein's (2007) tool development guidelines in the design and development research field. The ICT objectives of the UNESCO ICT-CFT were transformed into an electronic survey tool through a process of objective breakdown, expert review of the objective breakdown, transformation of objectives into resource requirements, and feedback creation. The electronic survey tool was pilot tested in computer labs at selected teacher training colleges in Ghana. In general, the tool was able to assess the capabilities of the computer labs surveyed and provided feedback as to which of the UNESCO ICT-CFT objectives could be taught and assessed in these centers. There were limited cases where the tool was unable to provide accurate feedback because of its inability to evaluate some participant supplied responses.

Contributions of the Study

This study contributes to the research body of design and development research. Tool development and use is important in instructional design and development. The study produced an online tool that is capable of being used to assess the resources of computer labs of teacher training colleges on their capability to be used to teach/assess UNESCO's ICT-CFT. It has provided a description of the processes involved in the design of such a tool and this information

could be used as another resource to guide future developers of similar online tools. The research

process employed in this study complied with Richey and Klein's (2007) guidelines for

undertaking a design and development research project. These guidelines included the use of

expert reviewers to address validity concerns and ensuring that the tool was usable in the

environment where it was pilot tested (through using limited graphics to ensure fast load times).

The study's methodology clearly stipulated that the results of the study are context specific and

generalizations may not accurately be made.

This study also contributed to bringing to the fore (especially in the field test) what ICT

competencies teachers should possess when they graduate. As mentioned in the literature

review, the UNESCO ICT-CFT is not well disseminated. Use of a tool like the one developed in

this study could potentially bring the UNESCO ICT-CFT directly into the hands of the

participants who are primarily tasked with training ICT teachers. This tool provides an additional

way to bolster the usefulness of the suggestions of UNESCO and gives potential users of the

document an additional resource to help focus their preparation and implementation efforts.

The pilot tests of the tool also demonstrated the ability of the tool to detect disparities in

resources available to teacher training colleges. Based on this information, governments could

use the results of the tool to make decisions on what resources to provide to the schools.

Next Steps

The pilot tests demonstrated multiple positive features of the tool but it also identified a

small number of problems. For example, the configuration of the tool as tested did not permit

participants to go back to a previous question to make changes. It also did not offer participants

the ability to save their progress, and come back to complete the survey at a later time. The tool

provided feedback to participants, but in some cases the feedback was not completely accurate.

If the tool is to be used in the future, and in a wider setting, features correcting these problems could be added. When done, it should be possible in future studies to focus on data that this tool is able to generate and not on the tool itself. Finally, although participants were given an opportunity to make comments on the tool, a potentially useful follow-up would be to contact these participants in-person or by phone for interviews to talk about how well the tool worked for them.

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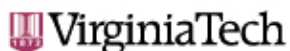
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Appendices

Appendix A – IRB Approval: Expert Reviewer Assessment

VirginiaTech

Office of Research Compliance
Institutional Review Board
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MEMORANDUM

DATE: November 10, 2016

TO: Ken Potter, Kwame Ansong-Gyimah

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: Assessing Computer Center Readiness to Implement UNESCO ICT Competency Framework for Teachers - Center Readiness Assessment Tool

IRB NUMBER: **16-574**

Effective November 10, 2016, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: **Exempt, under 45 CFR 46.110 category(ies) 2,4**
Protocol Approval Date: **November 10, 2016**
Protocol Expiration Date: **N/A**
Continuing Review Due Date*:   **N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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Appendix B- IRB Approval – Center Readiness Assessment Survey

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: February 16, 2017

TO: Ken Potter, Kwame Ansong-Gyimah

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: Assessing Computer Center Readiness to Implement UNESCO ICT Competency Framework for Teachers - Center Readiness Assessment Tool

IRB NUMBER: **17-088**

Effective February 15, 2017, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As: **Expedited, under 45 CFR 46.110 category(ies) 7**
Protocol Approval Date: **February 15, 2017**
Protocol Expiration Date: **February 14, 2018**
Continuing Review Due Date*:   **January 31, 2018**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

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Appendix C- Recruitment Letter

School of Education,
Virginia Tech
Blacksburg, VA 24060
USA

January 27, 2017

Dear Sir/Madam,

Invitation to test a tool for assessing computer center readiness to implement UNESCO ICT Competency Framework for Teachers (ICT-CFT)

I am writing a dissertation entitled 'Assessing Computer Center Readiness to Implement UNESCO ICT Competency Framework for Teachers'. As part of the process, I have developed an online survey tool that, when completed, can provide a guide as to what UNESCO ICT-CFT objectives are potentially achievable at a center.

May I please invite you to test the tool by answering a number of questions pertaining to the hardware/software available at your institution. Relevant experience essential to testing this tool are that you must:
- An ICT Tutor
- Teach a course at the College of Education that requires the use of an ICT Lab

As a participant, you will be asked to read each of the UNESCO Objective, and to select (from a checklist) hardware and software that you will use to teach and assess your students' competency, were you to teach these objectives.

I anticipate that this tool test will take about 1 hour to complete. Participation is voluntary and anonymous. Consent for participation in this study is given by your accessing and providing answers to the tool. The link to the tool is given below:

http://www.educate.vt.edu/objdiagnoser/

Please do not hesitate to contact me for any clarification. I can be reached at:
Phone: 540 394 8419
Email: kansong@vt.edu

Or via my faculty Advisor:

Dr. Ken Potter
Email: kpotter@vt.edu

Should you have any questions or concerns about the study's conduct or your rights as a research subject, you may contact the VT IRB Chair, Dr. David M. Moore at moored@vt.edu or [(540) 231-4991](tel:5402314991).

Thank you for your time.

Kwame Ansong-Gyimah
PhD Candidate
Virginia Tech

Appendix D –Researcher Breakdown of UNESCO ICT-CFT Objectives

	UNESCO Objectives	UNESCO Description of Activities		Analytical Breakdown of the UNESCO Objectives
A	Technology Literacy Teachers should be able to:			
1	Describe and demonstrate the use of common hardware.	Discuss and demonstrate the basic operation of various hardware technologies, such as desktop computers, laptops, printers, scanners, and hand-held devices.	1a	Discuss the use of common hardware
			1b	Demonstrate the use of common hardware
2	Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Discuss and demonstrate the basic tasks of word processors, demonstrate how they are used in instruction. Have participants create a text document in which they carry out these basic word processing tasks to generating a text document.	2a	Discuss the basic tasks of word processors such as entry, editing text and printing
			2b	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.
			2c	Describe the uses of word processors, such as text entry, editing text, formatting text, and printing.
			2d	Demonstrate the uses of word processors, such as text entry, editing text, formatting text, and printing.
3	Describe and demonstrate the purpose and basic features of presentation software and other digital resources.	Discuss the purpose of presentation software and demonstrate its general features and function. Have participants create a presentation on a topic of their choice using digital resources.	3a	Discuss the purpose of presentation software and other digital resources
			3b	Demonstrate the basic features of presentation software and other digital resources
			3c	Create a presentation on a topic of choice
4	Describe the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.	Discuss the purpose of graphics software and demonstrate the creation of a graphics display. Have participants create and share a graphic display.	4a	Discuss the purpose of graphics software
			4b	Demonstrate the creation of a graphics display
			4c	Create a simple graphic display
5	Describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website.	Discuss the purpose and structure of the Internet and the World Wide Web and participants' experiences with these. Demonstrate the use of a browser; have participants use a browser to access popular websites.	5a	Describe the Internet and the World Wide Web
			5b	Discuss the purpose of the Internet and World Wide Web
			5c	Demonstrate the use of a web browser
			5d	Use a browser to access popular websites
6	Use a search engine.	Demonstrate the use of a search engine; discuss and demonstrate simple keyword searches; have participants search for websites on their favorite topics and discuss the keyword strategies they used with the group for discussion.	6a	Demonstrate the use of a search engine
			6b	Use a search engine to search for favorite websites and topics of interest
			6c	Discuss key strategies for web searches
7	Create an email account and use it for a sustained series of email correspondence.	Demonstrate the creation and use of an email account; have participants create an email account and create and send a series of email messages.	7a	Create an email account
			7b	Create and send a series of email messages
8	Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.	Demonstrate a variety of tutorial and drill and practice packages in the subject which the participants teach and describe how such packages support the acquisition of subject matter knowledge. Have participants analyze specific packages in their subject area and describe how they support the acquisition of specific subject matter knowledge.	8a	Describe the function and purpose of tutorial and drill and practice software
			8b	Demonstrate a variety of tutorial and drill and practice packages in subject areas
			8c	Discuss how specific packages (in subject area) support knowledge acquisition
9	Locate off-the-shelf educational software packages and Web resources, evaluate	Have participants search websites and catalogs to identify appropriate software for specified learning	9a	Identify relevant off-the-shelf educational software

	UNESCO Objectives	UNESCO Description of Activities	Analytical Breakdown of the UNESCO Objectives	
	them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	objectives or standards and analyze these packages for accuracy and curriculum alignment. Have participants discuss the criteria they used for analyzing and evaluating the software.	9b	Analyze, evaluate and align off-the-shelf educational software to curriculum objectives
			9c	Discuss criteria used for analysis and evaluation of off-the-shelf software
10	Use networked record keeping software to take attendance, submit grades, and maintain student records.	Discuss the purposes and advantages of a networked recording keeping system, demonstrate the use of such a system, and have participants enter record keeping data for their class.	10a	Discuss the purpose and advantages of networked record keeping systems
			10b	Demonstrate the use of networked record keeping systems
			10c	Use a networked record keeping software to take attendance, submit grades and maintain student records
11	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.	Discuss the purposes and advantages of various communication and collaboration technologies; and have participants use these technologies to communicate and collaborate with others in the group.	11a	Discuss the purpose and advantages of various communication devices
			11b	Discuss the purpose and advantages of collaboration technologies
			11c	Use communication devices to engage with others in a group
			11d	Use Collaborative tools to engage in with other in a group
B				
12	Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.	Demonstrate the use of a variety of software packages in the subject domain; have participants explore and demonstrate these packages.	12a	Demonstrate the use of various subject specific open-ended software packages
13	Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.	Have participants search websites and catalogues to identify appropriate software for project-based learning in their subject field. Have participants develop evaluation criteria and rubrics and justify their selections based on effectiveness for the intended purpose.	13a	Discuss the usefulness of web resources and software for project based learning in specified subject areas
			13b	Develop evaluation criteria and rubric for assessing software and web resources for project based learning in specified subject areas
			13c	Evaluate the accuracy of software and web resources for project-based learning in specified subject areas
14	Use an authoring environment or tools to design online materials.	Demonstrate the use of an authoring environment or tools. Have participants work in groups to design an online unit of a course of study.	14a	Demonstrate the use of authoring environment or tools
			14b	Use an authoring environment or tool to design an online unit of a course of study
15	Use a network and appropriate software to manage, monitor, and assess progress of various student projects.	Demonstrate the use of networked project software that allows the teacher to manage, monitor, and assess student project work; have participants enter project data for their students' work.	15a	Use a network and appropriate software to enter students' academic data/records
			15b	Use a network and appropriate software to monitor and assess students' project work
16	Use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.	Discuss the use of online communication and collaboration environments by teachers to support student learning; have participants keep a log, share printouts, and demonstrate examples of their online interactions, in this regard.	16a	Discuss the use of communication tools to support student learning
			16b	Discuss the use of collaborative tools to support student learning
			16c	Demonstrate the use of communication and collaborative tools for student learning
			16d	Showcase examples of online interactions that support learning
17	Use the network to support student collaboration within and beyond the classroom.	Discuss the use of online communication and collaboration environments by students to support their collaborative project work and learning; have participants keep a log, share printouts, and demonstrate examples of student online interactions.	17a	Discuss the use of communication tools to support student-to-student interaction
			17b	Discuss the use of collaboration tools to support student teamwork
			17c	Showcase examples of online interactions that exemplify student online interaction

	UNESCO Objectives	UNESCO Description of Activities	Analytical Breakdown of the UNESCO Objectives	
18	Use search engines, online databases, and email to find people and resources for collaborative projects.	Discuss the use of search engines, online databases, and email to find people and resources for collaborative projects; have participants conduct searches related to a project for their course; engage in an online collaborative project; have participants reflect on their experiences, share with others, and discuss them.	18a	Discus the use of search engines, online databases and email to find people and resources for collaborative projects
			18b	Use search engines, online databases and email to find people and resources for collaborative projects
			18c	Discuss reflections and experiences on the use of search engines, online databases and email to find people and resources
C	Knowledge Creation			
19	Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.	Demonstrate a variety of software packages and digital production resources and describe how they support and advance students' innovation and knowledge creation practices. Have participants analyze specific examples of use of these resources in their subject area and describe how they support student innovation and knowledge creation. Have participants use and evaluate these tools in a unit that they design.	19a	Describe the function and purpose of ICT production tools and resources
			19b	Use ICT production tools and resources to student innovation and knowledge creation
20	Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.	Demonstrate a variety of virtual and knowledge building environments and describe how they support student learning communities. Have participants analyze specific examples of use of these resources in their subject area and describe how they support student learning communities. Have participants use and demonstrate the effectiveness of these tools in a unit that they design.	20a	Describe the function and purpose of virtual environments and knowledge building environments.
			20b	Analyze examples of virtual environments and knowledge building environments in subject area
			20c	Demonstrate the effectiveness of virtual and knowledge building environments in a lesson
21	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.	Demonstrate a variety of planning and thinking tools and describe how they support students' creation and planning of their own learning activities. Have participants analyze specific examples of use of these resources in their subject area and describe how they support the development of students' self-regulated learning. Have participants use and evaluate these tools in a unit that they design.	21a	Describe the function and purpose of planning and thinking tools
			21b	Demonstrate the use of a variety of planning and thinking tools that support students' creation and planning of learning activities

Researcher's Second Revision of UNESCO Object/Expert Reviewer Recommended Breakdown

UNESCO Objectives		First Researcher Analytical Breakdown of the UNESCO Objectives		Second Revision of Objectives (researcher		Expert Reviewers' Recommended Breakdown	
1	Describe and demonstrate the use of common hardware.	1a	Discuss the use of common hardware	1.1	Describe the use of common hardware	1.1	Describe the use of common hardware
		1b	Demonstrate the use of common hardware	1.2	Demonstrate the use of common hardware	1.2	Demonstrate the use of common hardware
2	Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	2a	Discuss the basic tasks of word processors such as entry, editing text and printing	2.1	Describe the basic tasks of word processors such as text entry, editing text, formatting text and printing.	2.1	Describe the basic tasks of word processors such as text entry, editing text, formatting text and printing.
		2b	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.	2.2	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.	2.2	Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.
		2c	Describe the uses of word processors, such as text entry, editing text, formatting text, and printing.				
		2d	Demonstrate the uses of word processors, such as text entry, editing text, formatting text, and printing.				
3	Describe and demonstrate the purpose and basic features of presentation software and other digital resources.	3a	Discuss the purpose of presentation software and other digital resources	3.1	Describe the purpose of presentation software and other digital resources.	3.1	Describe the purpose of presentation software and other digital resources.
		3b	Demonstrate the basic features of presentation software and other digital resources	3.2	Describe the basic features of presentation software and other digital resources	3.2	Describe the basic features of presentation software and other digital resources
				3.3	Demonstrate the purpose of presentation software and other digital resources.	3.3	Demonstrate the basic features of presentation software and other digital resources.
		3c	Create a presentation on a topic of choice	3.4	Demonstrate the basic features of presentation software and other digital resources	3.4	Demonstrate the basic features of presentation software and other digital resources
4	Describe the purpose and basic function of graphics software and use a graphics software package to create a simple graphic display.	4a	Discuss the purpose of graphics software	4.1	Describe the purpose of graphics software package.	4.1	Describe the purpose of graphics software package.
		4b	Demonstrate the creation of a graphics display	4.2	Describe the basic function of graphics software package.	4.2	Describe the basic function of graphics software package.
		4c	Create a simple graphic display	4.3	Use a graphics software package to create a simple graphic display.	4.3	Use a graphics software package to create a simple graphic display.
5	Describe the Internet and the World Wide Web, elaborate on their uses, describe how a browser works and use a URL to access a website.	5a	Describe the Internet and the World Wide Web	5.1	Describe the Internet and the World Wide Web.	5.1	Describe the Internet and the World Wide Web.
		5b	Discuss the purpose of the Internet and World Wide Web	5.2	Elaborate on the uses of the Internet and the World Wide Web.	5.2	Elaborate on the uses of the Internet and the World Wide Web.
		5c	Demonstrate the use of a web browser	5.3	Describe how a browser works.	5.3	Describe how a browser works.
		5d	Use a browser to access popular websites	5.4	Use a URL to access a website.	5.4	Use a URL to access a website.
6	Use a search engine.	6a	Demonstrate the use of a search engine	6.1	Use a search engine to find information relevant to specified tasks.	6.1	Use a search engine to find information relevant to specified tasks.
		6b	Use a search engine to search for favorite websites and topics of interest				
		6c	Discuss key strategies for web searches				
7	Create an email account and use it for a sustained series of email correspondence.	7a	Create an email account	7.1	Create an email account.	7.1	Create an email account.
		7b	Create and send a series of email messages	7.2	Use email for correspondence to send/receive/reply at least 5 messages.	7.2	Use email for correspondence to send/receive/reply at least 5 messages.

UNESCO Objectives		First Researcher Analytical Breakdown of the UNESCO Objectives		Second Revision of Objectives (researcher		Expert Reviewers' Recommended Breakdown	
8	Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.	8a	Describe the function and purpose of tutorial and drill and practice software	8.1	Describe the function and purpose of tutorial and drill and practice software.	8.1	Describe the function of tutorial and drill and practice software
		8b	Demonstrate a variety of tutorial and drill and practice packages in subject areas	8.2	Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.	8.2	Describe the purpose of tutorial and drill and practice software.
		8c	Discuss how specific packages (in subject area) support knowledge acquisition			8.3	Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.
9	Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	9a	Identify relevant off-the-shelf educational software	9.1	Select relevant off-the-shelf educational software packages and web resources.	9.1	Locate relevant off-the-shelf educational software packages and web resources.
		9b	Analyze, evaluate and align off-the-shelf educational software to curriculum objectives	9.2	Evaluate off-the-shelf educational software packages and web resources for accuracy and alignment with curriculum standards.	9.2	Evaluate off-the-shelf educational software packages and web resources for accuracy and alignment with curriculum standards.
		9c	Discuss criteria used for analysis and evaluation of off-the-shelf software	9.3	Match off-the-shelf educational software packages and web resources to the needs of specific students	9.3	Match off-the-shelf educational software packages and web resources to the needs of specific students.
10	Use networked record keeping software to take attendance, submit grades, and maintain student records.	10a	Discuss the purpose and advantages of networked record keeping systems	10.1	Use networked record keeping software to take attendance.	10.1	Use networked record keeping software to take attendance.
		10b	Demonstrate the use of networked record keeping systems	10.2	Use networked record keeping software to submit grades.	10.2	Use networked record keeping software to submit grades.
		10c	Use a networked record keeping software to take attendance, submit grades and maintain student records	10.3	Use networked record keeping software to maintain student records.	10.3	Use networked record keeping software to maintain student records.
11	Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.	11a	Discuss the purpose and advantages of various communication devices	11.1	Use common communication technologies (text messaging, voice calls, video calls, etc.).	11.1	Use common communication technologies (text messaging, voice calls, video calls, etc.).
		11b	Discuss the purpose and advantages of collaboration technologies	11.2	Use common collaboration technologies (video conferencing, web-based collaboration tools, social environments, etc.).	11.2	Use common collaboration technologies (video conferencing, web-based collaboration tools, social environments, etc.).
		11c	Use communication devices to engage with others in a group				
		11d	Use Collaborative tools to engage in with other in a group				
12	Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.	12a	Demonstrate the use of various subject specific open-ended software packages	12.1	Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.	12.1	Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.
13	Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.	13a	Discuss the usefulness of web resources and software for project based learning in specified subject areas	13.1	Evaluate accuracy of web resources in support of project-based learning in a subject area.	13.1	Evaluate accuracy of web resources in support of project-based learning in a subject area.
		13b	Develop evaluation criteria and rubric for assessing software and web resources for project based learning in specified subject areas	13.2	Evaluate usefulness of web resources in support of project-based learning in a subject area.	13.2	Evaluate usefulness of web resources in support of project-based learning in a subject area.

UNESCO Objectives		First Researcher Analytical Breakdown of the UNESCO Objectives		Second Revision of Objectives (researcher		Expert Reviewers' Recommended Breakdown	
		13c	Evaluate the accuracy of software and web resources for project-based learning in specified subject areas				
14	Use an authoring environment or tools to design online materials.	14a	Demonstrate the use of authoring environment or tools	14.1	Use an authoring environment or tools to design online materials.	14.1	Use an authoring environment or tools to design online materials.
		14b	Use an authoring environment or tool to design an online unit of a course of study				
15	Use a network and appropriate software to manage, monitor, and assess progress of various student projects.	15a	Use a network and appropriate software to enter students' academic data/records	15.1	Use a network and appropriate software to manage student projects.	15.1	Use a network and appropriate software to manage student projects.
		15b	Use a network and appropriate software to monitor and assess students' project work	15.2	Use a network and appropriate software to monitor progress of various student projects.	15.2	Use a network and appropriate software to monitor progress of various student projects.
				15.3	Use a network and appropriate software to assess progress of various student projects.	15.3	Use a network and appropriate software to assess progress of various student projects.
16	Use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.	16a	Discuss the use of communication tools to support student learning	16.1	Use ICT to communicate with students, peers, parents and the larger community in order to nurture student learning.	16.1	Use ICT to communicate with students, peers, parents and the larger community in order to nurture student learning.
		16b	Discuss the use of collaborative tools to support student learning	16.2	Use ICT to collaborate with students, peers, parents and the larger community in order to nurture student learning.	16.2	Use ICT to collaborate with students, peers, parents and the larger community in order to nurture student learning.
		16c	Demonstrate the use of communication and collaborative tools for student learning				
		16d	Showcase examples of online interactions that support learning				
17	Use the network to support student collaboration within and beyond the classroom.	17a	Discuss the use of communication tools to support student-to-student interaction	17.1	Use the network to support student collaboration within the classroom.	17.1	Use the network to support student collaboration within the classroom.
		17b	Discuss the use of collaboration tools to support student teamwork	17.2	Use the network to support student collaboration beyond the classroom.	17.2	Use the network to support student collaboration beyond the classroom
		17c	Showcase examples of online interactions that exemplify student online interaction				
18	Use search engines, online databases, and email to find people and resources for collaborative projects.	18a	Discus the use of search engines, online databases and email to find people and resources for collaborative projects	18.1	Use search engines to find people and resources for collaborative projects.	18.1	Use search engines to find people and resources for collaborative projects.
		18b	Use search engines, online databases and email to find people and resources for collaborative projects	18.2	Use online databases to find people and resources for collaborative projects.	18.2	Use online databases to find people and resources for collaborative projects.
		18c	Discuss reflections and experiences on the use of search engines, online databases and email to find people and resources	18.3	Use email to find people and resources for collaborative projects.	18.3	Use email to find people and resources for collaborative projects.
19	Describe the function and purpose of ICT production tools and	19a	Describe the function and purpose of ICT production tools and resources	19.1	Describe the function and purpose of ICT production tools and resources.	19.1	Describe the function of ICT production tools and resources.

	UNESCO Objectives		First Researcher Analytical Breakdown of the UNESCO Objectives		Second Revision of Objectives (researcher		Expert Reviewers' Recommended Breakdown
	resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.	19b	Use ICT production tools and resources to student innovation and knowledge creation	19.2	Use ICT production tools and resources to support students' innovation and knowledge creation.	19.2	Describe the purpose of ICT production tools and resources.
				19.3			Use ICT production tools and resources to support students' innovation and knowledge creation.
20	Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.	20a	Describe the function and purpose of virtual environments and knowledge building environments.	20.1	Describe the function and purpose of virtual environments.	20.1	Describe the function of virtual environments.
		20b	Analyze examples of virtual environments and knowledge building environments in subject area	20.2	Describe the function and purpose of knowledge building environments.	20.2	Describe the purpose of virtual environments.
		20c	Demonstrate the effectiveness of virtual and knowledge building environments in a lesson	20.3	Use virtual environments to support increased knowledge and understanding of subject matter.	20.3	Describe the function of knowledge building environments.
				20.4	Use knowledge building environment to support increased knowledge and understanding of subject matter.	20.4	Describe the purpose of knowledge building environments.
				20.5	Use virtual environments in the development of online and face-to-face learning activities.	20.5	Use virtual environments to support increased knowledge and understanding of subject matter.
				20.6	Use knowledge building environments in the development of online and face-to-face learning activities.	20.6	Use knowledge building environments to support increased knowledge and understanding of subject matter.
						20.7	Use virtual environments in the development of online and face-to-face learning activities.
						20.8	Use knowledge building environments in the development of online and face-to-face learning activities.
21	Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.	21a	Describe the function and purpose of planning and thinking tools	21.1	Describe the function and purpose of planning and thinking tools.	21.1	Describe the function of planning and thinking tools.
		21b	Demonstrate the use of a variety of planning and thinking tools that support students' creation and planning of learning activities	21.2	Use planning and thinking tools to support students' creation and planning of their own learning activities.	21.2	Describe the purpose of planning and thinking tools.
				21.3	Use planning and thinking tools to support students' continuous reflective thinking and learning.	21.3	Use planning and thinking tools to support students' creation of their own learning activities.
						21.4	Use planning and thinking tools to support students' planning of their own learning activities.
						21.5	Use planning and thinking tools to support students' continuous reflective thinking and learning.

Appendix E – Features of and Examples of Devices Needed to Achieve Objective

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
1. Describe and demonstrate the use of common hardware.	Describe the use of common hardware Demonstrate the use of common hardware	Ability to accept input such as text and sound, ability to distinguish between different touch gestures, execute commands, show output both on a screen (soft), and printed documents (hard), as well as sound output.	Desktop Computer, Laptop, cell phone, tablet, printer, scanner, Interactive Boards,
2 Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Describe the basic tasks of word processors such as text entry, editing text, formatting text and printing. Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.	Ability to show word processing procedures such as text entry, editing text, formatting text and printing text.	Desktop Computer, Laptop, Tablet, Printer, Smart Phone, Word Processing Software
3 Describe and demonstrate the purpose and basic features of presentation software and other digital resources.	Describe the purpose of presentation software and other digital resources. Describe the basic features of presentation software and other digital resources Demonstrate the features of presentation software and other digital resources.	Capable of producing text, formatting text, manipulate images and graphs and produce electronic slides for presentation	Desktop computer, laptop computer, Tablet, Presentation Software, Smart Phone, Digital Camera
4. Describe the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.	Describe the purpose of graphics software package. Describe the basic function of graphics software package. Use a graphics software package to create a simple graphic display.	Capable of creating and manipulating graphics (such as drawings, pictures, graphs, banners, etc.)	Desktop Computer, Laptop Computer, Tablet, Graphics Software (e.g., Illustrator, Photoshop, Draw, Paint)
5. Describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website.	Describe the Internet and the World Wide Web. Elaborate on the uses of the Internet and the World Wide Web. Describe how a browser works. Use a URL to access a website.	Capability to connect to a network; browser equipped device, active and working internet connection	Desktop Computer, Laptop, Smartphone, or Tablet. Access to the Internet
6. Use a search engine.	Use a search engine to find information relevant to specified tasks.	Capability of connecting to the internet, Internet	Desktop Computer, Laptop Computer, Smartphone, or tablet. Access to the Internet

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
		connection	
7. Create an email account and use it for a sustained series of email correspondence.	Create an email account.	Capability of connecting to the internet, Internet connection	Desktop Computer, Laptop Computer, Smartphone, or tablet. Access to the Internet
	Use email for correspondence to send/receive/reply at least 5 messages.		
8. Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.	Describe the function of tutorial and drill and practice software	Capable of running drill and practice software, Drill and Practice software	Desktop Computer, Laptop Computer, Tablet, Drill and Practice Software (e.g., Typing tutorial
	Describe the purpose of tutorial and drill and practice software.		
	Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.		
9. Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.	Locate relevant off-the-shelf educational software packages and web resources.	Capable of connecting to and searching the internet	Desktop Computer, Laptop Computer, Tablet, Smartphone, Internet access
	Evaluate off-the-shelf educational software packages and web resources for accuracy and alignment with curriculum standards.		
	Match off-the-shelf educational software packages and web resources to the needs of specific students.		
10 Use networked record keeping software to take attendance, submit grades, and maintain student records.	Use networked record keeping software to take attendance.	Network capability, Software for keeping student records	Desktop Computer, Laptop Computer, Tablet, Smartphone, Local Network, LMS
	Use networked record keeping software to submit grades.		
	Use networked record keeping software to maintain student records.		
11. Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.	Use common communication technologies (text messaging, voice calls, video calls, etc.).	Capable of connecting to a network, has video and audio capabilities, active and working accounts with social media environments	Cell Phone, Tablet, Desktop Computers, Laptop, Teleconference Equipment,
	Use common collaboration technologies (video conferencing, web-based collaboration tools, social environments, etc.).		
B	Knowledge Deepening Approach		
12 Operate various open-ended software packages appropriate to their subject matter area, such as visualization, data	Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.	Meets computing specification of various specialized software, access to specialized software, networked equipment,	Desktop Computer, Laptop Computer, Tablet, Spreadsheets (e.g., Calc), Word Processors (e.g. Write), database program (e.g. base), Drawing programs (e.g. Draw), Presentation Software (e.g.

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
analysis, role-play simulations, and online references.	Evaluate usefulness of web resources in support of project-based learning in a subject area.		Impress)
13 Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.	Evaluate accuracy of web resources in support of project-based learning in a subject area.	Capable of searching the internet	Desktop Computer, Laptop Computer, Tablet, Smartphone, Internet access
14 Use an authoring environment or tools to design online materials.	Use an authoring environment or tools to design online materials.	Ability to connect to a network, have authoring software installed, have the ability to store publish content, subscription to online content publishing service provider	Tablet, Desktop Computer, Laptop Computer, Authoring Software (such W2L, Xical, CourseLab, LAMS, etc.), Website hosting services (e.g. teacher page, google, etc.)
15. Use a network and appropriate software to manage, monitor, and assess progress of various student projects.	Use a network and appropriate software to manage student projects.	Network capability, Software for keeping student records, LMS	Desktop Computer, Laptop Computer, Tablet, Smartphone, Local Network, Sakai
	Use a network and appropriate software to monitor progress of various student projects.		
	Use a network and appropriate software to assess progress of various student projects.		
16. Use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.	Use ICT to communicate with students, peers, parents and the larger community in order to nurture student learning.	Network capability, Software for keeping student records, LMS	Desktop Computer, Laptop Computer, Tablet, Smartphone, Local Network, Blackboard
	Use ICT to collaborate with students, peers, parents and the larger community in order to nurture student learning.		
17. Use the network to support student collaboration within and beyond the classroom.	Use the network to support student collaboration within the classroom.	Network capability, Software for keeping student records, LMS	Desktop Computer, Laptop Computer, Tablet, Smartphone, Local Network, Blackboard
	Use the network to support student collaboration beyond the classroom		
18 Use search engines, online databases, and email to find people and resources for collaborative projects.	Use search engines to find people and resources for collaborative projects	Browsing capabilities, Internet connected, working email, ability for two or more people to share and/or work on the same file.	Tablet, Desktop Computer, Laptop, Internet connection, collaborative tools/services (e.g. Google drive and docs)
	Use online databases to find people and resources for collaborative projects.		
	Use email to find people and resources for collaborative projects.		

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
19 Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.	Describe the function of ICT production tools and resources. Describe the purpose of ICT production tools and resources Use ICT production tools and resources to support students' innovation and knowledge creation.	Computing capability for multimedia production, large storage capacities, ability to write/print to various media, network connected,	Desktop Computer, Laptop, multimedia production software (such as Premier, Photoshop, etc.), Large scale color printers, DVD R/W drives, Blu- ray drives, CD/DVD duplicating machines.
20 Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.	Describe the function of virtual environments. Describe the purpose of virtual environments. Describe the function of knowledge building environments. Describe the purpose of knowledge building environments. Use virtual environments to support increased knowledge and understanding of subject matter. Use knowledge building environments to support increased knowledge and understanding of subject matter. Use virtual environments in the development of online and face-to-face learning activities. Use knowledge building environments in the development of online and face-to-face learning activities.	Network capability, videoconferencing abilities, Internet access, collaborative software, Learning Management System (LMS) and presentation tools	Desktop Computer, Laptop, Tablet, Smartphones, Virtual meeting software, Projector, Blackboard,
21 Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.	Describe the function of planning and thinking tools. Describe the purpose of planning and thinking tools. Use planning and thinking tools to support students' creation of their own learning activities. Use planning and thinking tools to support students' planning of their own learning activities. Use planning and thinking tools to support students' continuous	Capability to accept and store various input such as text, images and sound, manipulate, revise and share resources, Internet access, specialized brainstorming/mind mapping software	Smartphones, Tablets, Laptops, Desktop computers, Brainstorming software (Inspiration, Bubbl, XMind, etc.)

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features
	reflective thinking and learning.		

UNESCO ICT-CFT	Revised Objective	What features are needed?	Examples of hardware, software and infrastructure with the necessary features

Appendix F – Expert Reviewer Survey Instrument

Introduction

Mager (1962) has provided a guide for creating instructional objectives. Amongst the components (conditions, performances, and criteria) of objectives, the performances that must be completed for the objectives to be attained are crucial. The following breakdown of objectives concentrates only on the performance parts of the objectives and does not include the conditions or criteria that would otherwise be necessary for the objectives to be considered 'good instructional objectives'. For each Objective, please indicate if the objective breakdown aligns with the UNESCO objective, and if not, what could be done to align, as closely as possible, the breakdown to the main UNESCO objective.

Q1 UNESCO ICT OBJECTIVE 1
1.0   Teachers should be able to describe and demonstrate the use of common hardware

Proposed Objective Breakdown:
1.1   Describe the use of common hardware
1.2   Demonstrate the use of common hardware

Does the proposed objective breakdown parts align with UNESCO ICT Objective 1?
➢ Yes
➢ No

Q1b   If No, please suggest a way to improve the objective breakdown.

Q2 UNESCO ICT OBJECTIVE 2
2.0   Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.

Proposed Objective Breakdown:
2.1   Describe the basic tasks of word processors such as text entry, editing text, formatting text and printing.
2.2   Demonstrate the basic tasks of word processors such as text entry, editing text, formatting text, and printing.
Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 2?
➢ Yes
➢ No

Q2b   If No, please suggest a way to improve the objective breakdown.

Q3 UNESCO ICT OBJECTIVE 3
3.0   Describe and demonstrate the purpose and basic features of presentation software and other digital resources.

Proposed Objective Breakdown:

 3.1 Describe the purpose of presentation software and other digital resources.

 3.2 Describe the basic features of presentation software and other digital resources

 3.3 Demonstrate the purpose of presentation software and other digital resources.

 3.4 Demonstrate the basic features of presentation software and other digital resources

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 3?

 ➢ Yes

 ➢ No

Q3b If No, please suggest a way to improve the objective breakdown.

Q4 UNESCO ICT OBJECTIVE 4

 4.0 Describe the purpose and basic function of graphics software and use a graphics software package to create a simple graphic display.

Proposed Objective Breakdown:

 4.1 Describe the purpose of graphics software package.

 4.2 Describe the basic function of graphics software package.

 4.3 Use a graphics software package to create a simple graphic display.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 4?

 ➢ Yes

 ➢ No

Q4b If No, please suggest a way to improve the objective breakdown.

Q5 UNESCO ICT OBJECTIVE 5

 5.0 Describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website.

Proposed Objective Breakdown:

 5.1 Describe the Internet and the World Wide Web.

 5.2 Elaborate on the uses of the Internet and the World Wide Web.

 5.3 Describe how a browser works.

 5.4 Use a URL to access a website.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 5?

 ➢ Yes

 ➢ No

Q5b   If No, please suggest a way to improve the objective breakdown.

Q6 UNESCO ICT OBJECTIVE 6
6.0   Use a search engine.

Proposed Objective Breakdown:
    6.1   Use a search engine to find information relevant to specified tasks.

Does the Objective breakdown align with the parts of the UNESCO ICT Objective 6?
- ➢ Yes
- ➢ No

Q6b   If No, please suggest a way to improve the objective breakdown.

Q7 UNESCO ICT OBJECTIVE 7
7.0   Create an email account and use it for a sustained series of email correspondence.

Proposed Objective Breakdown:
    7.1   Create an email account.
    7.2   Use email for correspondence to send/receive/reply at least 5 messages.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 7?
- ➢ Yes
- ➢ No

Q7b   If No, please suggest a way to improve the objective breakdown.

Q8 UNESCO ICT OBJECTIVE 8
8.0   Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.

Proposed Objective Breakdown:
    8.1   Describe the function and purpose of tutorial and drill and practice software.
    8.2   Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 8?
- ➢ Yes
- ➢ No

Q8b   If No, please suggest a way to improve the objective breakdown.

Q9 UNESCO ICT OBJECTIVE 9

9.0   Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.

Proposed Objective Breakdown:
  9.1   Select relevant off-the-shelf educational software packages and web resources.
  9.2   Evaluate off-the-shelf educational software packages and web resources for accuracy and alignment with curriculum standards.
  9.3   Match off-the-shelf educational software packages and web resources to the needs of specific students.

Do the Objective breakdown parts align with the parts of the UNESCO ICT Objective 9?
  ➢ Yes
  ➢ No

Q9b   If No, please suggest a way to improve the objective breakdown.

Q10 UNESCO ICT OBJECTIVE 10
  10.0 Use networked record keeping software to take attendance, submit grades, and maintain student records.

Proposed Objective Breakdown:
  10.1   Use networked record keeping software to take attendance.
  10.2   Use networked record keeping software to submit grades.
  10.3   Use networked record keeping software to maintain student records

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 10
  ➢ Yes
  ➢ No

Q10b   If No, please suggest a way to improve the objective breakdown.

Q11 UNESCO ICT OBJECTIVE 11
  11.0   Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.

Proposed Objective Breakdown:
  11.1   Use common communication technologies (text messaging, voice calls, video calls, etc.).
  11.2   Use common collaboration technologies (video conferencing, web-based collaboration tools, social environments, etc.).
Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 11?
  ➢ Yes

➥ No

Q11b   If No, please suggest a way to improve the objective breakdown.

Q12 UNESCO ICT OBJECTIVE 12

12.0   Operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.

Proposed Objective Breakdown:
12.1   Operate two or more open-ended software packages such as visualization, data analysis, role-play simulations, and online references in a manner that is appropriate to their subject matter.

Does the proposed objective breakdown align with the parts of the UNESCO ICT Objective 12?
➥ Yes
➥ No

Q12b   If No, please suggest a way to improve the objective breakdown.

Q13 UNESCO ICT OBJECTIVE 13

13.0   Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.

Proposed Objective Breakdown:
13.1   Evaluate accuracy of web resources in support of project-based learning in a subject area.
13.2   Evaluate usefulness of web resources in support of project-based learning in a subject area.

Does the proposed objective breakdown align with the parts of the UNESCO ICT Objective 13?
➥ Yes
➥ No

Q13b   If No, please suggest a way to improve the objective breakdown.

Q14 UNESCO ICT OBJECTIVE 14
14.0   Use an authoring environment or tools to design online materials

Proposed Objective Breakdown:
14.1   Use an authoring environment or tools to design online materials.

Does the proposed objective breakdown align with the parts of the UNESCO ICT Objective 14?
  ➢ Yes
  ➢ No

Q14b   If No, please suggest a way to improve the objective breakdown.

Q15 UNESCO ICT OBJECTIVE 15
15.0   Use a network and appropriate software to manage, monitor, and assess progress of various student projects.

Proposed Objective Breakdown:
  15.1   Use a network and appropriate software to manage student projects.
  15.2   Use a network and appropriate software to monitor progress of various student projects.
  15.3   Use a network and appropriate software to assess progress of various student projects.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 15?
  ➢ Yes
  ➢ No

Q15b   If No, please suggest a way to improve the objective breakdown.

Q16 UNESCO ICT OBJECTIVE 16
16.0   Use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.

Proposed Objective Breakdown:
  16.1   Use ICT to communicate with students, peers, parents and the larger community in order to nurture student learning.
  16.2   Use ICT to collaborate with students, peers, parents and the larger community in order to nurture student learning.

Do the Objective breakdown parts align with the parts of the UNESCO ICT Objective 16?
  ➢ Yes
  ➢ No

Q16b   If No, please suggest a way to improve the objective breakdown.

Q17 UNESCO ICT OBJECTIVE 17
17.0   Use the network to support student collaboration within and beyond the classroom.

Proposed Objective Breakdown:
      17.1   Use the network to support student collaboration within the classroom.
      17.2   Use the network to support student collaboration beyond the classroom

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 17?
    ➢ Yes
    ➢ No

Q17b   If No, please suggest a way to improve the objective breakdown.

Q18 UNESCO ICT OBJECTIVE 18
      18.0   Use search engines, online databases, and email to find people and resources for collaborative projects.

Proposed Objective Breakdown:
      18.1   Use search engines to find people and resources for collaborative projects.
      18.2   Use online databases to find people and resources for collaborative projects.
      18.3   Use email to find people and resources for collaborative projects.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 18?
    ➢ Yes
    ➢ No

Q18b   If No, please suggest a way to improve the objective breakdown.

Q19 UNESCO ICT OBJECTIVE 19
      19.0   Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.

Proposed Objective Breakdown:
      19.1   Describe the function and purpose of ICT production tools and resources.
      19.2   Use ICT production tools and resources to support students' innovation and knowledge creation.
Do the Objective breakdown parts align with the parts of the UNESCO ICT Objective 19?
    ➢ Yes
    ➢ No

Q19b   If No, please suggest a way to improve the objective breakdown.

Q20 UNESCO ICT OBJECTIVE 20

20.0 Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.

Proposed Objective Breakdown:
    20.1   Describe the function and purpose of virtual environments.
    20.2   Describe the function and purpose of knowledge building environments.
    20.3   Use virtual environments to support increased knowledge and understanding of subject matter.
    20.4   Use knowledge building environment to support increased knowledge and understanding of subject matter.
    20.5   Use virtual environments in the development of online and face-to-face learning activities.
    20.6   Use knowledge building environments in the development of online and face-to-face learning activities.

Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 20?
➢ Yes
➢ No

Q20b   If No, please suggest a way to improve the objective breakdown.

Q21 UNESCO ICT OBJECTIVE 21
    21.0   Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.

Proposed Objective Breakdown:
    21.1   Describe the function and purpose of planning and thinking tools.
    21.2   Use planning and thinking tools to support students' creation and planning of their own learning activities.
    21.3   Use planning and thinking tools to support students' continuous reflective thinking and learning.
Does the proposed objective breakdown parts align with the parts of the UNESCO ICT Objective 21?
➢ Yes
➢ No

Q21b   If No, please suggest a way to improve the objective breakdown.

End of Survey
Thank you for your time and contribution.

Appendix G – Expert Reviewer Feedback

UNESCO Objective 8

Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.

Researcher breakdown of UNESCO Objective

8.1   Describe the function and purpose of tutorial and drill and practice software

8.2   Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects

Expert Reviewer Recommended Breakdown of Objective

8.1   Describe the function of tutorial and drill and practice software.

8.2   Describe the purpose of tutorial and drill and practice software.

8.3   Describe how tutorial and drill and practice software support students' acquisition of knowledge of school subjects.

UNESCO Objective 9

Locate off-the-shelf educational software packages and web resources, and evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.

Researcher breakdown of UNESCO Objective

9.1   Select relevant off-the-shelf educational software packages and web resources.

9.2   Evaluate off-the-shelf educational software packages and web resources for accuracy and alignment with curriculum standards

9.3   Match off-the-shelf educational software packages and web resources to the need of specific students.

Expert Reviewer Recommended Breakdown of Objective

9.1   Locate relevant off-the-shelf educational software packages and web resources.

9.2   Evaluate off-the-shelf educational software packages and web resources for

accuracy and alignment with curriculum standards

9.3   Match off-the-shelf educational software packages and web resources to the need

of specific students.

UNESCO Objective 19

Describe the function and purpose of ICT production tools and resources (multimedia

recording and production equipment, editing tools, publication software, web design) and use

them to support students' innovation and knowledge creation.

Researcher breakdown of UNESCO Objective

19.1   Describe the function and purpose of ICT production tools and resources.

19.2   Use ICT production tools and resources to support students' innovation and

knowledge creation.

Expert Reviewer Recommended Breakdown of Objective

19.1   Describe the function of ICT production tools and resources.

19.2   Describe the purpose of ICT production tools and resources.

19.3   Use ICT production tools and resources to support students' innovation and

knowledge creation.

UNESCO Objective 20

Describe the function and purpose of ICT production tools and resources (multimedia

recording and production equipment, editing tools, publication software, web design) and use

them to support students' innovation and knowledge creation.

Researcher breakdown of UNESCO Objective

20.1   Describe the function and purpose of virtual environments

20.2   Describe the function and purpose of knowledge building environments

20.3   Use virtual environments to support increased knowledge and understanding of

subject matter.

20.4   Use knowledge building environments to support increased knowledge and

understanding of subject matter

20.5   Use virtual environments in the development of online and face-to-face learning

activities

20.6   Use knowledge building environments in the development of online and face-to-

face learning activities

Expert Reviewer Recommended Breakdown of Objective

20.1   Describe the function of virtual environments.

20.2   Describe the purpose of virtual environments.

20.3   Describe the function of knowledge building environments.

20.4   Describe the purpose of knowledge building environments.

20.5   Use virtual environments to support increased knowledge and understanding of

subject matter.

20.6   Use knowledge building environments to support increased knowledge and

understanding of subject matter.

20.7   Use virtual environments in the development of online and face-to-face learning

activities.

20.8   Use knowledge building environments in the development of online and face-to-face learning activities

UNESCO Objective 21

Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.

Researcher breakdown of UNESCO Objective

21.1   Describe the function and purpose of planning and thinking tools.

21.2   Use planning and thinking tools to support students' creation and planning of their own learning activities.

21.3   Use planning and thinking tools to support students' continuous reflective thinking and learning.

Expert Reviewer Recommended Breakdown of Objective

21.1   Describe the function of planning and thinking tools.

21.2   Describe the purpose of planning and thinking tools.

21.3   Use planning and thinking tools to support students' creation of their own learning activities.

21.4   Use planning and thinking tools to support students' planning of their own learning activities.

2.1.5   Use planning and thinking tools to support students' continuous reflective thinking and learning.

Appendix H – Feedback Responses to Participants

Responses (Teach)

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
1	Based on your responses, when teaching, you have the resource that can be used to describe and demonstrate the use of common hardware. Based on your responses, when teaching, you have the resource that can be used to describe the use of common hardware, but not to demonstrate the use of common hardware. Based on your responses, when teaching, you do not have the resource to describe and demonstrate the use of common hardware.	Based on your responses, when teaching, you have the resource to demonstrate the use of common hardware but not to describe the use of common hardware in main lab.	Once the resource for demonstration is available, the same resource can be used to describe the common hardware	In order to describe and demonstrate the use of common hardware, there must be present common hardware such as a desktop computer, laptop computer, a smartphone, a tablet, and a printer
2	Based on your responses, when teaching, you have the resource that can be used to describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing. Based on your responses, when teaching, you have the resource that can be used to describe the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing, but not to demonstrate the basic tasks and uses of word processors. Based on your responses, when teaching, you do not have the resource that can be used to describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.	Based on your responses, when teaching, you have the resource that can be used to demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing, but not to describe the basic tasks and uses of word processor.	Resource for demonstrating the basic tasks and uses of word processors can also be used to describe them.	To describe and demonstrate the basic tasks and uses of word processors, equipment and software such as a computer, tablet and word processing software must be present.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
3	Based on your responses, when teaching, you have the resource that can be used to describe and demonstrate the purpose and basic features of presentation software and other digital resources. Based on your responses, when teaching, you have the resource that can be used to describe the purpose and basic features of presentation software and other digital resources, but not the resource to demonstrate the basic features of presentation software and other digital resources. Based on your responses, when teaching, you do not have the resource that can be used to describe and demonstrate the purpose and basic features of presentation software and other digital resources.	Based on your responses, when teaching, you have the resource that can be used to demonstrate the purpose and basic features of presentation software and other digital resources, but not the resource to describe the basic features of presentation software and other digital resources.	Resource for demonstrating the purpose and basic features of presentation software and other digital resources can be used to describe the purpose and basic features of presentation software and other digital resources.	To describe and demonstrate the purpose and basic features of presentation software, equipment and software such as a computer, tablet and presentation software must be present.
4	Based on your responses, when teaching, you have the resource that can be used to describe and demonstrate the purpose and basic features of graphic software and use a graphic software package to create a simple graphic display. Based on your responses, when teaching, you have the resource that can be used to describe the purpose and basic function of graphic software, but not the resource to demonstrate how to use a graphic software package to create a simple graphic display. Based on your responses, when teaching, you	Based on your responses, when teaching, you have the resource to use a graphic software package to create a simple graphic display but not the resource to describe the purpose and basic function of graphic software.	The resource used to demonstrate and create a simple graphic display can be used to describe the purpose and basic features of graphic software.	To create a simple graphic display, there must be access to hardware such as a computer/laptop, tablet, and graphic display software.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	do not have the resource that can be used to describe and demonstrate the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.			
5	Based on your responses, when teaching, you have the resource that can be used in your teaching to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website. Based on your responses, when teaching, you have the resource that can be used to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not able to use a URL to access a website	Based on your responses, when teaching, you have the resource to use a URL to access a website in but not the resource to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not able to	To access a website means that there is resource available to describe the Internet and the World Wide Web and elaborate on their uses.	Not having access to an internet connected device (such a computer, tablet or smartphone) makes it impossible to use the internet.
6	Based on your responses, when teaching, you have the resource to be able to teach students how to use a search engine. Based on your responses, when teaching, you do not have the resource to use a search engine.			
7	Based on your responses, when teaching, you have the resource to create an email account and use it for a sustained series of email correspondence.			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	Based on your responses, when teaching, you do not have the resource to create an email account and use it for a sustained series of email correspondence.			
8	Based on your responses, when teaching, you have the resource to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects. Based on your responses, when teaching, you do not have the resource to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.			
9	Based on your responses, when teaching, you have the resource to locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students. Based on your responses, when teaching, you do not have the resource to locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.			
10	Based on your responses, when teaching, you have the resource to use networked record keeping software to take attendance, submit grades, and maintain student records.			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	Based on your responses, when teaching, you do not have the resource to use networked record keeping software to take attendance, submit grades, and maintain student records.			
11	Based on your responses, when teaching, you have the resource to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments. Based on your responses, when teaching, you do not have the resource to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.			
12	Based on your responses, when teaching, you have the resource to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references. Based on your responses, when teaching, you do not have the resource to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.			
13	Based on your responses, when teaching, you have the resource to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	Based on your responses, when teaching, you do not have the resource to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.			
14	Based on your responses, when teaching, you have the resource to use an authoring environment or tools to design online materials. Based on your responses, when teaching, you do not have the resource to use an authoring environment or tools to design online materials.			
15	Based on your responses, when teaching, you have the resource to use a network and appropriate software to manage, monitor, and assess progress of various student projects. Based on your responses, when teaching, you do not have the resource to use a network and appropriate software to manage, monitor, and assess progress of various student projects.			
16	Based on your responses, when teaching, you have the resource to use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning. Based on your responses, when teaching, you do not have the resource to use ICT to communicate and collaborate with students, peers, parents, and the larger community in			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	order to nurture student learning.			
17	Based on your responses, when teaching, you have the resource to use the network to support student collaboration within and beyond the classroom. Based on your responses, when teaching, you do not have the resource to use the network to support student collaboration within and beyond the classroom.			
18	Based on your responses, when teaching, you have the resource to use search engines, online databases, and email to find people and resources for collaborative projects. Based on your responses, when teaching, you do not have the resource to use search engines, online databases, and email to find people and resources for collaborative projects.			
19	Based on your responses, when teaching, you have the resource to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation. Based on your responses, when teaching, you have the resource to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools), but not able to use them to support students' innovation and knowledge	Based on your responses, when teaching, you have the resource to use ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) to support students' innovation and knowledge creation, but not able to describe the function and purpose of them.	The availability of the resource to use ICT production tools and resources to support students' innovation and knowledge creation means that it is possible to use these technologies to describe its purpose and function.	Production tools such as capable computers and software (e.g. Adobe Premier, Dreamweaver) are required to be able to attain this objective

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	creation. Based on your responses, when teaching, you do not have the resource to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.			
20	Based on your responses, when teaching, you have the resource to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities. Based on your responses, when teaching, you have the resource to describe the function and purpose of virtual environments and knowledge building environments (KBEs), but not able to use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities. Based on your responses, when teaching, you have the resource to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and	Based on your responses, when teaching, you have the resource to use knowledge building environments to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities, but not to describe them.	If there exists resource for use and support in knowledge building environments, those same technologies can serve the purpose of description	To use knowledge building environments, there must be the presence of internet connected devices, virtual meeting software and easy access to such systems.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	use them to support increased knowledge and understanding of subject matter, but not able to use them in the development of online and face-to-face learning communities. Based on your responses, when teaching, you do not have the resource to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.			
21	Based on your responses, when teaching, you have the resource to describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning. Based on your responses, when teaching, you have the resource to describe the function and purpose of planning and thinking tools, but not able to use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning. Based on your responses, when teaching, you do not have the resource to describe the function and purpose of planning and thinking tools and use them to support students'	Based on your responses, when teaching, you have the resource to use planning and thinking tools to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning, but not able to describe the function and purpose of planning and thinking tools.	If there exists planning and thinking tools to support students' creating and planning of their own learning activities, the same technologies could be used to describe them	Technologies such as networked resources, brainstorming software and ready access to these tools must exist in order to attain this objective.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	creation and planning of their own learning activities and their continuous reflective thinking and learning.			

Feedback Responses (Assess)

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
1	Based on your responses, you have the resource to assess your students' competency to describe and demonstrate the use of common hardware. Based on your responses, you have the resource to assess your students' competency to describe the use of common hardware, but not to demonstrate the use of common hardware. Based on your responses, you do not have the resource to assess your students' competency to describe and demonstrate the use of common hardware.	Based on your responses, you have the resource to assess your students' competency to demonstrate the use of common hardware but not to describe the use of common hardware in main lab.	Once the resource for demonstration is available, the same resource can be used to describe the common hardware	In order to describe and demonstrate the use of common hardware, there must be present common hardware such as a desktop computer, laptop computer, a smartphone, a tablet, and a printer
2	Based on your responses, you have the resource to assess your students' competency to describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing. Based on your responses, you have the resource to assess your students' competency to describe the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing, but not to demonstrate the basic tasks and uses of word processors. Based on your responses, you do not have the resource to assess your students' competency to describe and demonstrate the basic tasks and	Based on your responses, you have the resource to assess your students' competency to demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing, but not to describe the basic tasks and uses of word processor.	Resource for demonstrating the basic tasks and uses of word processors can also be used to describe them.	To describe and demonstrate the basic tasks and uses of word processors, equipment and software such as a computer, tablet and word processing software must be present.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	uses of word processors, such as text entry, editing text, formatting text, and printing.			
3	Based on your responses, you have the resource to assess your students' competency to describe and demonstrate the purpose and basic features of presentation software and other digital resources. Based on your responses, you have the resource to assess your students' competency to describe the purpose and basic features of presentation software and other digital resources, but not the resource to demonstrate the basic features of presentation software and other digital resources. Based on your responses, you do not have the resource to assess your students' competency to describe and demonstrate the purpose and basic features of presentation software and other digital resources.	Based on your responses, you have the resource to assess your students' competency to demonstrate the purpose and basic features of presentation software and other digital resources, but not the resource to describe the basic features of presentation software and other digital resources.	Resource for demonstrating the purpose and basic features of presentation software and other digital resources can be used to describe the purpose and basic features of presentation software and other digital resources.	To describe and demonstrate the purpose and basic features of presentation software, equipment and software such as a computer, tablet and presentation software must be present.
4	Based on your responses, you have the resource to assess your students' competency to describe and demonstrate the purpose and basic features of graphic software and use a graphic software package to create a simple graphic display. Based on your responses, you have the resource to assess your students' competency to describe the purpose and basic function of graphic software, but not the resource to	Based on your responses, you have the resource to assess your students' competency to use a graphic software package to create a simple graphic display but not the resource to describe the purpose and basic function of graphic software.	The resource used to demonstrate and create a simple graphic display can be used to describe the purpose and basic features of graphic software.	To create a simple graphic display, there must be access to hardware such as a computer/laptop, tablet, and graphic display software.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	demonstrate how to use a graphic software package to create a simple graphic display. Based on your responses, you do not have the resource to assess your students' competency to describe and demonstrate the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.			
5	Based on your responses, you have the resource to assess your students' competency to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website. Based on your responses, you do not have the resource to assess your students' competency to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not able to use a URL to access a website	Based on your responses, you have the resource to assess your students' competency to use a URL to access a website in but not the resource to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not able to	to access a website means that there is resource available to describe the Internet and the World Wide Web and elaborate on their uses.	Not having access to an internet connected device (such a computer, tablet or smartphone) makes it impossible to use the internet.
6	Based on your responses, you have the resource to assess your students' competency to teach students how to use a search engine. Based on your responses, you do not have the resource to assess your students' competency to use a search engine.			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
7	Based on your responses, you have the resource to assess your students' competency to create an email account and use it for a sustained series of email correspondence. Based on your responses, you do not have the resource to assess your students' competency to create an email account and use it for a sustained series of email correspondence.			
8	Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects. Based on your responses, you do not have the resource to assess your students' competency to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.			
9	Based on your responses, you have the resource to assess your students' competency to locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students. Based on your responses, you do not have the resource to assess your students' competency to locate off-the-shelf educational software packages and Web resources, evaluate them			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	for their accuracy and alignment with curriculum standards and match them to the needs of specific students.			
10	Based on your responses, you have the resource to assess your students' competency to use networked record keeping software to take attendance, submit grades, and maintain student records. Based on your responses, you do not have the resource to assess your students' competency to use networked record keeping software to take attendance, submit grades, and maintain student records.			
11	Based on your responses, you have the resource to assess your students' competency to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments. Based on your responses, you do not have the resource to assess your students' competency to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.			
12	Based on your responses, you have the resource to assess your students' competency to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	Based on your responses, you do not have the resource to assess your students' competency to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.			
13	Based on your responses, you have the resource to assess your students' competency to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area. Based on your responses, you do not have the resource to assess your students' competency to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.			
14	Based on your responses, you have the resource to assess your students' competency to use an authoring environment or tools to design online materials. Based on your responses, you do not have the resource to assess your students' competency to use an authoring environment or tools to design online materials.			
15	Based on your responses, you have the resource to assess your students' competency to use a network and appropriate software to manage, monitor, and assess progress of various student projects. Based on your responses, you do not have the resource to assess your students' competency			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	to use a network and appropriate software to manage, monitor, and assess progress of various student projects.			
16	Based on your responses, you have the resource to assess your students' competency to use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning. Based on your responses, you do not have the resource to assess your students' competency to use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.			
17	Based on your responses, you have the resource to assess your students' competency to use the network to support student collaboration within and beyond the classroom. Based on your responses, you do not have the resource to assess your students' competency to use the network to support student collaboration within and beyond the classroom.			
18	Based on your responses, you have the resource to assess your students' competency to use search engines, online databases, and email to find people and resources for collaborative projects. Based on your responses, you do not have the			

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	resource to assess your students' competency to use search engines, online databases, and email to find people and resources for collaborative projects.			
19	Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation. Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools), but not able to use them to support students' innovation and knowledge creation. Based on your responses, you do not have the resource to assess your students' competency to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.	Based on your responses, you have the resource to assess your students' competency to use ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) to support students' innovation and knowledge creation, but not able to describe the function and purpose of them.	The availability of the resource to use ICT production tools and resources to support students' innovation and knowledge creation means that it is possible to use these technologies to describe its purpose and function.	Production tools such as capable computers and software (e.g. Adobe Premier, Dreamweaver) are required to be able to attain this objective
20	Based on your responses, you have the resource to assess your students' competency	Based on your responses, you have the resource to	If there exists resource for use and support in	To use knowledge building environments,

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities. Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of virtual environments and knowledge building environments (KBEs), but not able to use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities. Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter, but not able to use them in the development of online and face-to-face learning communities. Based on your responses, you do not have the resource to assess your students' competency to describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online	assess your students' competency to use knowledge building environments to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities, but not to describe them.	knowledge building environments, those same technologies can serve the purpose of description	there must be the presence of internet connected devices, virtual meeting software and easy access to such systems.

Objective	Feedback Options	Feedback option(s) not considered	Assumption for non-consideration	Rationale for non-consideration
	and face-to-face learning communities.			
21	Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning. Based on your responses, you have the resource to assess your students' competency to describe the function and purpose of planning and thinking tools, but not able to use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning. Based on your responses, you do not have the resource to assess your students' competency to describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.	Based on your responses, you have the resource to assess your students' competency to use planning and thinking tools to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning, but not able to describe the function and purpose of planning and thinking tools.	If there exists planning and thinking tools to support students' creating and planning of their own learning activities, the same technologies could be used to describe them	Technologies such as networked resources, brainstorming software and ready access to these tools must exist in order to attain this objective.

Appendix I – Center Readiness Survey Questions

Questionnaire for Assessing Center Readiness to <u>Teach and Assess</u> ICT Objectives of the UNESCO ICT-CFT

The United Nations Educational, Scientific and Cultural Organization (UNESCO) published an ICT-Competency Framework for Teachers (ICT-CFT) in 2011. The goal of the ICT-CFT is to provide a blueprint by which governments around the world could tailor their teacher education programs to produce a '21st century workforce' that could incorporate ICT effectively in their teaching. This tool is aimed at collecting data that will be used, in part, to determine the readiness of computer centers and labs (at teacher training colleges in Ghana) to train teachers who have the knowledge and skills that meet the ICT section of the UNESCO stated objectives. The researcher intends to use the data collected to complete a PhD dissertation.

The survey is in three parts: Part I solicits general ICT (and other ICT dependent) infrastructure/resources available at your College. Part II is designed to collect data on the ICT resources available for teaching pre-service teachers' ICT competency. Part III of this survey collects data on ICT resources available for assessing pre-service teachers' ICT competency. Time estimated for completion of this survey is approximately 1 hour and 30 Minutes.

For each question, please select as many options as are applicable to you currently. Also, supply responses for blank answer-type questions. Please be as candid as possible. If you have other equipment that is not stated, select 'other' and provide the name for any such resource.

Thank you for your participation.

Part I

General Infrastructure available at College

Name of College:

Question 1

How many computer labs does your College have?

…

Question 2

How many computers (in working condition) are in the lab?
(Or depending on if more labs are selected)
How many computers (in working condition) are in the labs?

Lab No.	Computers
Main Lab	
Lab 2	
Lab 3	

Question 3

On average, how old are the computers in the lab?
(Or depending on if more labs are selected)
On average, how old are the computers in the labs?

Lab No.	Main Lab	Lab 2	Lab 3
0 – 2 Years			
3 – 4 Years			
Over 5 Years			

Question 4

On average, how many hours of electricity supply does your computer lab have in a typical school day?
(Or depending on if more labs are selected)
On average, how many hours of electricity supply do your computer labs have in a typical school day?

Lab No.	Hours

Main Lab	
Lab 2	
Lab 3	

Question 5

Do you experience power fluctuations at your computer lab?
(Or depending on if more labs are selected)
Do you experience power fluctuations at your computer labs?

Lab No.	Power Fluctuation
Main Lab	Yes/No
Lab 2	Yes/No
Lab 3	Yes/No

Question 5B

What times do such fluctuations occur mostly?

Lab No.	Power Fluctuation
Main Lab	7AM - Noon/Noon-5PM/5PM-10PM
Lab 2	7AM - Noon/Noon-5PM/5PM-10PM
Lab 3	7AM - Noon/Noon-5PM/5PM-10PM

Question 6

Do you have a standby generator for your lab?
(Or depending on if more labs are selected)
Do you have standby generators for your computer labs?

Lab No.	Standby Generator
Main Lab	Yes/No
Lab 2	Yes/No
Lab 3	Yes/No

Question 7

Is your College connected to the internet?

    a)   Yes
    b)   No

Question 7B
What type of internet connection does your College have?

    a)   Satellite
    b)   Fiber Optic
    c)   Cable/DSL
    d)   Mi-Fi (provided by cellular phone companies)
    e)   Dial up

Question 7C

How does your lab connect to the College's internet?
(Or depending on if more labs are selected)
How do your labs connect to the College's internet?

Lab No.	Internet Connection
Main Lab	Wi-Fi (wireless)/Ethernet (wired)/Both
Lab 2	Wi-Fi (wireless)/Ethernet (wired)/Both
Lab 3	Wi-Fi (wireless)/Ethernet (wired)/Both

Question 8

What is the current student population at the College?

Year	Number of Students
Year 1	
Year 2	
Year 3	

Question 9

What courses require the use of a computer lab?

… (the respondent will list courses, so allow for a fill in)

Question 10

Are students allowed to bring their own computers into to the lab?
(Or depending on if more labs are selected)
Are students allowed to bring their own computers into the labs?
    a)   Yes
    b)   No

Question 10B

On average, what percentage of students would you estimate use their own computers in the lab?
(Or depending on if more labs are selected)
On average, what percentage of students would you estimate use their own computers in the labs?

Year	Percentage of Students
Year 1	
Year 2	
Year 3	

Question 11

From the list below, please select all the resources that you have at your computer lab.

Hardware Resource	Main Lab	Lab 2	Lab 3
Desktop Computer			
Laptop Computer			
Tablet			
Smartphone			
Cellphone			
Printer			
Scanner			
Interactive Board			
Projector			
Digital Camera			
Teleconference Equipment			
Large-Scale Printers			
Duplicating Machines			
Optical R/W Drives (e.g. DVD, CD, etc.)			
Other			
Software Resource			
Word Processing Software (e.g. MS Word, Pages, OpenOffice)			
Presentation Software (e.g. PowerPoint, Keynote)			
Spreadsheet Software (e.g. Excel)			
Graphics Software (e.g. Illustrator, Photoshop)			
Database Software			
Drawing Software			
Authoring Software (Camtasia, etc.)			
Drill and Practice Software (e.g. Typing Tutorial)			
Internet Browser			
Off-the-Shelf educational software			

Collaborative tools (e.g. Google Docs)			
Multimedia Production Software (e.g. Adobe Premier, Photoshop, etc.)			
Virtual Meeting Software (e.g. Skype)			
Brainstorming Software (e.g. Inspiration, Bubbl, etc.)			
Web Production Software (e.g. Adobe Dreamweaver)			
Other			
Infrastructure Resource			
Internet Access			
Learning Management System (e.g. Moodle)			
Local Network			
Website Hosting Services (e.g. Google, teacher page, etc.)			
Other			

Part II: Center Readiness to <u>Teach</u> UNESCO ICT-CFT Standards

Note: Answers to the following questions should be based on resources available in your main (best equipped) lab.

Question 1

To **describe** common ICT hardware, which of the following equipment would you use to teach students? Select all that apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

Question 2

To **demonstrate** basic tasks and uses of common ICT hardware, which of the following would you use to teach students? Select all that apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

Question 3

Which of the following would you use if you were to teach students to describe the basic tasks of word processors such as text entry, text editing, text formatting and text print? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Word Processing Software (MS Word, Pages, OpenOffice, etc.) ☐	
b) Laptop Computer	☐		
c) Smartphone	☐		
d) Tablet	☐		
e) Printer	☐		
f) Scanner			

Question 4

If you were to **demonstrate** to your students, the basic tasks of word processors (text entry, editing text, formatting text and printing) which of the following equipment/software, would you use?

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Word Processing Software (Word, Pages, OpenOffice, etc.) ☐	
b) Laptop Computer	☐		
c) Smartphone	☐		
d) Tablet	☐		
e) Printer	☐		
f) Other			

Question 5

Which of the following would you use to **describe** the purpose and basic features of presentation software and other digital resources to your students? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Presentation Software (PowerPoint, Keynote, etc.) ☐	
b) Laptop Computer	☐	b) Other	
c) Smartphone	☐		
d) Tablet	☐		
e) Digital Camera	☐		

Question 6

In order to **demonstrate** the features of presentation software and other digital resources, which of the following hardware/software would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Presentation Software (PowerPoint, Keynote, etc.) ☐	
b) Laptop Computer	☐	b) Other	
c) Smartphone	☐		
d) Tablet	☐		
e) Digital Camera	☐		
f) Other			

UNESCO Objective 4: Describe the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display. Select all that apply.

Question 7

If you were to **describe** the purpose and basic function of graphic software to your students, which of the following hardware and software would you use? Select all that apply.

Hardware		Software		Infrastructure
a) Desktop Computer	☐	a) Graphics Software (Illustrator, Photoshop, Draw, etc.)	☐	
b) Laptop Computer	☐	b) Other		
c) Smartphone	☐			
d) Tablet	☐			
e) Projector	☐			
f) Other				

Question 8

In order to teach your students how to **use** graphic software to create simple graphic displays, which of the following would you use? Select all that apply.

Hardware		Software		Infrastructure
a) Desktop Computer	☐	a) Graphics Software (Illustrator, Photoshop, Draw, etc.)	☐	
b) Laptop Computer	☐	b) Other		
c) Smartphone	☐			
d) Tablet	☐			
e) Projector	☐			
f) Other				

Question 9

In **describing** the Internet and the World Wide Web, their uses and how a browser works to your students, indicate which of the following you would use: Select all that apply.

Hardware		Software		Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	☐	a) Internet Access	☐
b) Laptop Computer	☐			b) Other	
c) Smartphone	☐				
d) Tablet	☐				

e) Projector ☐	
f) Other	

Question 10

If you were to teach your students to **use** URL to access websites, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Internet Browser	a) Internet Access ☐
b) Laptop Computer ☐		b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Projector ☐		
f) Other		

Question 11

Which of the following will you use, if you were to teach your students how to use a search engine? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Internet Browser ☐	a) Internet Access ☐
b) Laptop Computer ☐		b) Other ☐
c) Smartphone ☐		
d) Tablet ☐		
e) Projector ☐		
f) Other ☐		

Question 12

In order to teach your students to **create** and use email accounts, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Internet Browser	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Projector ☐		
f) Other		

Question 13

In the event that you were to **describe** to your students the functions and purpose of tutorial and drill and practice software, and how it supports acquisition of knowledge of school subjects, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Drill and Practice Software	
b) Laptop Computer	☐	b) Other	
c) Smartphone	☐		
d) Tablet	☐		
f) Other			

Question 14

To teach students how to **locate** off-the-shelf educational software packages and other web resources what resources will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Off-the-shelf educational Software	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Question 15

To teach students how to **evaluate** off-the-shelf educational software packages and other web resources for accuracy and alignment with curriculum standards what resources will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Off-the-shelf educational Software	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Question 16

To teach students how to **match** off-the-shelf educational software packages and other web resources to the needs of specific students, what resources will you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Off-the-shelf educational Software	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Other		

Question 17

Which of the following would you use for the purposes of teaching your students to use networked record keeping software to take attendance, submit grades and maintain students' records? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐		a) Internet Access ☐
b) Laptop Computer ☐		b) Local Network
c) Smartphone ☐		a) Learning Management System
d) Tablet ☐		
e) Other		

Question 18

Supposing you were to teach students to **use** common communication and collaboration technologies (e.g. text messaging, video conferencing and social media), which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Collaborative Tools (e.g. Google Docs)	a) Internet Access ☐
b) Laptop Computer ☐	b)Virtual Meeting Software (e.g. Skype)	b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Teleconference Equipment		
f) Other		

Question 19
To teach students to **operate** various open-ended software packages appropriate to subject matter areas, what hardware and software would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Spreadsheet Software (e.g. Excel)	a) Internet Access ☐
b) Laptop Computer	☐	b) Word Processing Software (e.g. M.S Word)	b) Other
c) Smartphone	☐	c) Database Software	
d) Tablet	☐	d) Drawing Software	
e) Teleconference Equipment		e) Presentation Software	
f) Other		f) Other	

Question 20

In order to teach students to **evaluate** the accuracy and usefulness of web resources in support of project-based learning in subject areas, what resources would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Other	a) Internet Access ☐
b) Laptop Computer	☐		b) Other
c) Smartphone	☐		
d) Tablet	☐		
e) Other			

Question 21

Which of the following would you use to teach students to **use** an authoring environment/tool to design online materials? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Authoring Software (e.g. Camtasia)	a) Internet Access ☐
b) Laptop Computer	☐	b) Other	b) Web Hosting Service (e.g. Google, teacher page.)
c) Tablet	☐		c) Other
d) Other			

Question 22

To teach students to **use** online resources to manage, monitor and assess students' project progress, which if the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Learning Management System
c) Smartphone ☐		
d) Tablet ☐		
e) Other		

Question 23

For the purposes of teaching students to **use** ICT to communicate and collaborate with peers, parents and the community, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Learning Management System
c) Smartphone ☐		c) Local Network
d) Tablet ☐		
e) Other		

Question 24

To teach students to use the network to support collaboration within and beyond the classroom, what resources would you use?

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Learning Management System (e.g. Moodle)
c) Smartphone ☐		c) Local Network
d) Tablet ☐		d) Other
e) Other		

Question 25

For the purpose of teaching students to **use** search engines, online databases and email to find people and resources for collaborative projects, which of the following will you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Collaborative Tools (e.g. Google Docs)	a) Internet Access ☐
b) Laptop Computer	☐	b) Other	b) Learning Management System (e.g. Moodle)
c) Smartphone	☐		c) Local Network
d) Tablet	☐		d) Other
e) Other			

Question 26

To teach students to be able to **describe** the function and purpose of ICT production tools and resources, which of the following tools and resources would you use? Select all that apply.

Main Lab

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Multimedia Production Software (e.g. Adobe Premier, Photoshop, etc.)	a) Other	☐
b) Laptop Computer	☐	b) Graphics Software (e.g. Illustrator		
c) Large-Scale Printers	☐	c) Web Production Software (e.g. Adobe Dreamweaver)		
d) Optical R/W Drives	☐	d) Other		
e) Duplicating Machines				
f) Other				

Question 27

To teach students to use ICT Production tools and resources to **innovate** and create knowledge, what resources would you use? Select all that apply.

Hardware	Software	Infrastructure

a) Desktop Computer ☐	a) Multimedia Production Software (e.g. Adobe Premier, Photoshop, etc.)	a) Other ☐
b) Laptop Computer ☐	b) Graphics Software, e.g. Illustrator)	
c) Large-Scale Printers ☐	c) Web Design Software (e.g. Adobe Dreamweaver)	
d) Optical R/W Drives ☐	d) Other	
e) Duplicating Machines		
f) Other		

Note: Knowledge Building Environments are defined as settings in which knowledge and ideas are collaboratively created, and such knowledge and ideas are likely to achieve more than the sum of what all individuals could have accomplished on their own (Scardamalia & Bereiter, 2003).

Question 28

To teach students to **describe** the function and purpose of virtual environments and knowledge building environments, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Learning Management System (e.g. Moodle, Blackboard, etc.)
c) Smartphone ☐		c) Other
d) Tablet ☐		
e) Projector		
f) Other		

Question 29

To teach students to **use** virtual environments and knowledge building environments to support increased knowledge, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access ☐
b) Laptop Computer ☐	b) Collaborative tools (e.g.	b) Learning

	Google Docs)	Management System (e.g. Moodle)
c) Smartphone ☐		c) Other
d) Tablet ☐		
e) Projector		
f) Other		

Question 30

What resources will you use to teach students to **use** virtual environments and knowledge building environments in the development of learning communities (online and face-to-face)? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Learning Management System (e.g. Moodle, Blackboard, etc.)
c) Smartphone ☐		c) Other
d) Tablet ☐		
e) Projector		
f) Other		

Question 31

To **describe** the function and purpose of planning and thinking tools to your students, which of the following tools would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Brainstorming Software (Inspiration, Bubbl, XMind, etc.)	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Other		

Question 32

Which of the following will you use to teach students to create and plan their own learning activities? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Brainstorming Software (Inspiration, Bubbl, XMind, etc.)	a) Internet Access ☐
b) Laptop Computer	☐	b) Other	b) Other
c) Smartphone	☐		
d) Tablet	☐		
e) Other			

Part III
Center Readiness to Assess UNESCO ICT-CFT Standards

Question 1

Which of the following would you use to assess students' competency to **describe** common ICT hardware? Select all that Apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

Question 2

Which of the following would you have to assess students' competency to **demonstrate** basic tasks and uses of common ICT hardware? Select all that apply.

a) Desktop Computer	☐	d) Tablet	☐	g) Interactive Board	☐
b) Laptop Computer	☐	e) Printer	☐	h) Projector	☐
c) Smartphone	☐	f) Scanner	☐	i) Other (Please Specify)	☐

Question 3

Which of the following would you use you if you were to assess students' competency to describe the basic tasks of word processors such as text entry, text editing, text formatting and text printing? Select all that apply.

Hardware		Software		Infrastructure
a) Desktop Computer	☐	d) Word Processing Software (Word, Pages, OpenOffice, etc.) ☐		
b) Laptop Computer	☐	e) Printer	☐	
c) Smartphone	☐	f) Scanner	☐	
d) Tablet	☐			
e) Printer	☐			

Question 4

If you were to assess your students' competency to **demonstrate** the basic tasks of word processors (text entry, editing text, formatting text and printing) which of the following equipment/software, would you use? Select all that apply.

Hardware	Software	Infrastructure

a) Desktop Computer ☐	a) Word Processing Software (Word, Pages, OpenOffice, etc.) ☐	
b) Laptop Computer ☐		
c) Smartphone ☐		
d) Tablet ☐		
e) Printer ☐		
f) Other		

Question 5

To assess your students' competency to **describe** the purpose and basic features of presentation software, which of the following will you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Presentation Software (PowerPoint, Keynote, etc.) ☐	
b) Laptop Computer ☐	b) Other	
c) Smartphone ☐		
d) Tablet ☐		
e) Digital Camera ☐		
f) Other		

Question 6

Which of the following will you use in assessing your students' competency to **demonstrate** the features of presentation software and other digital resources? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Presentation Software (PowerPoint, Keynote, etc.) ☐	
b) Laptop Computer ☐	b) Other	
c) Smartphone ☐		
d) Tablet ☐		
e) Digital Camera ☐		
f) Other		

Question 7

If you were to assess your students' competency to **describe** the purpose and basic function of graphic software, which of the following hardware and software would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Graphics Software (Illustrator, Photoshop, Draw, etc.) ☐	
b) Laptop Computer	☐	b) Other	
c) Smartphone	☐		
d) Tablet	☐		
e) Projector	☐		
f) Other			

Question 8

In order to assess your students' competency on how to **use** graphic software to create simple graphic displays, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Graphics Software (Illustrator, Photoshop, Draw, etc.) ☐	
b) Laptop Computer	☐	b) Other	
c) Smartphone	☐		
d) Tablet	☐		
e) Projector	☐		
f) Other			

Question 9

In assessing your students' competency to **describe** the Internet and the World Wide Web, their uses and how a browser works, select which of the following you would use: Select all that apply

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Internet Browser	a) Internet Access ☐
b) Laptop Computer	☐		Other
c) Smartphone	☐		
d) Tablet	☐		
e) Projector	☐		
f) Other			

Question 10

If you were to assess your students' competency to **use** URL to access websites, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	a) Internet Access	☐
b) Laptop Computer	☐		b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Projector	☐			
f) Other				

Question 11

If you were to assess your students' competency on how to use a search engine, which of the following will you have to use?

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	a) Internet Access	☐
b) Laptop Computer	☐		b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Projector	☐			
f) Other				

Question 12

In order to assess your students' competency to **create** and use email accounts, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Internet Browser	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Projector	☐			
f) Other				

Question 13

If you were to assess your students' competency to **describe** the functions and purpose of tutorial and drill and practice software, and how it supports acquisition of knowledge of school subjects, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Drill and Practice Software	a) Electricity	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
f) Other				

Question 14

To assess students' competency on how to **locate** off-the-shelf educational software packages and other web resources what resources will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Off-the-shelf educational Software	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Question 15

To assess students' competency on how to **evaluate** off-the-shelf educational software packages and other web resources for accuracy and alignment with curriculum standards what resources will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Off-the-shelf educational Software	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Question 16

To assess students' competency on how to **match** off-the-shelf educational software packages and other web to the needs of specific students, what resources will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Off-the-shelf educational Software	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	

c) Smartphone ☐		
d) Tablet ☐		
e) Other		

Question 17

Which of the following will you use for the purposes of assessing your students' competency to use networked record keeping software to take attendance, submit grades and maintain students' records? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Learning Management System	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Local Network
c) Smartphone ☐		c) Other
d) Tablet ☐		
e) Other		

Question 18

Supposing you were to assess your students' competency to **use** common communication and collaboration technologies (e.g. text messaging, video conferencing and social media), which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Teleconference Equipment		
f) Other		

Question 19

To assess students' competency to **operate** various open-ended software packages appropriate to subject matter areas, what hardware and software would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Spreadsheet	a) Internet Access ☐
b) Laptop Computer ☐	b) Word Processor	b) Other
c) Smartphone ☐	c) Database Software	
d) Tablet ☐	d) Drawing Software	
e) Teleconference	e) Presentation Software	

Equipment		
f) Other	f) Other	

Question 20

In order to assess students' competency to **evaluate** the accuracy and usefulness of web resources in support of project-based learning in subject areas, what resources would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Other
c) Smartphone ☐		
d) Tablet ☐		
e) Other		

Question 21

Which of the following would you use to assess students' competency to **use** an authoring environment/tool to design online materials? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Authoring Software (e.g. W2L, Xical, CourseLab, Camtasia	a) Internet Access ☐
b) Laptop Computer ☐	b) Other	b) Web Hosting Service (teacher page, google, etc.)
c) Tablet ☐		c) Other
c) Other		

Question 22

To assess students' competency to **use** online resources to manage, monitor and assess students' project progress, which of the following would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Other	a) Internet Access ☐
b) Laptop Computer ☐		b) Learning Management System
c) Smartphone ☐		
d) Tablet ☐		

f) Other		

Question 23

For the purpose of assessing students' competency to **use** ICT to communicate and collaborate with peers, parents and the community, which of the following would you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Other	a) Internet Access	☐
b) Laptop Computer	☐		b) Learning Management System	
c) Smartphone	☐		c) Local Network	
d) Tablet	☐			
e) Other				

Question 24

To assess students' competency to use the network to support collaboration within and beyond the classroom, what resources would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Other	a) Internet Access ☐
b) Laptop Computer	☐		b) Learning Management System (e.g. Moodle, Blackboard, etc.)
c) Smartphone	☐		c) Local Network
d) Tablet	☐		d) Other
e) Other			

Question 25

For the purpose of assessing students' competency to **use** search engines, online databases and email to find people and resources for collaborative projects, which of the following resources would you use? Select all that apply.

Hardware		Software	Infrastructure
a) Desktop Computer	☐	a) Collaborative Tools (e.g. Google Docs)	a) Internet Access ☐
b) Laptop Computer	☐	b) Other	b) Learning Management System (e.g. Moodle,

		Blackboard, etc.)
c) Smartphone ☐		c) Local Network
d) Tablet ☐		d) Other
e) Other		

Question 26

To assess students' competency to be able to **describe** the function and purpose of ICT production tools and resources, which of the following tools and resources would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Multimedia Production Software (e.g. Adobe Premier, Photoshop, etc.)	a) Other ☐
b) Laptop Computer ☐	b) Publication Software (e.g. Microsoft Publisher, Adobe In Design, etc.)	
c) Large-Scale Printers ☐	c) Web Design Software (e.g. Adobe Dreamweaver)	
d) Optical R/W Drives ☐	d) Other	
e) Duplicating Machines		
f) Other		

Question 27

To assess students' competency to use ICT Production tools and resources to **innovate** and create knowledge, what resources would you use? Select all that apply.

Hardware	Software	Infrastructure
a) Desktop Computer ☐	a) Multimedia Production Software (e.g. Adobe Premier, Photoshop, etc.)	a) Other ☐
b) Laptop Computer ☐	b) Publication Software (e.g. Microsoft Publisher, Adobe In Design, etc.)	
c) Large-Scale Printers ☐	c) Web Design Software (e.g. Adobe Dreamweaver)	
d) Optical R/W Drives ☐	d) Other	
e) Duplicating Machines		
f) Other		

Question 28

To assess students' competency to **describe** the function and purpose of virtual environments and knowledge building environments, which of the following will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Learning Management System (e.g. Moodle, Blackboard, etc.)	
c) Smartphone	☐		c) Other	
d) Tablet	☐			
e) Projector				
f) Other				

Question 29

To assess students' competency to **use** virtual environments and knowledge building environments to support increased knowledge, which of the following will you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Learning Management System (e.g. Moodle, Blackboard, etc.)	
c) Smartphone	☐		c) Other	
d) Tablet	☐			
e) Projector				
f) Other				

Question 30

What will you use to assess students' competency to **use** virtual environments and knowledge building environments in the development of learning communities (online and face-to-face)? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Virtual Meeting Software (e.g. Skype)	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Learning Management System (e.g. Moodle, Blackboard, etc.)	

c) Smartphone	☐		c) Other
d) Tablet	☐		
e) Projector			
f) Other			

Question 31

To assess students' competency to **describe** the function and purpose of planning and thinking tools, which of the following tools would you use? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Brainstorming Software (Inspiration, Bubbl, XMind, etc.)	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Question 32

Which of the following will you use to assess students' competency to create and plan their own learning activities? Select all that apply.

Hardware		Software	Infrastructure	
a) Desktop Computer	☐	a) Brainstorming Software (Inspiration, Bubbl, XMind, etc.)	a) Internet Access	☐
b) Laptop Computer	☐	b) Other	b) Other	
c) Smartphone	☐			
d) Tablet	☐			
e) Other				

Reference:

Scardamalia, M., & Bereiter, C. (2003), Knowledge building, in Guthrie, J. W., Encyclopedia of Education, Macmillan Reference, New York K, pp. 1370–1373

Appendix J – Sample Feedback Page

DIAGNOSIS RESULTS

Objective 1 : Describe and demonstrate the use of common hardware.

Teach students:

Assess students' competency:

Result: Based on your responses, when teaching, you have the technology that can be used to describe and demonstrate the use of common hardware.

Result: Based on your responses, you have the technology to assess your students' competency to describe and demonstrate the use of common hardware.

Objective 2 : Describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.

Teach students:

Assess students' competency:

Result: Based on your responses, when teaching, you have the technology that can be used to describe and demonstrate the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing.

Result: Based on your responses, you have the technology to assess your students' competency to describe the basic tasks and uses of word processors, such as text entry, editing text, formatting text, and printing, but not to demonstrate the basic tasks and uses of word processors.

Objective 3 : Describe and demonstrate the purpose and basic features of presentation software and other digital resources.

Teach students:

Assess students' competency:

Result: Based on your responses, when teaching, you have the technology that can be used to describe and demonstrate the purpose and basic features of presentation software and other digital resources.

Result: Based on your responses, you have the technology to assess your students' competency to describe and demonstrate the purpose and basic features of presentation software and other digital resources.

Objective 4 : Describe the purpose and basic function of graphic software and use a graphic software package to create a simple graphic display.

Teach students:

Assess students' competency:

Result: Based on your responses, when teaching, you have the technology that can be used to describe and demonstrate the purpose and basic features of graphic software and use a graphic software package to create a simple graphic display.

Result: Based on your responses, you have the technology to assess your students' competency to describe and demonstrate the purpose and basic features of graphic software and use a graphic software package to create a simple graphic display.

Objective 5 : Describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works and use a URL to access a website.

Teach students:

Assess students' competency:

Result: Based on your responses, when teaching, you have the technology that can be used to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not able to use a URL to access a website

Result: Based on your responses, you have the technology to assess your students' competency to describe the Internet and the World Wide Web, elaborate on their uses, and describe how a browser works, but not to use a URL to access a website.

Objective 6 : Use a search engine.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use a search engine.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use a search engine.

Objective 7 : Create an email account and use it for a sustained series of email correspondence.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to create an email account and use it for a sustained series of email correspondence.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to create an email account and use it for a sustained series of email correspondence.

Objective 8 : Describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.

Teach students:

Result: Based on your responses, when teaching, you have the technology to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to describe the function and purpose of tutorial and drill and practice software and how it supports students' acquisition of knowledge of school subjects.

Objective 9 : Locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.

Teach students:

Result: Based on your responses, when teaching, you have the technology to locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to locate off-the-shelf educational software packages and Web resources, evaluate them for their accuracy and alignment with curriculum standards and match them to the needs of specific students.

Objective 10 : Use networked record keeping software to take attendance, submit grades, and maintain student records.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use networked record keeping software to take attendance, submit grades, and maintain student records.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to use networked record keeping software to take attendance, submit grades, and maintain student records.

Objective 11 : Use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.

Teach students:

Result: Based on your responses, when teaching, you have the technology to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to use common communication and collaboration technologies, such as text messaging, video conferencing, and web-based collaboration and social environments.

Objective 12 : Operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play, simulations, and online references.

Teach students:

Result: Based on your responses, when teaching, you have the technology to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to operate various open-ended software packages appropriate to their subject matter area, such as visualization, data analysis, role-play simulations, and online references.

Objective 13 : Evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to evaluate the accuracy and usefulness of Web resources in support of project-based learning in a subject area.

Objective 14 : Use an authoring environment or tools to design online materials.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use an authoring environment or tools to design online materials.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use an authoring environment or tools to design online materials.

Objective 15 : Use a network and appropriate software to manage, monitor, and assess progress of various student projects.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use a network and appropriate software to manage, monitor, and assess progress of various student projects.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use a network and appropriate software to manage, monitor, and assess progress of various student projects.

Objective 16 : Use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use ICT to communicate and collaborate with students, peers, parents, and the larger community in order to nurture student learning.

Objective 17 : Use the network to support student collaboration within and beyond the classroom.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use the network to support student collaboration within and beyond the classroom.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use the network to support student collaboration within and beyond the classroom.

Objective 18 : Use search engines, online databases, and email to find people and resources for collaborative projects.

Teach students:

Result: Based on your responses, when teaching, you do not have the technology to use search engines, online databases, and email to find people and resources for collaborative projects.

Assess students' competency:

Result: Based on your responses, you do not have the technology to assess your students' competency to use search engines, online databases, and email to find people and resources for collaborative projects.

Objective 19 : Describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools) and use them to support students' innovation and knowledge creation.

Teach students:

Result: Based on your responses, when teaching, you have the technology to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools), but not able to use them to support students' innovation and knowledge creation.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to describe the function and purpose of ICT production tools and resources (multimedia recording and production equipment, editing tools, publication software, web design tools), but not able to use them to support students' innovation and knowledge creation.

Objective 20 : Describe the function and purpose of virtual environments and knowledge building environments (KBEs) and use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.

Teach students:

Result: Based on your responses, when teaching, you have the technology to describe the function and purpose of virtual environments

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to describe the function and purpose of virtual

and knowledge building environments (KBEs), but not able to use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.

environments and knowledge building environments (KBEs), but not able to use them to support increased knowledge and understanding of subject matter and the development of online and face-to-face learning communities.

Objective 21 : Describe the function and purpose of planning and thinking tools and use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.

Teach students:

Result: Based on your responses, when teaching, you have the technology to describe the function and purpose of planning and thinking tools, but not able to use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.

Assess students' competency:

Result: Based on your responses, you have the technology to assess your students' competency to describe the function and purpose of planning and thinking tools, but not able to use them to support students' creation and planning of their own learning activities and their continuous reflective thinking and learning.

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