Sudan University of Science and Technology
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Sudanese Secondary School Teachers' Readiness Towards E-learning

إستعداد معلمي المدارس الثانوية السودانية للتعلُّم الإلكتروني

A thesis submitted by:

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(إنّ الله وملائكته يصلُّون علي
النَبي يأيها الّذين
ءامنوا صلُوا علية وسلّموا تسليما)

صدق الله العظيم

سورة الاحزاب*

DEDICATION:

I dedicate this thesis to my family

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ABSTRACT

The aim of this study is to investigate Sudanese secondary school teachers' e-learning readiness.

The main research question deriving this study is:

What are the various factors contributing to e-learning readiness in schools that make some Sudanese secondary teachers show an early involvement in e-learning innovations while others show later response or resistance to this new technology?

In this study, both quantitative and qualitative methods were used to collect data from the selected participants. These methods assisted in building a base on a complete understanding of the research problem; in this study the qualitative method was used for triangulation of the data. The research used questionnaires; interviews, classroom observations as principal methods of data collection. The sample of this study was 130 teachers from various Sudanese secondary school in Khartoum state as well as 13 principals.

The following are some of the effective results revealed from this study, which can help in successful implementing of e-learning in education system if it can be put into Sudanese decision maker's consideration.

There were many problems existing in the Sudanese secondary schools significantly deterred the teachers' readiness to ICT. Some of these problems include:

1. Absence of strategic implementation in computer training in secondary schools.
2. Lack of adequate information on ICT and its effective role in increasing secondary school teacher's efficiency.
3. Misuse and mismanagement of computers in secondary schools.
4. Lack of teachers trained on how to integrate e-learning into their teaching curriculum.

5. Presence of large numbers of pupils in classrooms, lack of equipments, suitable and relevant infrastructures, specialized and effective educational programs, and high cost of computer hardwares and their related maintenance.

ملخص الدراسة

هدفت هذه الدراسة الي التحقق من مدي استعداد المعلميين بالمدارس الثانوية السودانية للتعلُم الالكتروني.

تنحدرهذه الدراسة من السؤال الرئيسي التالي:

ماهي العناصر المتنوعة التي تساهم في جاهزية المدارس للتعلُم الالكتروني التي قادت بعض المعلميين بالمدارس الثانوية السودانية للمبادره في تطبيق التعلُم الالكتروني بينما ابدا الاخرون الاستجابة المتاخره أو المعارضة لة؟

أستخدم الباحث كُل من المنهج الكمي والنوعي لجمع البيانات من عينة الدراسة, وذلك من أجل تكوين فهم متكامل لمشكلة البحث .وكان الهدف من المنهج النوعي علي وجة الخصوص هو التحقق من مدي صدق وثبات وتكامل المعلومات المتحصلة من عينة الدراسة. أستخدم الباحث كل من الادوات التالية : الاستبانة , الملاحظة والمقابلة لجمع البيانات من عينة الدراسة. تتكون عينة هذه الدراسة من 130 معلما ومعلمة من المدارس الثانوية بالسودان من ولاية الخرطوم بالاضافة الي 13 مديرا من مديري المدارس الثانوية.

خلصت هذه الدراسة الي نتائج فاعلة ومهمة تسهم في نجاح تطبيق التعلُم الالكتروني في جميع المؤسسات التعليمية بالسودان, اذا وضعت في عين الاعتبار من قبل الجهات الرسمية في البلاد .نذكر منها علي سبيل المثال لا الحصر الاتي:

توجد كثير من المعوقات في المدارس الثانوية السودانية توثر بصوره فاعلة في عدم استعداد الاساتذه للتعلُم الالكتروني من بينها الاتي :

1. عدم وجود استراتيجية واضحة للتطبيق التعلُم الالكتروني في البلاد.
2. عدم توفر معلومات وافية عن الدورالفاعل الذي تقوم بة تكنولوجيا الاتصال والمعلومات في العملية التعليمية.
3. سوء التخطيط والاداره لاستخدام للحواسيب في بعض المدارس الثانوية بالسودان.

4. عدم تدريب المعلمين نحو تكامل تكنولوجيا الاتصال والمعلومات في العملية التعليمية خاصة
5. ازيداد اعداد الطلاب في الفصول الدراسية وعدم تهيئة الفصول لمقابلة هذا العدد الهائل من جانب الاجهزة والادوات التكنولوجية وذلك بسبب ارتفاع اسعارها وتكلفة صيانتها .
6. عدم توفير ربط شبكي واسع للاستفاده منه في تطبيق التقانة الحديثة في العملية التعليمية.

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Chapter one

Introduction

The aim of this study was to determine which factors contributed to e-learning readiness in Sudanese secondary schools and to establish why some teachers were early adopters in e-learning innovation relative to others. To accomplish this aim, participants from various Sudanese secondary school teachers as well as principals in Khartoum were selected. Data were then collected through interviews, observations and questionnaires using various methods.

Background

Sudan is the largest country in Africa covering an area of 2,505,000 km^2 (or 8.3%), 60% of Africa's irrigated lands and 9^{th} largest country in the World (or 1.7%), (World Bank, 2003). Sudan is bordered by nine countries. Sudan is not only geographically and religiously diverse, but also is a multicultural, multiethnic, and multilingual country with 134 listed languages. Sudan has experienced civil war between the South and North, a conflict which not only reduced the economic growth and therefore the pace of development and capacity building in the country, but also crippled the education system in the country. As a result, funds, facilities, ICT equipment and well trained teachers in e-learning were also affected.

In Sudan, education is compulsory and lasts for eleven years. These eleven years period is divided into eight (8) years of basic education and three (3) years of secondary education (FME, 2004). Recently, Sudan has witnessed the introduction of information and communication technology (ICT) that has revolutionized in some secondary schools and workplaces. The government provided each public secondary school with ten computers and added computer science to the school curriculum. The major problem encountered however, is that no prior

training was provided to the teachers in the government universities to implement the newly introduced curriculum on ICT in secondary schools.

Statement of the problem

The 2003 e-learning readiness rankings concluded that e-learning is a global phenomenon and it is a technology that is growing very fast. The increase in e-learning technologies is ascribed to the need for both regional and global economic growth, reduce the costs of conventional training, and simplify the role of secondary teachers for better understanding of learners (Noss and Pachler, 1999; Aydin and Tasci, 2005). Although ICT is very important in economic growth and development, not all Sudanese secondary school teachers accept these technologies and their related changes. It is argued that ICT is costly, takes long time to attain such technologies, new skills are required to use ICT in their classrooms, and it is a potential threat to their employment (Fisher, 1993; Leask, 2001). Similarly, teachers are afraid that such technologies will separate teachers from learners, resulting in learning performance BECTA of teachers (1999). Other factors include: (1) lack of confidence, experience, motivation, and training.

(2) Access to resources and the timetabled use of designated ICT classrooms.

(3) Unreliability of equipment.

(4) Classroom practices which clash with the culture of pupils' exploration, collaboration, debate, and interactions within which much technology-based activity is said to be situated Dawes (2001). Although currently the wide- spread of technological innovation greatly facilitates educational process, why are some Sudanese secondary school teachers not ready to use it; How can we ensure that our learners are well equipped and participate actively in a highly and competitive technological world? In view of this, policy makers in Sudan are trying to

implement a curriculum which includes computer science as a subject and distribute PCs in many secondary schools. The results and experience gained from this research would be of benefit to Sudan and other countries with similar interests in exploring the use of e-learning technology in new teaching curriculums and learning activities.

Rationale of the study

A better educational satisfies the future needs of secondary school learners as well as the preparation of teachers for the ICT revolution. It can only be achieved through a precise intervention with regard to the current situation in our schools and the challenges ahead of e-learning. It is therefore not enough to equip secondary schools with large numbers of computers while neglecting users. Rationally, it is crucial to firstly equip secondary school teachers with adequate knowledge on ICT while cultivating their morale to lean affront appropriate strategic plan for its implementation. So, willingness and readiness of secondary school teachers to participate in the ICT revolution, as well as their clear understanding of such technology, is by far the fundamental key to the sustainability of such newly introduced innovation in secondary school curriculums Owston (2004).Finally, the rationale of this study builds upon the following:

- An economic rationale: the development of ICT skills is necessary to meet the need for a skilled work force, as learning is related to future jobs and careers;
- A social rationale: this builds on the belief that all pupils should know about and be familiars with computers in order to become responsible and well-informed citizens;
- An educational rationale: ICT is seen as a supportive tool to improve teaching and
- Learning; and
- A catalytic rationale: ICT is expected to accelerate educational innovations.

Purpose of the study

The purpose of this study was to determine the various factors contributing to readiness towards e-learning in Sudanese secondary schools and to investigate why some secondary school teacher's shows more readiness while others show lack of readiness towards e-learning.

Research Objectives

The objectives of this study are:

- To determine various characteristics contributing to e-learning readiness in secondary schools.
- To investigate why some Sudanese secondary school teachers show an early response (early adopters?) relative to others who show late response (late adopters, or laggards?) to e-learning readiness.
- To determine the factors affecting readiness towards e-learning in Sudanese secondary schools and the role of teachers to overcome such factors.

Research questions

Main question

The main research question deriving this study is:

What are the various factors contributing to e-learning readiness in schools that make some teachers show an early involvement in e-learning innovations while others show later response or resistance to this new technology?

Sub-questions

The questions derived from study are:

1. What is e-learning readiness for Sudanese teachers?
2. What are the factors affecting readiness towards e-learning in Sudanese secondary schools?
3. Why do some teachers show an early adopter while others show later readiness towards e-learning?
4. How do teachers overcome the factors regatary affecting readiness to e-learning in Sudanese secondary schools?

Sub – Questions

In order to answer the above questions the following sub-sub- Questions were generated:

- What is the relationship between the school connectivity and teacher attitudes towards e-learning?
- To what extent does the application of technology increase or decrease teacher's effectiveness?
- What is the role of training in encouraging teachers towards e-learning?
- How does the school director encourage or discourage teacher in using technology in school.
- What is the relationship between school support and teachers attitudes for e-learning?

Theoretical framework

The constructivist learning theory and philosophy demands change in the role of both teachers and learners (Dewey, 1916; Piaget, 1973; Vygotsky, 1978 and Bruner, 1996). e-learning caused changes in the education meaning so that, it is important for the researcher to have a clear picture with regard to change and technological innovation from the following author's point of

views such as: (Fullan, 1991; Rogers, 2005; Kozma, 2003; Kozma, 2004; Clarke, 2003). As a result, motivation is one of the most important factors that demand attention of every one involved with e-learning ARCS Keller (1983).

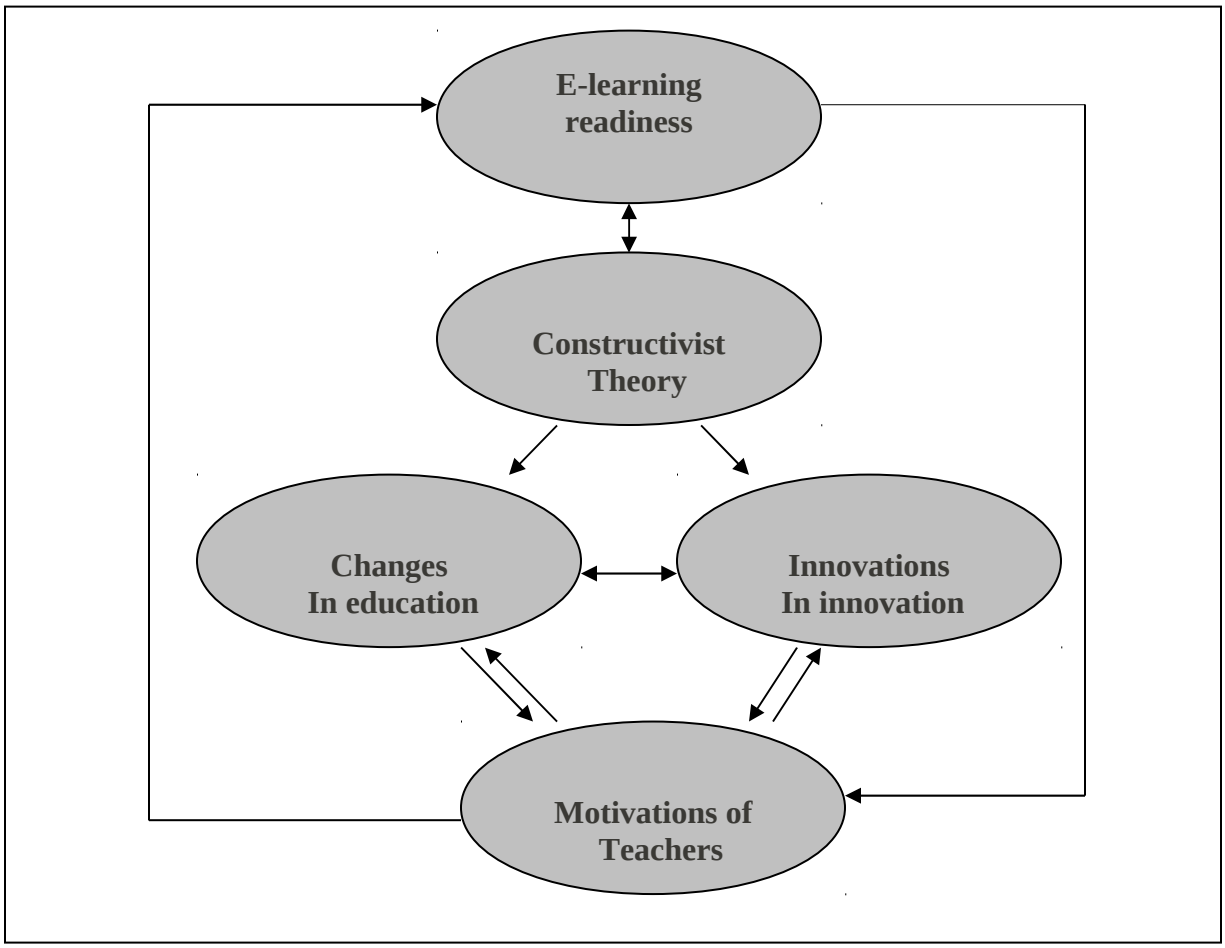

Figure 1.1 Therotical prespective of this study ezzelden (2009)

Research Methodology

In this study, both quantitative and qualitative methods were used to collect data from the selected participants. These methods assisted in building a base on a complete understanding of the research problem. The use of both quantitative and qualitative methods together a terminology known as mixed methods Creswell, (2007); in this study the qualitative method was used for triangulation of the quantitative data. Mixed methods of research are those studies or

lines of inquiry that integrate one or more qualitative and quantitative techniques for data collection and/or analysis Borkan (2004).

Qualitative methods

Qualitative method is defined as an inquiry process of understanding a social or human problem based on building a complex, holistic picture, formed in words, reporting detailed views of participants conducted in a natural setting Creswell (2007:P.103). It could also be defined as a multi-focus method, involving an interpretive, naturalistic approach to its subject matter Denzin and Lincoln (1994). Use of this method enabled to study things in their natural settings and related interpretations i.e. teacher's feelings while busy in their natural working environment, the differences in adopting ICT between teachers, and obstacles that hinder implementation of ICT in their classrooms Cohen and Morrison (2000). In this method, secondary school teachers were observed while busy in their normal and daily activities. Interviews were similarly conducted to secondary school directors. With this method, sufficient data were collected leading to the understanding of why some Sudanese secondary school teachers responded earlier to e-learning technology compared to others who didn’t and even to the extent of not using a computer in their classrooms.

Quantitative methods

In this method, data were collected through 130 structured questionnaires purposely designed to Sudanese secondary school teachers to clearly answer the research questions and objectives.

Research Matrix

Table 1:1 Matrix

Research Question	Data collection instrument		
	Interview	Questionnaire	Classroom Observation
What is the relationship between the school connectivity and teacher attitudes towards e-learning?	√	√	√
To what extent does the application of technology increase or decrease teachers effectiveness	√	√	√
What is the role of training in encouraging teachers towards e-learning?	√	√	√
What is the relationship between school support and teachers attitudes for e-learning?	√	√	
How does the school director encourage or discourage teacher in using technology in school.	√	√	

Data collection instruments

Observations

Semi-structured and participatory observations of the classrooms were conducted, each observed lesson assigned to two observers in order to explore the actual classroom practices. An observation worksheet was also declared for this purpose and field notes taken with reference to the relevant variables described in the research framework, including how secondary school teachers use ICT in their daily teaching practices. The observed data were then triangulated with those collected from interviews conducted with secondary school teachers. In order to obtain participation from teachers for this study, special participatory forms were distributed in order to obtain their consent. In view of this 130 Sudanese secondary school, male and female teachers

accepted to participate. They were observed in their actual classes while busy doing their normal routine of duties. All the observation work sheets were done before the start of lessons. Teachers participatory as well as classroom observations have been reported as advantageous. They include ability to gain insights and develop relationship with the participants, and provision of detailed information about the participants and their setting and collection of authentic and accurate data Gay (2003) Classroom observations on the other hand facilitated necessary clarifications and elaborations on the teacher's perspectives O'Donoghue (2007).

Interviews

An interview is a purposeful interaction between two or more people focused on one person trying to get a required information or a face-to-face encounter between the researcher and participant on lives, experiences or situations Taylor and Bogdan, 1984; Gay (2003). Such interviews permit to researchers to obtain important data which could not be acquired from observation only Cohen and Morrison (2000). In this study, open ended questions, semi-structured one-hr long interviews were conducted with thirteen Sudanese secondary school principals representing decision makers from three localities in Khartoum state. The objective was to capture the organizational factors of leadership, teachers belief nd general school readiness to e-learning. A list of questions with reference to the relevant variables (i.e. the role of teacher training, school support, and innovations, teaching and learning, and roles of ICT and connectivity) guided the interviews. The interviews were conducted during and after collecting the questionnaires information from the teachers. The interviews were all audio-recorded and transcribed for further analysis or interpretation. The data gathered from these interviews were also triangulated with those from classroom observations.

Questionnaire

The general purpose of the questionnaire was to elicit direct judgments; obtain uniform, straightforward; and easy data for analysis. Questionnaire encompasses variety of instruments in which the subject responds to written questions to elicit reactions, belief and attitudes. The researcher constructs a set of appropriate questions and asks the subjects to answer them. According to McMillan and Schumacher (2001), questionnaires can both be produced relatively rapidly and inexpensively and can easily be distributed simultaneously too many people. In this study, the questionnaire was designed to gather either qualitative data such as teacher's attitudes and belief bout e-learning or quantitative data such as the types of training the teachers have and numbers of educational software they used, and to elicit information from the 130 Sudanese secondary school teachers on their attitude towards e-learning readiness. The questionnaires were distributed to participants of the study according to the sample size. The distribution will explain at later stage.

Population and sampling

A population is a group of elements or cases, individual objects or events, that conform to specific criteria and to which we intend to generalize the results of the research McMillan and Schumacher (2001: P 23). In this study, the population was 1624 Sudanese secondary school teachers divided into subgroups from Khartoum state according to number of localities. These localities were Omdurman, Khartoum and Bahari. Accordingly, 417 male and 399 female teachers were drawn from Omdurman, 477 male and 452 female teachers were from Khartoum, and 423 male and 473 female teachers represented Bahari locality. From these localities, samples of five% were randomly drawn from each subgroup(Table 1:2). The research sample similarly

included thirteen Sudanese secondary schools principals, representing decision makers. These divisions permitted the comparison of subgroup results.

Table 1:2: Sample size of the studied population according to locality.

Locality	Male teacher	Female teachers	Five % of male	Five % of female
Khartoum	477	452	24	22
Omdurman	417	399	21	20
Bahri	423	473	20	23
Total	1317	1324	65	65

Data Source Ministry of education Khartoum state record in academic year (2008-2009.P, 1).

Validity and Reliability

Validity is the best available approximation to the truth of a given proposition, inference, or conclusion. Validity is essential criterion for quantitative and qualitative paradigms in terms of credibility, neutrality or Confirmability, consistency or dependability and applicability or transferability (Lincoln and Guba, 1985; Cohen et al, 2000; Trochim, 2001; Patton, 2002). In this research, reliability of observation was achieved through replicates or double-coding Miles and Huberman (1994). Double coding was achieved by both researcher and his assistant doing the same job, in same time, in the same schools, observing the same teachers while doing their job in classroom. The reliability of the questionnaires was assessed through Cronbach's alpha analyses, which showed that the instruments and the scales have internal consistency and reliability. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. However, there is actually no lower limit to the coefficient. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. Based upon the formula = rk / [1 + (k -1) r] where k is the number of items considered and r is the mean of the inter-item correlations the size of alpha is determined by both the number of items in the scale and the mean inter-item

correlations. Generalization analyses were also performed to ensure that individual teachers received reliable data. In this study, different data collection techniques were used (i.e. interviews, observations, and questionnaire) also meant to ensure validity. Additionally, triangulation was used to search for any convergence among multiple and different sources of information and form themes or categories in the study Creswell and Miller (2000). Although the size of participants in this research was small compared to the target population, it is expected that the data collected will be sufficient to give an overview of all target populations and populations.

Credibility

Credibility in a study is enhanced when strategies are put in place to check on the inequity of data and to allow for direct testing of findings and interpretations by the human sources from which they have come (Lincoln and Guba, 1985; O'Donoghue, 2007). In this study, credibility was enhanced by the extended period of data collection and triangulation as suggested by McMillan and Wergin (2002).

Transferability

Transferability refers to the extent by which results provide insights useful comparable to other settings. The strategies used in this study will enable judgments to be made about the transferability of the findings to other contexts including detailed analysis of questionnaires instruments, interviews and observations. This study were transfer to all Sudanese secondary school teachers, because they shared the same contents and with similar characteristics

Data Analysis

Descriptive and interpretive analysis was used to analyze qualitative data gathered through interviews. The data from semi structured interviews were analyzed using a coding schemes system which categorized the data into smaller clusters of similar content to allow for simple statistical analysis Nachmias and Frankfort-Nachmias (1996). A computer program, MSWord was used to categorize and group these data into smaller clusters according to the research questions. In this study, an inductive coding scheme was used for data analysis. In this scheme, data were transcribed from the recorded tables used to record participants' responses. This raw data from the transcripts, including the response from each of the interviews, were then organized into major coding sections according to the key themes. These were then grouped together in order to determine the main argument to each section. A computer spreadsheet program, MSExcel was used to organize the data according to coding schemes. Data from the questionnaire and observation worksheets were analyzed using basic descriptive statistics and factor analysis, using SPSS (Statistical Package for the Social Sciences).

Significance of the study

The study was supported the following:

- Shed light on the difficulties and barriers of implementing ICT in Sudanese secondary schools.
- Provide better understanding for policymakers on the teacher’s situation in Sudan and build coherent strategic plans to implement e-learning secondary schools.
- Enlighten The Ministry of education, training department about effective teachers training means and how it could be implemented.

- Enlighten the teachers to realize the importance of introducing ICT in their teaching strategies

Ethical considerations

As in every other aspect of the research, the ethics has its own important value added to the research. In order to conduct interviews with the interviewees of this study, several ethical procedures were followed:

- Proper official and unofficial consultations were made to obtain permissions from the respondents in order to gain their trust.
- The purpose of the study was explained and emphasized as well as the need to get such information.
- All participants were assured of confidentiality and anonymity throughout the study.
- The results were distributed to the participants.

Delimitations of the study

This study concerns secondary school readiness towards e-learning. In order to keep focused and to ensure validity, some issue should be considered:

• Time of study: April 2007 - December 2009.

• Location of study: Khartoum, Sudan.

Structure of the research report

The dissertation consists of six chapters:

Chapter one provides a general overview of the study. It introduces the research problem, research objectives, and research questions and shows how the research is to be done.

Chapter two consists of related literature review of the research problem based on research questions that asked in chapter one.

Chapter three provides a description of the research methods that were used during the study.

Chapter four offers a comprehensive report of the results gained during Data collection

Chapter five discussions of the data

Chapter six gives conclusion, recommendations drawn from the research and recommendations for further studies.

Chapter two

Literature Review

Introduction

E-learning has caused radical changes in all spheres of society. Nowadays many workplaces realized its importance in increasing the efficiency and achievement of their companies and institutions; therefore they have started to consider computer skills and knowledge as basic

qualifications for job seekers. The school's responsibility is to prepare and equip the upcoming generation (future work-force) with knowledge that will help them to cope with future needs. Teachers are directly responsible for this enabling task, but unfortunately many educators in Sudan have no computer skills.

This literature review focuses on basic concepts e-learning today in contradiction to learning by means of radio and television though they are electronic devices. In addition; the focus was also done on the role of ICT in school, with particular reference to how it has changed teachers' roles. Finally, it will be useful to reflect on Rogers (2003) model of "diffusions of innovations." Rogers categorizes targeted beneficiaries of reform according to their responsiveness to change. This will help me to classify teachers in the same way, and thus to understand why some teachers respond to e-leaning more readily than other. Special attention will be given to what Fullan (1991) says about educational change with particular reference to how the teacher's role has changed from controlling the entire learning process to mainly facilitating it by means of (ICT).The review also covers national and international literature about barriers that prevent teachers from responding to e-learning readiness.

What is e-learning, and what are the criteria for determining readiness for e-leaning?

A better understanding of e-learning readiness can be gain through understanding what e-learning means. Also explain the important of e-learning in our life is an other medium to clarify the ambiguity of the term as well as the e-learning principles. Knowing stage model to analyze, track and compare different journeys of e-learning readiness make it easy for identifying the stage of e-learning readiness at any institute.

What is e-learning?

The following are just a few of existing definitions of e-learning:

- E-learning includes the acquisition, generation and exchange of knowledge with the aid of information and communications technology (ICT) Bowles (2003).
- E-learning includes training methods that ultimately depend on the internet or intranet as a medium of diffusion. From this broad definition – in comparing a whole range of training situations - we can extract the principle that it particularly lends itself to distance learning Wasseige (1999).
- E-learning can also be defined as "… any learning situation where methods and techniques enable electronic devices combined with instructors and learners who are physically separated and who used methods and techniques enable by electronic devices to transmit instructional massages over the distance between them" Stubbs and Burnham (1990, p.234).
- In another definition: E-learning is "…the delivery of learning, training or education through electronic mean, including digital collaboration, satellite broadcasting, CD ROMS, video and audio conferencing, mobile technology, interactive television, and

Web-based technologies. Online learning is a subset of e-learning involving learning that is experienced through the use of computer networks such as intranets, and the Internet Wardca (2003, p.1).

- E-Learning covers delivery of interaction with a wide range of instructional material that can be made available on a CD-ROM or a DVD over a local area network (LAN) or on the Internet. It includes Computer-based Training (CBT), Web-based Training (WBT), and Electronic Performance Support Systems (EPSS), distance or online learning and online tutorials. The major advantage to students is its easy access Ron Kurtus (2004).
- Finally, e-learning is the searching of internet facilities to create and deliver a rich learning environment that includes a broad range of instructional and informational resources and solutions. The object of the exercise includes improvement of individual and organizational performance Rosenberg (2005).

In **Summary** e-learning entails the teachers' use of information and communications technology (ICT) to extend, enhance and enrich learning activity. It consists in ICT- assisted of acquisition of knowledge, skills and attitudes by constructing and deconstructing learning.

Why do we have e-learning?

Generally, our day-to-day activities are now routinely technological based, for example electronic access to cash or shopping, searching new textbook, contacting distance supervisors and attending conferences that for a large majority if not all of us techno-familiarity is a necessary. Many people however, remain on the other side of the 'digital divide,' isolated by such factors as sock-economic circumstances, simply a lack of interest, perhaps through personal choice or other cultural influence. ICT is all round us and becoming more and more pervasive. Such pervasiveness of technology- based activities across society that there are some

governments that do not have information technology-related learning programmes as the part of educational policies. Since the early 1960s until now one of the most widely acknowledged benefits has been the many uses of computers in delivering education and facilitating learning, though some teachers are still passively waiting for someone to take the initiative on their behalf Holmes and Gardner (2006).

E-learning principles

Bowles (2003, p.11) "Established twelve principles that were at the core of strategic or policy frameworks seeking to implement effective and efficient e-learning within organizational or regional settings:

1. E-learning can be defined as learning that includes the acquisition, generation and transfer of knowledge using information and communications technology (ICT).

2. E-learning predictions for content, service and technology market segments lack comparability and reliability as no agreed scientific basis exists for the definitions used.

3. E-learning is an example of a convergent activity where maximizing effective and efficient implementation depends on understanding complex system interactions.

4. E-learning has to move beyond the e-training focus on individual skills to incorporate capabilities which build shared meaning and a culture of collaboration.

5. E-learning has the strategic value of enhancing knowledge capital through the transfer and generation of both codified, explicit knowledge and unmodified, tacit knowledge.

6. E-learning has maximum strategic impact when it deploys pedagogy appropriate to the individual learner while enhancing situated performance and thinking.

7. E-learning occurs most effectively when improved individual learning is the primary end and technology the means.

8. E-learning is both a process of learning transfer and a means for improving collaboration and knowledge generation.

9. E-learning can cause transformation while enhancing an organization's and community's capacity to respond to change.

10. E-learning can be implemented to enhance organizational learning and so improve business processes and competitiveness.

11. E-learning is an activity that inherently involves exchanges moderated by technology and therefore can affect service exchanges within and outside an organization.

12. To implement e-learning efficiently and effectively, a quality instructional design process (analyze, build, implement and improve) must ensure a continuous cycle based on rigorous evaluation at all levels." Bowles (2003, p.11).

These twelve principles may appear more like critical success factors than the usual statements that underpin learning. This is intentional. What underpins each of the principles is sound research focused on system-level strategic outcomes, not just issues of pedagogy and technology.

E-learning readiness

Bowles (2003) has proposed a four-stage model to analyze, track and compare different journeys to e-learning readiness. Each stage can be summarized as follows:

"Level 1- Awareness: The organization is aware of the need for e-learning but has made only basic advances. Information is transferred electronically using static web pages, CD-ROMs or computer based instruction on stand-alone platforms. There is little or no networking of individual learning and data cannot be captured and analyzed in real-time. The relationship

between learning and knowledge management is inadvertent at best. The main focus is on cost reduction and wider distribution and access.

Level 2- Enablement: The organization searches for interactivity and real-time data capture across networked electronic-learning media. Users can search and navigate stored content to access appropriate learning at the right time. Transfer of explicit knowledge between individuals' increases as e-learning is used to enhance knowledge distribution, especially via self-paced content. At this stage, cost savings drive the advancement of the e-learning strategy.

Level 3- Integration: The organization or its suppliers generate personalized e-learning products and services with integrated architecture. Open architecture maximizes the integration of front-end and back-end systems and permits learning to be translated into improved business processes and customer value. E-learning is integrated with knowledge management, performance management, personnel (human capital) management, and continuous improvement strategies. A conscious effort is made to enhance tactical knowledge in a way that promotes collaboration and further embeds knowledge within the unique context of the organization.

Level 4-Maturity: Innovation and extended deployment of e-learning are used to leverage core business interests and help redesign core services, supply chains and business processes to better meet customer needs and preferences. E-learning is an essential component for building the organization's unique competitive advantage and enabling improved agility and responsiveness to future contingencies." Bowles (2003, p. 5).

The process of transformation towards e-learning requires a long-term view on return on investment, and impacts on business strategy and staff capacity to transfer knowledge. E-learning technology is integrated into known business processes and management feels that the interventions are 'under control Illustrated in the following: S - curve diagram

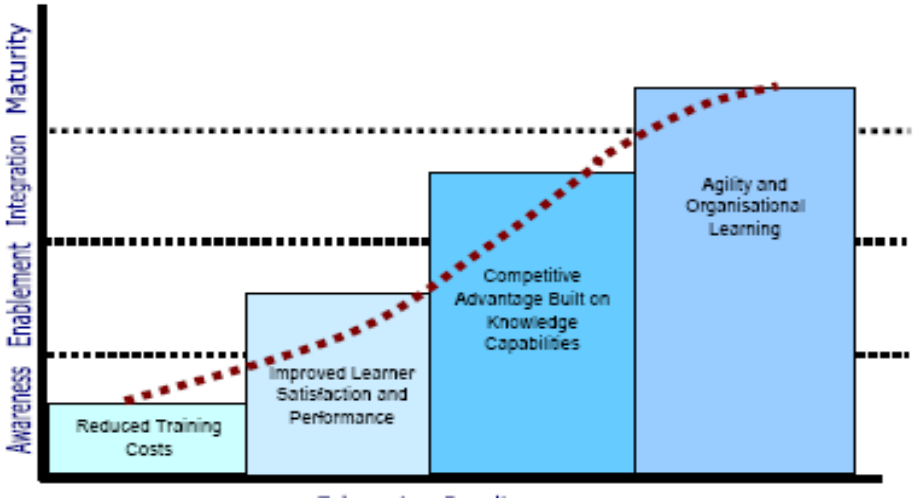

Figure 2.2 S-curve of e-learning readiness Bowles (2003, p. 6).

Innovations and e-learning undertakings

One of the most serious changes that have appeared in societies over the past twenty years has been the introduction of ICT into all spheres of life. Our lives, both in the workplace and at home, have changed in different ways. Some of these changes have made life easier, while others may cause new problems and challenges ETUCE (2004-2006). E-learning exploits interactive technologies and communication systems to enhance the learning experience. It has the potential to transform the manner in which we teach and learn across the board. It can raise standards and widen participation in lifelong learning. It cannot take the place of teachers and lecturers but at the side of existing methods can enhance the quality and reach of their teaching and reduce the time spent on administration. It can enable every learner to achieve his or her potential and help to build an educational workforce empowered to change. It makes possible a truly ambitious education system for a future learning society Clarke (2003).

“E-learning has the potential to revolutionize the way we teach and learn. A great deal of progress has been made so far but there is much more to do.” E-learning can take us a further step forward. This is about embedding and exploiting technologies in everything we do, and

getting ICT embedded across the curriculum for all subjects and in all pedagogues, Clarke (2003, p.1).

E-learning is considered as the biggest growth factor on the internet, and in the globalization era which causes change and a demand for a well-educated workforce. This has driven many countries to rethink their education systems and to up-grade to suit the demands of the technological age Clarke (2003).

According to Zemsky and Massy (2004, p.1) “there are three innovations that have controlled the educational arena over the last two decades are: (1) the high-stakes testing; (2) national and occasionally international ranking systems; (3) the third one is e-learning principal the major educational innovation and the only one of the three that actually focuses on educational content. It derives from the linking of rapidly maturing information technologies and a renewed interest in how, when, and why people learn."

“E-learning is also the innovation that garnered the most venture capital, the most press coverage and, not surprisingly, the most ambitious promises. Among the claims made a support of e-learning investments, three are particularly noteworthy:

First: the marriage of new electronic technologies and newly accepted theories of learning promised to yield a revolution in pedagogy.

Second: Delivered can be taken whenever and wherever a computer and a connection to the internet can be found.

Third: that the market would provide the financing necessary for the industry to live up to its potential Zemsky and Massy (2004, p.2).

Advantages and disadvantages of e-learning

Table 2.1 e-learning

Categories	Advantages	Disadvantages	Implications
Content and learning materials. Teaching. Education, corporations and to all types of learners.	It is possible, saves time, and produces measurable results E-learning is more cost-effective than traditional learning because it eliminates travel costs. E-learning also has measurable assessments which can be created so that both teachers and students will know what were learned when they have completed courses and how they achieved. Learners learn at their own pace. Learner learns through a variety of activities that apply to learners' many different learning styles. They can fit e-learning into their busy schedule, so it	Learners need to have access to a computer as well as the Internet. They also need to have computer skills with programmes such as word processing, Internet browsers, and e-mail, because without these skills and software it is not possible for the student to succeed in e-learning. Learners need to be very comfortable using a computer. Slow Internet connections or older computers may make accessing course materials difficult causing learners to become frustrated and give up. Managing computer files and online learning software can seem complex to learners with beginning level computer skills. Without good computer organizational skills learners may lose or misplace reports so that they	Learners have access to a computer as well as the Internet, so that they can make good use of it. At many Sudanese secondary schools Teachers weren't well trained in ICT skills. The numbers of computers were not enough for the learners. Sudanese secondary school teacher's loads cause difficulties for ICT training. Lack of infrastructures and reliable access to ICT facilities as well as lack of new teaching methods affect the Sudanese secondary teacher's e-learning readiness.

Summary

E-learning offers opportunities for both educators and learners to enrich their teaching and learning experiences through virtual environments that support not only delivery but also the exploration and application of information and the promotion of new knowledge Holmes and Gardner (2006).

In conclusion I completely disagree with those who consider e-learning's prerequisites, such as: access to a computer, and to the internet as well as computer operating skills and the motivation to make use of e-learning, to be disadvantages or unfortunate hurdles that militate against the use of e-learning because in the world of today these prerequisites have acquired such critical importance that non-compliance with them is the equivalent of being unable o read an write. The following are particular advantages of e-learning for educators:

Accessibility: access to knowledge and related data anywhere, on a cross-enterprise basis.

Flexibility: An e-learning environment provides a flexible workflow and process model that can be fine –turned and configured to meet the organization's needs. For that I totally accept e-learning as advantages innovation in 21st century.

Why schools have to adopt ICT?

Edwyn (2001, p10) Set out that in at least three important respects, the dramatic changes in education brought about by introduction of ICT differs from any previous reforms**.** "**Firstly**, the earlier curriculum reform take place inside the education and the educator governed. ICT has arisen outside the world of education, but with irresistible case to adoption within schools. Secondly, the learners are more contented and comfortable with the ICT than their teachers. Finally, ICT has major implications for whole learning environments. We can distinguish three main rationales for the inclusion of ICT in education: the economic, the social and pedagogical.

For the economic rationale the focus is on the perceived needs for the economy – the present and future and the requirements in many areas of employments to have personnel with ICT skills. Knowledge of and familiarity with ICT are important factors of employability as the 21st century unfolds. Awareness of this economic dimension may encourage teachers generally to equip themselves with ICT knowledge for their own sake and in order to help their learners grow in the competitive educational arena.

The social rationale focuses on ICT facilities becoming a prerequisite for participation in society and the workplace. ICT competence is seen as a combinations of important “life skills." Societies will suffer if some of their members have little or no facilities to foster and accommodate ICT skills.

The pedagogical rationale concentrates on the role of ICT in teaching and learning. The potential for this has developed rapidly and dramatically with the advances in ICT, from earlier “drill and practice”, programmes and limited use of small numbers of subjects. ICT can increase the breath and richness of learning, not least through topicality and realism that the new resources can bring. It can support the development of higher -order thinking skills, including analysis and synthesis.” Edwyn (2001, p10)

ICT in schools

The introduction of ICT, the emergence of network computers together with internet and intranet access /facilities in the education has changed our perception of the world and the needs of learners and teachers, as well as their, educational objectives. Learning processes became two-way communication exercise and the approach to education change in principle from teacher-centered to a learner-centered orientation. This radical shift necessitated a training effort to enable teachers to meet the new demand attendant, Leask and Pachler (2005). The need for a

reorientation exercise is underscored by the proverb says: “if we don’t change direction, we’ll end up exactly where we started." Rosenberg (2005, p.41).As noted by Kozma (2004) ICT plays an important role in disseminating general knowledge, not only by way of physical transition, but by serving as a management tool to organize information and use it for analytical purposes to solve problems and make decisions. It is also used to create knowledge and supports the production of works of literature, art, and culture. New skills and habits are required to perform these functions. For example hardware and software have to be used to search for, organize, analyze, and synthesize information to create new ideas, to share knowledge and to solve complex, real-world problems to improve the human condition.

Kozma (2003) examined the findings of 174 case studies world wide of innovative pedagogical practices involving the use of information technology. The investigation revealed that teachers in many countries have began to use ICT as an aid to teaching and learning, often in the context of multi-disciplinary projects and more importantly to change their role from serving as source and fount of information to that of facilitation and everything it entails. The case studies showed that learners who were exposed to the new facilitating a approach were more likely to develop new ICT skills, problem solving methods as well as information management collaboration and communication skills.

Staff development and the adoption of innovations

The effectiveness of ICT in education depends on teachers’ ability to apply the relevant technologies effectively, which means that a training effort is required to equip teachers to use ICT appropriately. However staff development until recently has been neglected in this regard in favour of acquiring hardware and infrastructure such as: software, networks connectivity; fortunately the need to correct this skewed emphasis has been recognized as attested by the

following quotation Laval and Reuben (2004, p.5) “Teachers are key players in any educational innovation effort inside the classroom. Therefore, each school should support strategy that focus on a teacher training, and provides several additional activities; this strategy carefully considers how to best develop teachers’ ICT skills as well as their self-confidence in classroom uses of ICT. Depending upon their attitude towards technology, teachers might be grossly classified as innovators, resistant, or mainstream. Consequently, training strategies should address the special needs and attitudes about technology of all three groups. Achieving significant uses of technology inside the classroom is still a major challenge worldwide, and there is no reported breakthrough on this."

McCarney (2004, p1) states that, “previous studies into teacher attitude and motivation have identified staff development as one of the contributing factors in using ICT effectively in the classroom. Substantial funds have been provided for such staff development in recent years in the UK. Currently, ICT training is being funded to a level of £23m in Scotland and £230m in England and Wales over the period 2000–2003."

According to the U.S. Congress Office of Technology Assessment (1995) helping teachers to use technology effectively may be the most important thing to ensure current and future investment in technology. Further findings are that most teachers have not had adequate technology training and feel insufficiently qualified to introduce technology effectively in curricula. According to Farby and Higgs (1997, p 390), "the lack of professional development represents a very significant barrier to technology integration. Teachers cannot be expected to use technology effectively unless they are taught how and when use it. This need for training is crucial enough that Technology Literacy Challenge programme from the U.S. Department of Education (1998) made professional development one of the four "pillars" of the programme. Professional

development is cited as key to effective technology integration and student learning and that it takes most time that most would anticipate, even as long as five years to effectively infuse technology in schools.

One finding from Apple Computer ACOT research is that feedback and dialogue among colleagues is a critical factor in the adoption of new knowledge and skills learned in technology staff development workshops."

Guskey (2002, p.381) notes that “High quality staff development is a central component in nearly every proposal for improving education." Because Sudanese secondary school teachers today remain in their positions for longer periods of time, and fewer new teachers enter the ICT field, improvements in our schools will clearly require enhancement of the professional skills of present staff members. In this regard Wilson and Berne (1999, p. 173) comments “in the past ten years, the calls for a commitment to teacher learning have increased exponentially, most likely from a confluence of forces. The standards movement is one such force. Calls for higher standards for teachers inevitably erupted alongside calls for higher standards for students."

According to Cohen and Ball (1990) to meet the future needs, assessments and standards attendant upon the shift from a teacher-centered learning to the learner-centered approach, teachers would have to undergo special preparation training. Wilson and Berne (1999, p.173) note that “reformers began to realize that curriculum and testing changes would not directly lead to changed teaching practices. New measures of student performance would entail new ways of teaching." Professional development was fail-safe way to reform. Groups such as the National Council of Teachers of Mathematics (1991), the National Council of Teachers of English (1996), the National Board for Professional Teaching Standards (1989) and the Interstate Consortium of

Chief State School Officers have authored mission statements and subsequent standards for professional teachers and teaching. Professional teachers require professional development. Guskey (2002, p.381) states that “the professional development programmes are systematic efforts to bring about change in the classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students." “The majority of professional development programmes fail because they do not take into account two crucial factors:

(1) What motivates teachers to engage in professional development, and

(2) The process by which change in teachers typically occurs.” Guskey (1986, p.7).Although teachers are generally required to take part in professional development by certification or contractual agreements, most report that they engage in these activities because they want to become better teachers. They see professional development programmes as among the most promising and most readily available routes to growth on the job Fullan (1991) - not only as a way to combat boredom and alienation, but also as a pathway to increased competence and greater professional satisfaction Huberman (1995). “It is important to note that, for the vast majority of teachers, becoming a better teacher means enhancing student learning outcomes” Guskey (2002, p.382). Fullan (999) found that regardless of teaching level, most teachers define their success in terms of their pupils’ behaviors and activities, rather than in terms of themselves or other criteria’. What attracts teachers to professional development, therefore, is their belief that it will expand their knowledge and skills, contribute to their growth, and enhance their effectiveness with students. But teachers also tend to be quite pragmatic.

What they hope to gain through professional development are specific, concrete, and practical ideas that directly relate to the day-to-day operation of their classrooms (Fullan and Miles, 1992). Development programmes that fail to address these needs are unlikely to succeed.

As stated earlier by Guskey (2002, p.381) the three major goals of professional development programmes are" change in the classroom practices of teachers, change in their attitudes and beliefs, and change in the learning outcomes of students." Of particular importance to efforts to facilitate change, however, is the sequence in which these outcomes most frequently occur.

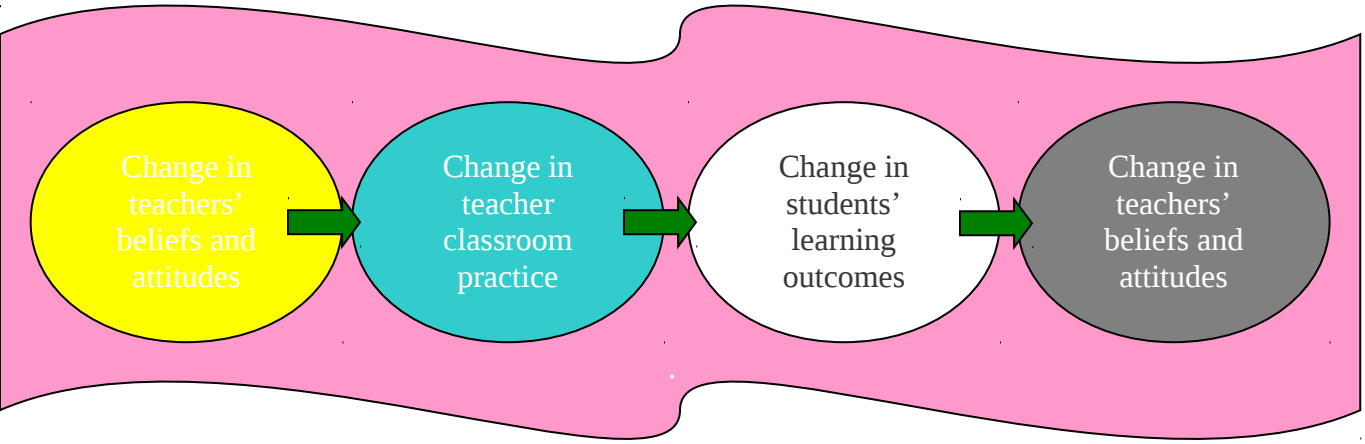

Figure 3.2 Model of teacher change Guskey (2002, p.383)

Guskey (2002, p.383) in his model of teacher change shown in Figure two above suggests a different sequence of the three major outcomes of professional development. According to the model," significant change in teachers' attitudes and beliefs occurs primarily after they gain evidence of improvements in student learning. These improvements typically result from excitement teachers have made in their classroom practices such as a new instructional approach, the use of new materials or curricula, or simply a modification in teaching procedures or classroom format." Despite the lack of substantial empirical evidence about what teachers learn (or do not learn) in traditional professional development activities, many educators have embraced the calls for a whole-sale rejection of the traditional, replacing the old with new images of meaningful professional development. Principles for designing such work appear in

Little (1988) which notes the following features of effective staff development:

(a) It ensures collaboration to produce understanding, investment, thoughtful development, and a fair, rigorous test of selected ideas.

(b) It requires collective participation in training and implementation.

(c) It is focused on crucial problems of curriculum and instruction.

(d) It is conducted often enough and long enough to ensure progressive gains in knowledge, skill, and confidence.

(e) It is congruent with and contributes to professional habits and norms of collegiality and experimentation.

Abdal-Haqq (1995, p.1) lists similar set of characteristics, claiming:

1. Professional staff development must continue at all time to be effective.
2. It must include training, practice, and feedback; opportunities for individual reflection and group inquiry into practice; and coaching or other follow-up procedures.
3. It is school based and embedded in teachers' work.
4. It is collaborative, providing opportunities for teachers to interact with peers.
5. It focuses on student learning, which should, in part, guide assessment of its effectiveness.
6. It encourages and supports school-based and teacher initiatives.
7. It is rooted in the knowledge base for teaching.
8. It incorporates constructivist approaches to teaching and learning.
9. It recognizes teachers as professionals and adult learners.
10. It provides adequate time and follow-up support.
11. It is accessible and inclusive." Abdal-Haqq (1995, p.1)

Teacher changes

Entering the new century Cheng (2001, p.61) stated that "In facing up to the challenges in the new millennium, we need a new paradigm for rethinking and reforming our school and teacher education." (p. 61)**.** In comparison with other developing countries Sudan is making almost no progress forwards integrating ICT in its school system.

According to the Education and Manpower Bureau (1998) ICT need to be bought into school curricula as well as teacher education programmes to be effectives. It is expected that ICTcourse it will be made compulsory for teachers to become competent users of IT in the context of performing their function at education; and apparently incipient endeavors in this regard are becoming evident among teachers although it will take time before IT becomes a significant of teaching and learning in Sudan. Critical awareness of the need for ICT is implemented effectively through out the education system Lee (2002).It should note in this regard that it is hard for teachers to face the perceived risk of breaking away from traditional approaches to instruction. They need time to realize the potential benefit of implementing ICT and become committed to the implementation process, beyond textbooks and themselves. In order to become change agents, they must help students understand and make use of the many forms of access to information and then apply the information usefully. At the very least, teachers need to employ a wide range of technological tools and software as personal instructional with its facility while reformers may see ICT as a means to effect significant changes in curriculum and instruction; it needs to be acknowledged that the crucial agent of change is the classroom teacher.

Lee (2002) stated that current reforms within the education sector mean that teachers' work is increasingly being carried out in a state of almost constant flux which easily translates into additional professional demands within an already over challenging workplace. In spite of all this

teachers must invariably integrate ICT elements into different key learning areas and encourage students to use ICT to enhance their learning. The success of this integration depends very much on a number of factors, including the nature of the subject content and the readiness of teachers**.** It needs to be emphasized here that ICT must not be taught in isolation but as an a applied discipline within the teaching context.

The implementation of ICT in teaching can be difficult because it is not one innovation but a combination of related innovations, including hardware and multiple computer applications, Hall and Hord (2001). As noted by Fullan (1991) it is extremely difficult to change the pedagogical beliefs that drive teachers' choice of instructional strategy. When introducing ICT into the classroom, it takes concerted effort on the part of teachers to emphasize content and pedagogy, rather than the sophistication of hardware and technical skills. It is equally difficult to engage students in meaningful and relevant learning and allow them to construct knowledge. Teachers therefore need to bring exciting and stimulating curricula into the classroom, integrate technology into the curriculum and devise alternative ways of assessing students' work. Teaching strategy should be flexible to enable adjustment to a variety of learning styles. Policy-makers need to sympathize and not underestimate the difficulties that teachers have in developing skills for using ICT in the classroom. They need to acquire basic ICT skills and then ensure that students in their charge gain such skills in step by step process, failing which they will be unable to use ICT as a primary tool for teaching and learning Lee (2002).

"Even supposing that teachers have been given some professional development and possess the ICT skills, they would still need to carefully consider when, what, and how to teach the ICT skills to their students", Teacher Training Agency (1998, P. 3). Teachers may choose to use very

simple or complex technologies to achieve their educational vision. Somekh (1997) has demonstrated that " the use of IT can provide innovative learning experiences, but in all cases a great deal depends upon the teacher to provide the context which makes this possible" (p.114).Somekh (1997) goes on to indicate that "Teachers need to be competent and confident users of hardware and software, but this in itself is not enough. They need to be convinced of the value of ICT because many teachers tend to perceive themselves to be technologically incompetent and often feel deskilled and demoralized when they first begin to use computers in the classroom." Somekh (1997, P.116).

Teachers' ICT skills and understanding

In this section, the focus will be on how teachers' and learners' roles are changed by ICT in the classroom and the skills and understanding teachers need to implement ICT effectively. As noted by BECTA (2003, p.4) "In a review of research into ICT and pedagogy the following ICT skills and the understanding needed by teachers in this regard were identified:

- Understand the relationship between a range of ICT resources, concepts, processes and skills in their subject.
- Use their subject expertise to obtain and select appropriate ICT resources that will help them meet the learning objectives of a particular lesson. Resources include subject-specific software as well as more generic resources.
- Because of the potential of ICT recourses to assist learners' presentation skills, challenge their thinking and extend their learning.
- Have confidence in using a range of ICT resources, which can only be achieved through frequent practice with a reasonably sized group of ICT users.

- Understand that some uses of ICT will change the nature and representation of knowledge and the way that the subject is presented to and engaged by the pupils**."** (p.4)

According to Wheeler (2000) ICT will bring about several benefits to the learner and the teacher. These include sharing of resources and learning environments as well as the promotion of collaborative learning and a general move towards greater learner autonomy. Therefore it is important to emphasize the effective changes that technology brings about in the role of both teachers and learners Collins and Berge (1996).

Table 2.2 change in instructors' and learners' roles(Collins and Berge (1996)

Changing instructor role	**Changing student role**
From oracle and lecturer to consultant, .guide and resource provider	From passive receptacles for hand-me-down .knowledge to constructors of their own knowledge
Teachers become expert questioners, .rather than providers of the answers	Students become complex problem-solvers, rather .than memorizers of facts
Teachers become designers of student learning experiences rather than just .providers of content	.Students see topics from multiple perspectives
Teachers provide only the initial structure to student work, encouraging .increasing self-direction	Students refine their own questions and search for .their own answers
Teachers present multiple perspectives .on topics, emphasizing the salient points	Students work as group members on more collaborative/cooperative assignments; group .interaction is significantly increased
From solitary teacher to a member of a learning team (reduces isolation some .(times experienced by teachers	.Increased multi-cultural awareness
From teacher having total autonomy to .activities that can be broadly assessed	Student works towards fluency with the same tools as .professionals in their field

From total control of the teaching environment o sharing with students as a .fellow learner	More emphasis on students as autonomous, independent, self –motivated managers of their own .time and learning process
More emphasis on sensitivity to student .learning styles	Discussion of students' own woks in the classroom
Teacher-learner power structures erode observation of the teacher's expert performance or just learning to pass the .test	Emphasis on knowledge use rather than only emphasis on acquiring learning strategies (both individually (and collaboratively .Access to resources is significantly expanded

2.1 ICT and change in the teacher's role

Although the information age is characterized by rapid change and uncertainty, there is one thing of which all educationalists and stakeholders can be certain - teachers will have to adapt to change if they are to survive and keep pace with new methods and technologies. Arguably the area of the most rapid change is that of Information and Communications Technologies (ICT). One of the serious questions being asked by many teachers is: What will be the long-term impact of introducing these technologies in the classroom? Another question is: What kind of skills will teachers need to acquire in order to be effective in an ICT based learning environment. Wheeler (2000) states that with the inevitable proliferation of ICT in the classroom the role of the teacher must change and these are the four key reasons why this must happen:

Firstly, overhead projectors and chalkboards will probably become obsolete if teacher presents information by means of networked resources. Furthermore, if students are distributed over several classrooms - which are becoming more common place - localized resources will become redundant and new electronic forms of distributed communication will have to be employed.

Secondly, ICT may also make some assessment methods redundant. Low level (purely factual) knowledge for example, has been traditionally tested by the use of multiple choice questions. In an ICT environment, on-line tests can easily be used which instantly provide the teacher with a wide range of information associated with the learner's score. Comparisons of previous scores and dates of assessment, for example, will indicate a child's progress, and each student can be allocated an individualized electronic action-plan data base each successive test's results can be entered automatically Wheeler (2000).

Thirdly, teacher can no longer teach content alone but have to encourage critical thinking skills, promote information literacy, and nurture collaborative working practices to prepare children for a new world in which no job is guaranteed for life and where people switch careers several times. The internet gives access to an exponentially growing storehouse of information sources, almost unlimited networks of people and computers, and unprecedented learning and research opportunities. It is a network of networks, providing opportunities for inquiry-based learning where teachers and students are able to access some of the world's largest information archives. Students and teachers are able to connect with each other, learn flexibly, and collaborate with others around the world. Generally speaking, geographical distance is no longer a barrier and the age of 'borderless' provision of education has arrived. Teaching strategies and resources can be shared through communication with other educators and may be integrated across the curriculum. The internet provides a wealth of information to the extent that it is now impossible to comprehensively track the amount of information available. Unfortunately, misinformation and inaccuracies are also common on the net which mean that the teacher will have to keep a watchful eye on information management if it derives from the net alone, thus the new knowledge technology presents critically further unknown challenges.

Finally, teachers must begin to reappraise the methods by which they meet children's learning needs and match curricula to the requirements of human thought. The Internet can be an excellent way to adapt information to meet the characteristics of human information processing. Traditional methods of imparting knowledge, such as lectures, books and conference papers, are characterized by a linear progression of information. Human minds are more adaptable than this, using non-linear strategies for problem solving, representation and the storage and retrieval of information Wheeler (2000).

Constructivist learning theory

According to Chan (2006) although innovative ideas on teaching and learning have been progressively introduced over the past few decades, traditional views have been used in many schools. Such views often consider students as "empty vessels" waiting to be filled with knowledge. Students are now learners who come to the classroom with their unique backgrounds, experience, conceptual frameworks, learning styles and personal circumstances. Teachers now become learning facilitators rather than reservoirs of knowledge. Psychology of learning has shifted from behaviorism to cognitivism to constructivism. For the teachers to cope with changing or restructuring schools have to assimilate the current innovation effectively in teaching and learning methods as well as school administration have to change significantly for e-learning to be successful. Moreover ICT implementation can not proceed efficiently and effectively without appropriate reform of in-service professional development of teacher, reform of teacher preparation programmes, and substitutions of a learner-centered approach for outdated teacher-centered approach to education.

According to Charalambos (2005) the reorientation to a learner-centered approach as well as constructivist approach, has contributed critically towards effective implementation of ICT, as an

aid to teaching and learning. Teacher therefore need to be given ample opportunity to engage in meaningful activities, collaborate with peers, exchange ideas, provide and receive feedback from peers, and reflect critically on their works. Constructivism is both a philosophy and a theory of learning. The key concept of constructivism is that learning is an active process of creating, rather than acquiring, knowledge. Many educational psychologists were more concerned with what was going on inside the human brain than how to get in. Dewey (1916), Piaget (1973), Vygotsky (1978, 1978) and Bruner (1996) each proposed that learners could learn actively and construct new knowledge based on their prior knowledge. In these perspectives, the role of the instructor is to facilitate Ornstein and Hunkins (1998). For Dewey (1916) a situation represents the experience of the environment affecting the learner and the interaction that takes place between the learner and his or her environment. Knowledge is therefore based on active experience. However, Piaget and Dewey believed that the educator's role involved the shaping of the learner's real experience of the environment and knowledge that surroundings tend to promote through experience that leads to growth, Ornstein and Hunkins (1998).

Dewey (1916) considered that the main function of education was to improve the reasoning process. He also recommended the adapting of his problem-solving method in many subjects. A student who is not really motivated will not perceive a problem, so problems selected for the study should be derived from learner's interest (Ornstein and Hunkins, 1998). Therefore, the methods of constructivism emphasized development of the learner's ability to solve real-life problems. As a result, problem solving and free discovery came together. In other words, knowledge is dynamic and is built around the process of discovery (Dewey, 1916).

Dewey considered the teacher as the guide rather than a director since learning allowed for creative interaction with the teacher rather than with outcomes - based teaching. Vygotsky

emphasized socio-cultural context (human interaction) and its impact on what is learned Vygotsky (1978) his theory is known as “social constructivism” in review of this emphasis , which is particularly expressed in the thesis that learning is not passive in the sense that learners are passive reacceptance of knowledge, but are actively engaged at all times in a process of constructing knowledge from what is received through the senses .It follow education based on this principle is naturally learner-centered, while the instructor plays an advising and facilitating role. Learners should be allowed to construct knowledge rather than being given knowledge through instruction Duffy and Cunningham (1996).The major emphasis of constructivists is situated learning, which conceives learning as contextual. Learning activities that allow learners to contextualize the information should be used in online instruction. If the information has to be applied in many contexts, then learning strategies that promote multi-contextual learning should be used to make sure that learners can indeed apply the information broadly. Learning is moving away from one-way instruction to construction and discovery of knowledge Tapscott (1998).

Epstein (2002) asserts that there are nine general principles of learning that are derived from constructivism:

(1) Learning is an active process in which the learner constructs meaning from sensory input.

(2) People learn to learn as they learn. Learning consists both of constructing meaning and constructing systems of meaning.

(3) Physical actions and hands-on experience may be necessary for learning, especially for children. More particularly activities need to be provided that engage the mind as well as the hand. Dewey called this reflective activity.

(4) Learning involves language: the language that we use influences our learning. Vygotsky, a psychologist who constructed substantially to the theory of constructivism, argued that language and learning are inseparable.

(5) Learning is a social activity: our learning is intimately associated with our connection with other human being e.g. teachers, peers, family, and casual acquaintances.

Dewey pointed out that most of traditional learning is directed toward isolating the learner from social interaction, and towards seeing education as a one-on-one relationship between the learner and the objective material being learned.

(6) Learning is contextual: we learn in relationship to what else we know, what we believe, our prejudices and our fears.

(7) One needs knowledge to learn: it is not possible to absorb new knowledge without having some structure developed from previous knowledge to build on. The more we know, the more we learn.

(8) Learning is not instantaneous: it takes time. For significant learning we need to revisit ideas, ponder them, try them out, play with them, and use them.

(9) The key component to learning is motivation (Epstein, 2002).

E-learning and motivation

Zhao and Cziko (2001, p.27) Identified three conditions that must be fulfilled for teachers to be motivated and to use ICT in their teaching practice: "

1. Teachers must believe that by using technology they are more likely to achieve a higher-level goal than through other means ('effectiveness').

2. They must believe that if used, technology will not disturb the other high-level goals that they want to achieve ('disturbances').

3. Finally, teachers must believe that they are in control, having the ability and resources to use ICT effectively (‘control)."

The use of more technology does not lead to motivated students. E-learning instruction has transformed the student teacher relationship by making it less personal. Teachers are expected to transform the classroom into an online environment, so they have to consider how to motivate students in an e-learning environment TEC (2004).E-learning has developed rapidly from simple ways of delivery to complex learning environments in which motivation is an essential factor for success/failure .In the age of life-long learning and increased competition for time, motivation becomes a salient issue. Motivation in e-learning is seen as a matter of design: proper instructional design and provision of suitable learning activities will engage all learners. Only recent research has considered the learner as a source of information for his/her motivational state, although not really involving the learner but trying to infer his/her motivation from interaction with teachers, peers and the system.

Motivation is essential to learning. According to Malone and Lepper (1987) motivation is divided into two types: (1) intrinsic motivation which is driven from the learner’s interest; and (2) extrinsic motivation which is imposed. Most learners need extrinsic stimulation to learn, regardless of how effective the online materials are. The issue is whether to use intrinsic motivation (driven from within the learner) or extrinsic motivation (instructor and performance driven). Designers of online learning materials should use intrinsic motivation strategies, (Malone, 1981); but extrinsic motivation should also be used since some learners are depend on it. Keller proposed a model (ARCS attention, relevance, confidence, satisfaction) for learner motivation, (Keller, 1983); Keller and Suzuki, (1988).

Attention: Capture learners' attention at the start of the lesson and make sure it stays with you throughout the lesson. The e-learning materials must include an activity at the start of the learning session .To connect with the learner it is necessary for the teacher to be equipped with a variety of tactic, such as interesting graphics, animation or any kind of event that introduces incongruity or conflict Keller and Suzuki (1988)

Relevance: Inform learners of lesson objectives and the benefit they could derive from the lesson. Strategies could include describing how learners will benefit from taking the lesson and how they can use what they learn in real-life situations. This strategy helps to contextualize the learning and make it more meaningful, thereby maintaining interest throughout the learning session.

According to Keller (1883), having clear goals is a key component of relevance. Learner goals can be extrinsic to the learning in that it is necessary to pass a course to be eligible for a desired opportunity, but a stronger level of motivation to learn is achieved when the learner experiences intrinsic goal orientation, that is when the learner is engaged in actions that are personally interesting and freely chosen.

Confidence: Use strategies such as designing for success and informing learners of the lesson expectations. Design for success by sequencing from simple to complex, or known to unknown, and use strategies that actively involve learners in constructing their knowledge by centering the learning process. Confidence is accomplished by the teacher when helping students establish positive expectancies for success and to then experience success under conditions where they attribute their successes to their own abilities and efforts rather than to luck, or to the task being too easy or difficult Weiner (1974).

Satisfaction: To secure satisfaction teachers have to provide learners with positive feedback on performance, encouragement when they experience difficult, and allow learners to apply what they learn in real-life situations. Learners like to know how they are doing, and they like to contextualize what they are learning by applying the information in real life. To increase the understanding of the relation between e-learning and motivational processes it is necessary for the teacher to gain a better understanding of learning materials and activities that are developed to increase motivation Keller and Suzuki (1988).

Why are some teachers quicker than other to notice and response to e-learning readiness while others show later response or resistance to it?

In this section the Rogers model of innovation adaptors will be taken as the standard against which to compare different teachers' responsiveness to teachers' readiness to engage in e-learning.

Why are radical changes needed in schools?

In the 21st century, the ever-increasing needs of individuals and society are placing a heavy burden on established educational institutions. At the same time traditional structures and methods of teaching appear less and less responsive to the challenges of our turbulent times. There is a clarion call for innovation and transformation among teachers everywhere, especially in the elementary school, the most crucial stage in the development of a human being. Furthermore, the internal problems of schooling are inseparable from external changes on a global scale and must be seen in the context of contemporary world problems. These, in turn, will not be solved unless approached and treated educationally as well as economically, politically, and socio-culturally. Students who enter school are communicative, curious, creative,

and capable of learning many things. They have proved this already by mastering a mother tongue, physical motion, complicated games and many other life skills UNESCO (2005).“However, we believe that the traditional school of the 20th century, which is still very much with us, diminishes these abilities over the period of learning. We need a new kind of school for the 21st century UNESCO (2005, p.19).The recent radical changes in education imposed demands that teachers be equipped to assure a professional role as ICT managers whose technical and pedagogical skills are continually updated to match advances in technology and its applications in the learning environment. Much will be achieved through electronic networking with colleagues in schools, universities and other relevant institutions. ICT is becoming both the object of professional growth and the medium through which it is achieved. Without adequate investment in teachers’ professional development and enhanced professional activities, effective technological integration into schools cannot succeed Edwyn (2001). Meanwhile, in many schools today, and probably for time to come, only the teachers with regular access to ICT are teachers of a special subject called Information Technology, or Computer Science, or Informatics. These teachers will execute the important mission of being agents of change, not only in ICT, but also in the whole system of education since ICT is the instrument that can launch an important and general paradigm shift” UNESCO (2005, p.188).

Why do teachers need to understand the educational change

Dewy in ‘Democracy and Education’ says: “Society not only exists by transmission and by communication, it exists in transmission and communication." Fullan, (1991, p.117) notes: “Educational change depends on what teachers do and think- it’s as simple and as complex as that.” For educational change to happen, teachers will have to understand themselves and be understood by others (Fullan, 1991). (Nisbet, 1969) points out the multifaceted nature of

implementing change. We must understand stability and order which identifies where teachers are and how they will access and cope with wanted and unwanted change.

According to Ellsworth (2000) classrooms and schools become effective when:

(1) Quality people (teachers) are recruited to teaching, and

(2) The work place is organized to simulate and reward accomplishment. Change surrounds us every day in the form of new technology and new ideas which affect our perceptions of the world. We are immersed in this process without even trying to understand its nature. The appearance of an information -based society has caused changes never seen before. For decades now, change has become an increasingly dominate topic that tends to bush aside, override all others. According to Fullan (1991) one of the most fundamental problems in education today is that people do not have a clear, coherent sense of what kind of educational change is necessary, for what purpose and how to achieve it. Thus, there is much faddism, superficiality, confusion, failure of programme change, unwarranted and misdirected endeavour and misunderstood reform. What we need is a more coherent picture of people who are involved in or affected by educational change to make sense of what they are doing. This is apparent in developing countries where people try to implement change before they have decided what they need to change or why or how it should be accomplished. The pursuit of educational change must proceed from a roundly argued rationale ranging from the minutiae of practical implementation to the overarching philosophy that motivates the process of change. Educational change for which real innovation, even at the simplest level in the classroom, is multidimensional Fullan (1991) identifies at least three dimensions in implementing any new programme or policy:

(1) The possible use of new or revised materials (instructional resources such as curriculum material or technologies.

(2) The possible use of new teaching strategies or approaches.

(3) The possible alteration of beliefs (pedagogical).

All three factors of change are necessary because together they represent the means of achieving a particular educational goal or set of goals. For many researchers the process of change takes place in three phases: Initiation, also referred to as mobilization or adaptation, consists of processes that lead up to and includes a decision to adapt or proceed with a change. Phase II – implementation or initial use (usually two or three trial years to put an idea or reform into practice. Phase III- continuation in corporation with institutionalization refers to whether the change gets built in an ongoing part of the system or disappears by means of discarding decisions or through attrition Fullan (1991).

According to Fullan (1991, 42)"the earlier research on the initiation and implementation process stressed the impact of the nature of the change itself on the nature of the potential user that is teachers in their classrooms."

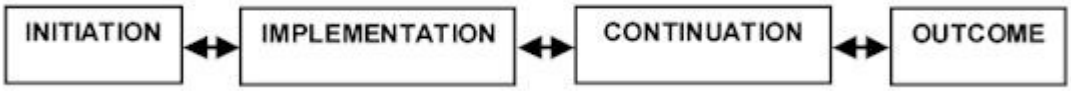

Figure 2.4 Simplified overview of the process of change: initiation, implementation, continuation, and outcome Adapted from Fullan (1991, p. 48).

Fullan (1991) model of the change process

Initiation: This is the process leading up to and including the decision to proceed with implementation. Many variables can influence whether and when teachers start implementing (ICT) in their teaching process. In this section I will concentrate on factor associated with planned or oriented change. The sequence is immaterially, but different combinations are significant. Here are eight factors affecting initiation phase according to Fullan (1991, p.51):

1. Existence and quality of innovations: “Educational innovation found in plentiful numbers. Innovations are usually a response to social incentives, while market conditions set limit to achievable innovative change. Both variety and quality of innovation are critical issue where e-learning is concerned. Quality according to National Diffusion Network (NDN) is a programme that brings about observable change, but its exact definition is controversial. After year of trail and error, however, and continuing development, quality standards do seem to be improving."
2. Access to innovations: “second factor related to initiation is the selectivity that results by default from varying degrees of access to information. For example individual teachers are less likely to come into contact with new ideas, if they are restricted to the classroom and cannot contact their professional peers in a professional context. The professional literature and occasional workshops to which they are exposed cannot make up for the lack of regular personal contact, which is essential in order to keep up with latest development in the professional domain.

Finally, access to information, as is obvious but rarely emphasized, depends on communication infrastructure, ease of transportation, resources, and density of population in the geographical area concerned. Naturally, well-develop and networked urban areas after much better access to information than poorly developed and sparsely settled rural areas” Fullan (1991, p.53).

3. Advocacy from central administration: “initiation of change never occurs without an advocate, and one of the most powerful is the chief district administrator and his/ her staff, especially in combination with school board support or mandate. In some instances, the school district administration may not be interested in innovations, and little may

happen. But when there is an interest whatever for reason, whether it is a mandate from the board, or the initiative of a reform minded or career-oriented administrator, it is the superintendent and central staff who combine the access, internal authority, and resources necessary to seek out external funds for a particular change programme, or to obtain board support. A number of studies show that the districts chiefs are key figures who need to be drawn into the process of advocating, supporting, and initiating new ideas" Fullan (1991, p.54)**.**

4. Teacher advocacy: "Teachers as a group are relatively isolated from new ideas and lack the time and energy to follow through on ideas that come their way. In research that conducted by Little's (1982) into improvements and working condition at six schools it was found that improvement occurred when:
    - teachers engaged in frequent, and increasingly practice oriented discussion of teaching practice;
    - teachers and administrators interacted frequently and developed "a shared language" concerning teaching strategies and needs ; and
    - Teachers and administrators planned, designed and evaluated teaching materials and practices in concert.

According to Fullan (1991, p.55)" teachers need to acquire an improvement mentality so that they will always be on the look out for opportunities to improve existing systems.

5. External change agents: "play an important part in initiating change. They make people aware of the existence of new practices; help school manager choose among a range of new practices; sometimes help to arrange funding ; work with local facilitators to develop plans for implementation; arrange and conduct initial training; and sometimes most

influential at the early stages of changes and when they work with the local leaders", Fullan (1991,p.56).

6. Community pressure/ support/ apathy: "In general terms, and depending on circumstance; communities can either

(1) Put pressure on school district administrators (directly or through school boards) to "do something" about a problem;

(2) Proposed measures that they consider to be course productive and;

(3) Do nothing (passive support or apathy).The role of the community in the initiation process is not straightforward, but this is understood in light of the following considerations:

- Major geographic changes create turbulence in the environment, which may lead to change or irreconcilable conflict, depending on the presence of other factors.
- Most communities do not actively participate in decisions to implement educational change.
- Better educated communities seem to put pressure on their schools to adopt high-quality, academic-oriented changes. They can also react strongly and effectively against proposed changes that they do not like.
- Less educated communities are less likely to initiate change or put effective pressure on educators to initiate changes on their behalf. They are also less likely to resist change because of deficient knowledge, but they can be effective if only motivated" Fullan (1991, P.57).

7. New policy – funds (Federal/State/ Local): "Since we are talking about "causes of adoption," we need make only two points. First, without the existence of state and federal lobby groups and reform-minded policymakers, many new social change programmes

would never even get formally adopted. Many major educational initiatives are generated through government policy making and legislation in areas in greatest needs of reform, such as special education, desegregation, basic skills, teacher education, and the like.

The second point is more of a dilemma. On the one hand policies are often left ambiguous and general; it is easier in this cause for local district to adopt policy in principle, but problems such as lack of implementation emerge at later stages" Fullan, (1991, P.59).

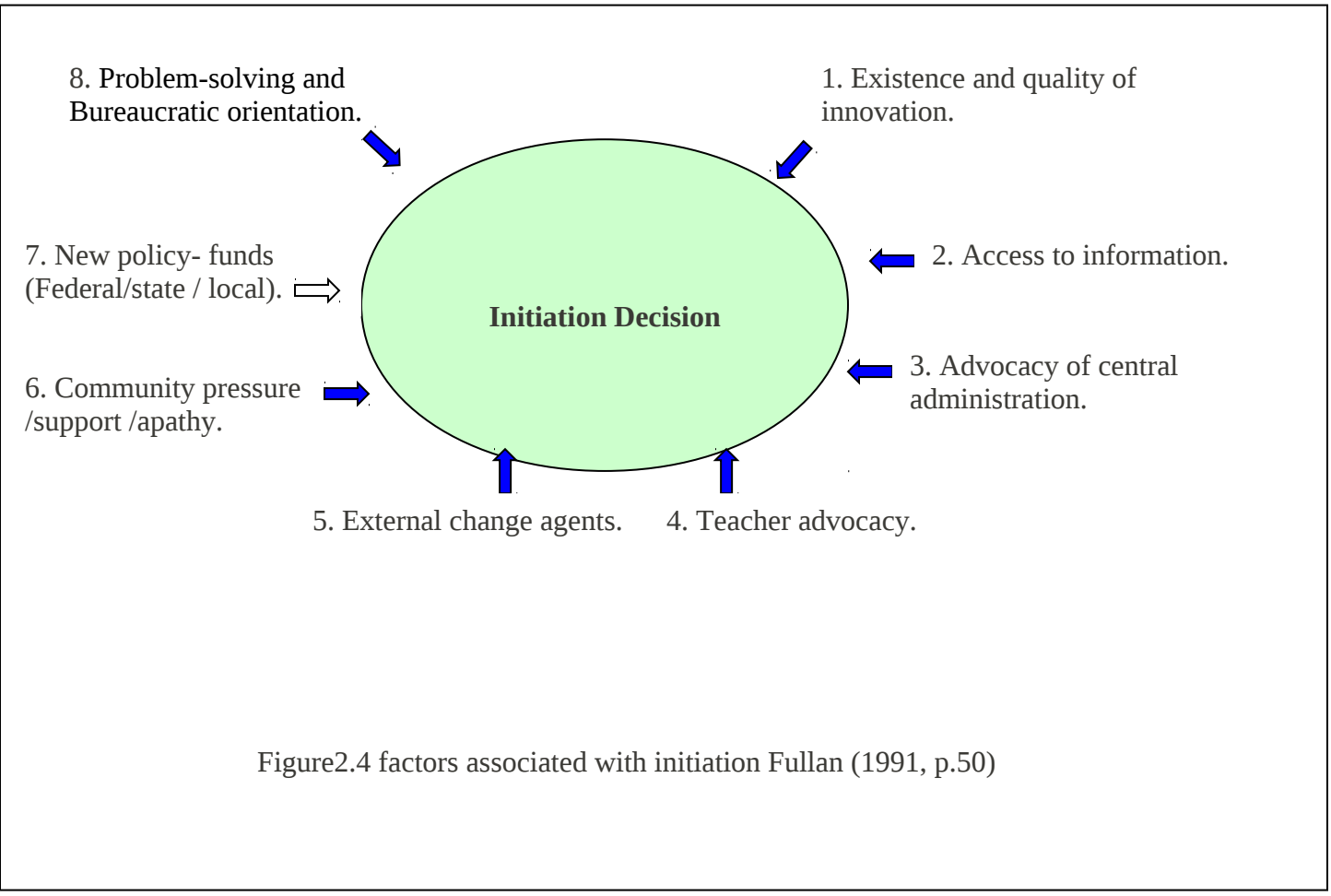

Figure2.4 factors associated with initiation Fullan (1991, p.50)

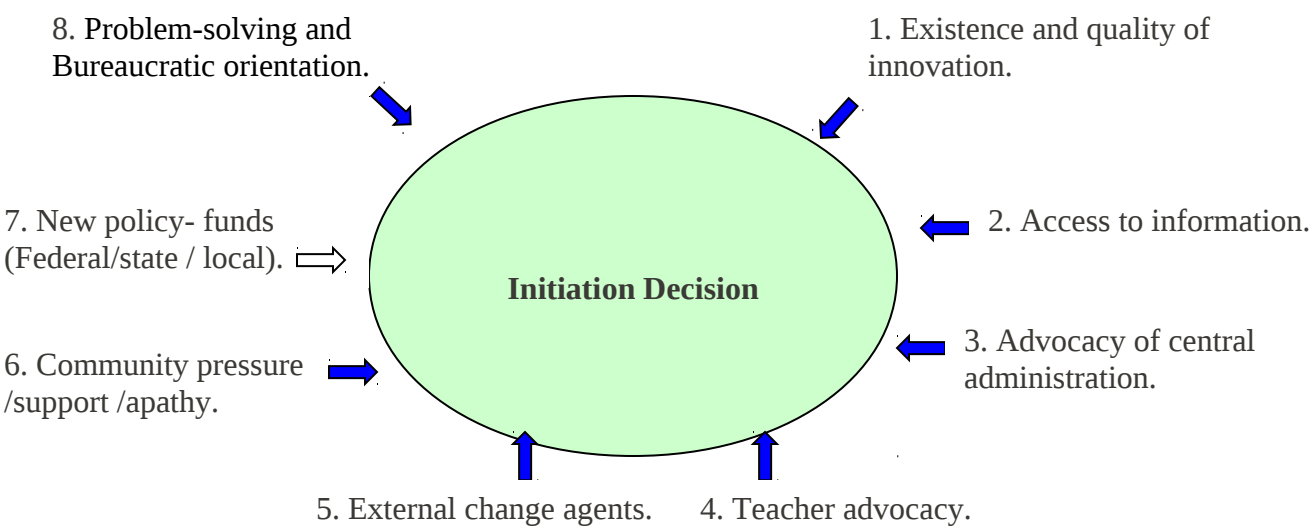

Figure 04: Factor associated with initiation Fullan (1991, p. 50)

Implementation:

Fullan and Stigelbauer (1991) identified three areas of the major factors affecting implementation: characteristics of change, local characteristics and external factors (government and other agencies). They identified different stakeholders in local, and federal and governmental levels. They also identified characterizations of change to each stakeholder and the issues that each stakeholder should consider before committing a change effort or rejecting it.

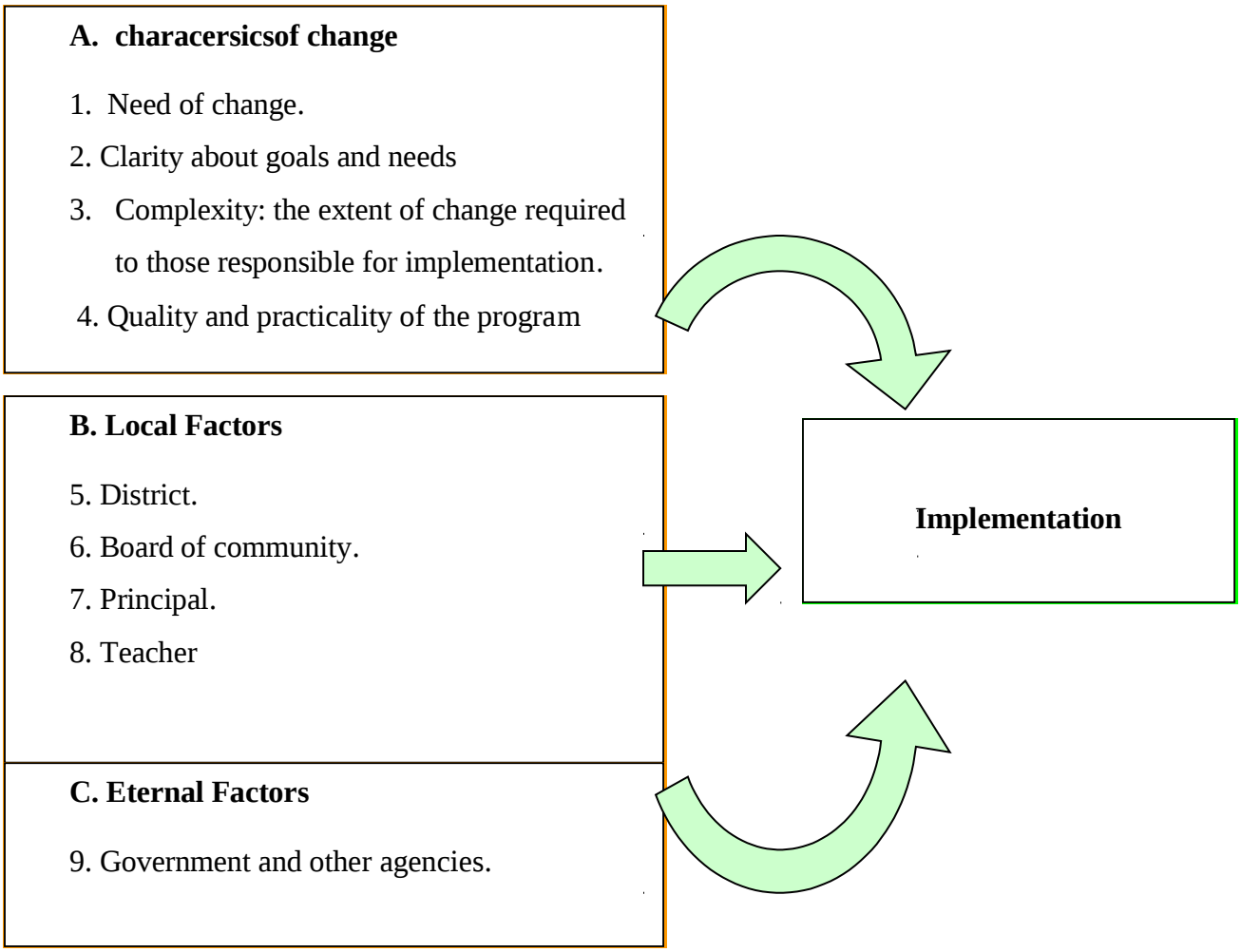

Figure 25 :Interactive Factors Affecting Implementation, adapted from Fullan (1991, P. 68).

Continuation:

Continuation is a decision about institutionalizing an innovation according to whether, first of all, reaction to it is negative or positive; secondly whether it becomes change and its outcome; and

- Firmly embedded or built into the structure (through policy/budget/timetable).
- it has won the commitment of a critical mass of administrators or teachers to the new situation;
- It has established procedures for continuing assistance Fullan (1991).

Outcome:

Attention to the following perspectives on the change process may support the achievement of a positive or successful change outcome:

- Active initiation and participation: change does not end with initial action of change, but in evolves as it continuous to be operationalised and brings about environmental changes.
- Pressure, support and negotiation.
- Changes in skills, thinking, and committed actions.
- Overriding problem of ownership Fullan (1991).

In summary, Fullan (1993, p34) suggests qualities required to implement change effectively:

- " The ability to work with polar opposites: imposition of change vs. self-learning; planning vs. uncertainty; problems vs. creative resolution; vision vs. fixed direction; individual vs. groups; centralizing vs. decentralizing; personal change vs. system change.
- Dynamic interdependency of state accountability and local autonomy.
- Combination of individuals and societal agencies.
- Internal connectedness with individual persons and within organization and external connectedness with others and the environment."

Fullan (1999, p.18) notes out the importance of realizing that the educational change process is complex. To deal with such complexity is not to control the change, but to guide it.

Fullan provides eight new lessons about guiding change: "

1. Moral purpose is complex and problematic.
2. Theories of education and theories of change need each other.
3. Conflict and diversity are our friends.
4. Understand the meaning of operating on the edge of chaos.
5. Emotional intelligence is anxiety provoking and anxiety containing.
6. Collaborative cultures are anxiety provoking and anxiety containing.
7. Attack incoherence connectedness and knowledge creation are critical.
8. There is no single solution." Fullan (1999, p.18).

What are the stages that teachers need to go through as they learn about and adopt these innovative applications of technology?

There are a number of important adoption models. The focus was given to the most important works in the field. Rogers models Rogers (2003, p.12) "Formulated the innovation decision process theory according to which there are five distinct stages to the process of diffusion:

- **Knowledge**: is created when an individual learner of the existence of an innovation becomes familiar with how it works.
- **Persuasion**: This is happen when a person becomes favorably disposed to an innovation.
- **Decision**: A process evidenced in activities that lead to a choice to adopt or reject an innovation.
- **Implementation**: This happen when someone starts making use of an innovation.
- **Confirmation**: support for a decision to introduce an introduction, or support for the reversal of such decision as a result of conflict. ” Rogers (2003, p.169)

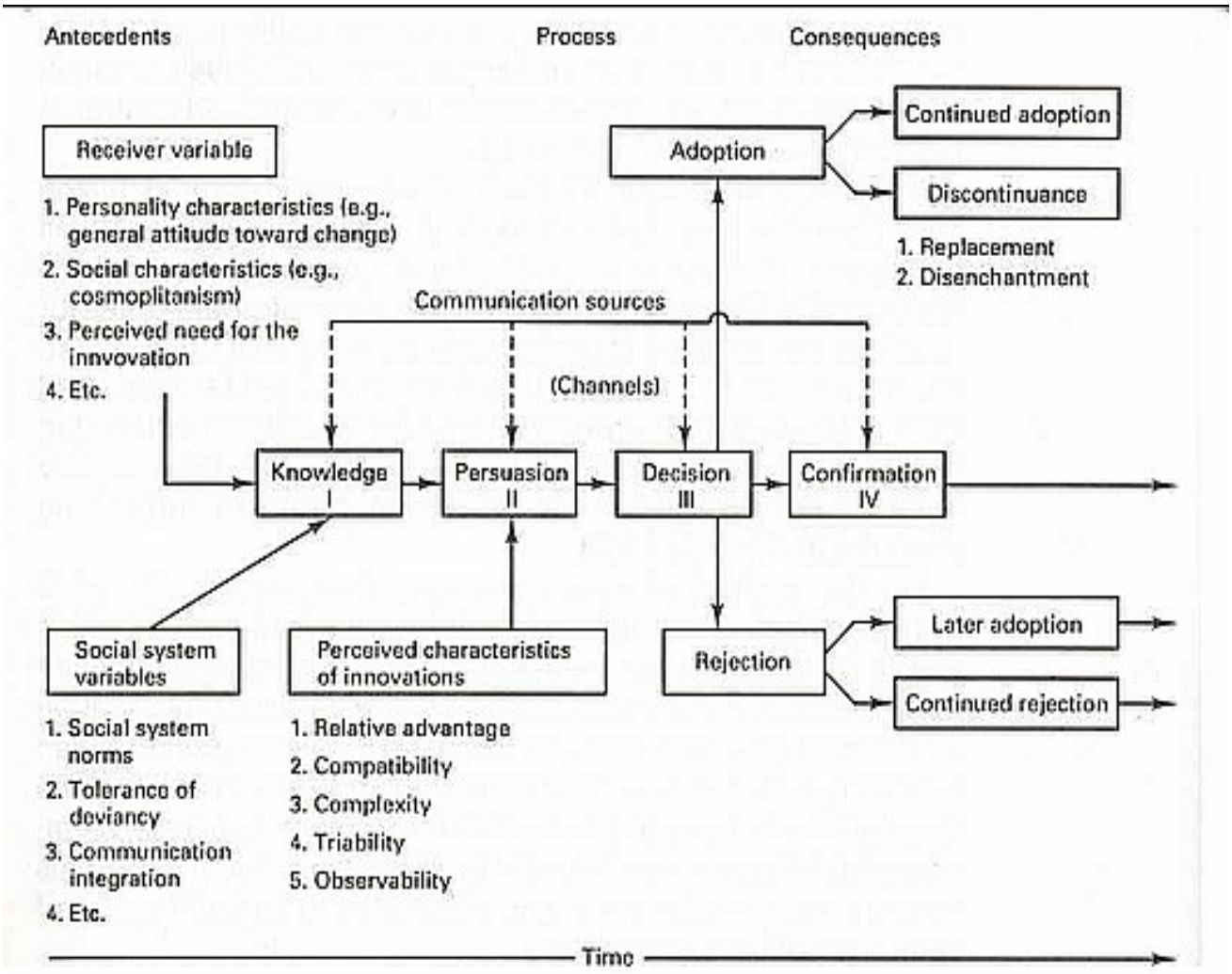

Figure 2-6:: Rogers Diffusion of Innovation Model: Rogers (2003).

Rogers (2003) diffusion of innovation theory, centered on the conditions which increase or decrease the likelihood that a new idea, practice, or product would be adopted by members of a given culture. Rogers defined diffusion as "the process by which an innovation is communicated through certain channels over a period of time among the members of a social system."

Rogers (2005) in this theory and research study suggests that over time, the social system, the opinions, needs, and perceptions of the potential adopters are primary forces that influence adoption.

The concerns-Based Adoption Model of Hall and Loucks (1979) is useful in explaining the lack of teacher investment in innovations and describes the seven levels of concern that teachers experience as they adopt a new practice:

- **Awareness.** Teachers are relatively uncommitted to or uninvolved with the innovation.
- **Informational.** Teachers have a general interest in the innovation and would like to know more about it.
- **Personal.** Teachers want to learn about the personal ramifications of the innovation. They question how the innovation will affect them.

- **Management.** Teachers learn the processes and tasks of the innovation. They focus on information and resources.
- **Consequence.** Teachers focus on the innovation's impact on students.
- **Collaboration.** Teachers co-operate with other teachers in implementing the innovation.
- **Refocusing.** Teachers consider the benefits of the innovation and think of additional alternatives that might work even better.

Innovativeness and adoption categories

Rogers (2003, p. 267) states that “the individuals in a social system do not all adopt an innovation at the same time. Rather, they adopt in an over-time sequence, so that individuals can be classified into adopter categories on the basis of when they first begin using a new idea." Figure: 2 shows the normal frequent distribution divided into five categories in which the author used two statistic, mean and standard deviation to divide a normal adopter distribution into five categories. Vertical lines are drawn to make of the standard deviation on either side of the mean so that the normal curve is divided into categories with standardized percentage of respondent in each category. The five adopter categories are: (1) Innovators (2) Early Adopters (3) Early Majority (4) Late Majority (5) Laggards**.** These five adopter categories and approximate percentage of individuals included in each are located on the normal adopter distribution in the figure. The area lying to the left f the mean time of adoption (of an innovation) minus two standards deviation” Rogers (2003, p. 267)

Rogers (2003) in his individual innovativeness theory suggests that individual’s react differently to change based on a stable trait or predisposition. He has developed a classification scheme of potential adopters based on their receptivity. The figure below can be used to shows how teachers react differently to e-learning as a new innovation.

Here are the main characteristics and values of each adopter categories according Rogers (2003) this classifications of adopter categories will help to understand why some teachers response an early to e-learning innovations while other resistance and to some extents it help to identify characteristic of teachers who contribute to e-learning readiness.

- **Innovators -** the risk takers willing to take the initiative and time to try something new.

In more details their interest in new ideas leads them to out of a local circle of peer net works and into more cosmopolite social relationships and enjoy with communication patterns and friendship among a clique of innovators. “Being an innovator has several prerequisites."
The ability to understand and apply complex technical knowledge is also needed. The innovator must be able to cope with a high degree of uncertainty about an innovation at time he or she adopts. The innovator must also be willing to accept an occasional setback when a new proves unsuccessful, as inevitably happens.” Rogers (2003, p. 282).

- **Early Adopters** –“are a more integrated part of the local social system than are innovators. Early adopters are consider by many to be “individual to check with” before adopting a new idea. This adopter category is generally sought by change agents as a local missionary for speeding the diffusion process. They are tending to be respected group leaders, the individuals essential to adoption by whole group”, Rogers (2003, p. 283).
- **Early Majority** – adopt the new ideas just before the average member of a system. The early majority interacts frequently with their peers but seldom hold positions of leadership in a system. The early majority characterize by: careful, safe, deliberate individuals unwilling to risk time or other resources.

- **Late Majority** – “adopt the new ideas just after the average member of a system. Those suspect of or resistant to change. Hard to move without significant influence” Rogers, (2003, p. 283).
- **Laggards** – “are the last in a social system to adopt an innovation. They possess almost no opinion leadership. They are near isolates in social system. These are those who are consistent or even adamant in resisting change. Pressure needed to force change” Rogers (2003, p. 284).

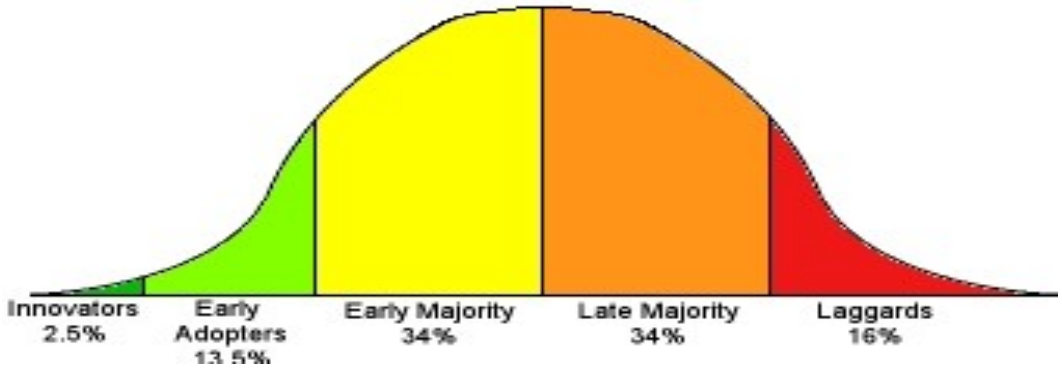

Figure 0-7: the relationship between the types of adapters divided by innovativeness and their place on the adaptation curve Rogers (2003, p.281).

Teachers and adoption of technological innovations

There are many models describing teachers and the adoption of technological innovations. According to Rogers (1986) the ways in which adoption of ICT differs from other types of innovations are as follows:

1. A critical mass of adopters is needed to convince the majority of other teachers of the utility of the technology.

2. To ensure the success of the adoption and diffusion regular and repeated use is necessary.
3. Information and communication technologies can be used in a variety of ways and adoption is part of a process that involves significant evolution on the part of the adopters.

Research conducted by Apple Computer in the Apple Classroom of Tomorrow (ACTO) cited that teachers pass through several stages as they integrate technologies into the educational environment Dwyer, Ringstaff, and Sandholtz (1991).The model contains five stages--Entry, Adoption, Adaptation, Appropriation, and Invention.

Entry - teachers struggle to cope with and establish order in the transformed classroom

Adoption - the beginning of adoption into the traditional classroom

Adaptation - while traditional teaching methods still predominate, but now supported with technology.

Appropriation - with increasing confidence teachers become confident and pedagogically innovative.

Invention - creativity including active experimentation by teachers and students.

Ely's eight conditions of change

Donald P. Ely is one of the few authors who have done extensive research into the implementation of instructional innovations. His research (1990, 1999) has shown that the existence of certain conditions tends to facilitate the teachers implementation of an innovation. These conditions are:

1) **Dissatisfaction with the status quo:** an emotional discomfort that results from perceiving the current method as inefficient or ineffective. This condition does not have as much influence as the other seven (Ely 1990, 1999).

2) **Knowledge and Skills:** an assessment of the current level of skills and knowledge of the product users. Ely reports that this condition consistently ranks as one of the most influential conditions among the eight Ely (1990, 1999).

3) **Adequate Resources:** the amount of resources currently available to successfully implement the innovation. Resources include finances, hardware, software and personnel Ely (1990, 1999).

4) **Time:** adequate time and compensated time for users to become educated and skilled in how to use the innovation. This condition refers not only to the organization's willingness to provide time but the users' willingness to devote learning time for implementation Ely (1990, 1999).

5) **Rewards or Incentives:** the existence of incentives that motivate users to employ the innovation, or rewards provided by the organization for those who do use the innovation (Ely, 1990, 1999).

6) **Participation:** the involvement of key stakeholders in decisions that relate to the planning and design of the innovation. The condition refers to all stakeholders but emphasizes the participation of product users Ely (1990, 1999).

7) **Commitment:** the perception by users that the powerbrokers of the organization (i.e. Presidents, CEO, Vice-Presidents) actively support the implementation of the innovation Ely (1990, 1999).

8) **Leadership:** an active involvement by immediate supervisors in assisting the users in implementing the innovation Ely (1990, 1999).

Summary

In this section, I summarized what Rogers set out about characteristics of both an earlier and later adopter, this classification will help me to investigate why some teachers show an early response to e-learning while others do not.

Table 3: shows the comparison between the earlier and lower adopter under three headings: (1) socio- economic status, (2) personality values, and (3) communication behavior Rogers (2003).

Table 2.3: Summary

Characteristic of adopter categories	**Earlier adopters**	**Later adopters**
Socioeconomic Status		
Age .1	There is no relation between age and .innovativeness	There is no relation between age .and innovativeness
.Years of formal education .2	Have more years of formal .education	Have few years of formal .education
Literate .3	.More likely to be literate	.Unlikely to be literate
Social status (income , level of living, possession of wealth, occupational prestige, self perceived identification with (social class , and the like .4	.Higher	.Lower
Social mobility .5	Have a greater degree of upward .social mobility	Have a worse degree of upward .social mobility
Personality Values		
Empathy .1	Have a greater ability to launch himself/ herself into the role of .another	Have a greater ability to launch himself/ herself into the role of .another
Dogmatic .2	Less dogmatic, .i.e. Would welcome .new ideas	More dogmatic, .i.e. would not .welcome new ideas
Dealing with abstractions .3	Have a greater ability to deal with abstraction i.e. can adopt a new ideas according to abstract stimuli, such as received from the mass	Have a worse ability to deal with abstraction i.e. can not adopt a new ideas according to an abstract stimuli, such as received from the

	.media	.mass media
Rationality .4	Have a greater rationality i.e. Can use most effective means to reach a .given end	Have a worse rationality i.e. he / she is not seek to use most effective means to reach a given end
Intelligence .5	.Have more intelligence	.Have less intelligence
Attitude towards change .6	Have more favorable attitude toward .change	Have less favorable attitude toward .change
Cope with uncertainty and risk .7	Are better able cope with uncertainty and risk	Are worse able cope with ?uncertainty and risk
Communication Behavior		
Social participation .1	.Have more social participation	.Have less social participation
Connectedness.2	Are more highly interconnected through interpersonal networks in .their social system	Are lower interconnected through interpersonal networks in their .social system
Mass media communication .3	Have greater exposure to mass channels	Have less contact with mass media .communication channels
response to Information .4 about innovation	Actively seek Information about .innovations	Passively seek Information about .innovations
knowledge of innovations .5	Have greater knowledge of .innovations	Have less knowledge of .innovations

2.2 What barriers obstruct the use of ICT in teaching?

Introduction

In this section I am going to identify the barriers that obstruct teachers from using ICT in their teaching and look at their causes and effects and how teachers overcome them. Identification of the teacher's barriers is the first step to eliminate them. Ginsberg and McCormick, (1998) state that though teachers agree on the potential that lies in computer technology to effect significant changes in education, more often than the full potential of the computer is not being exploited. The reality is that computers are most often employed to

supplement traditional classroom pedagogy and have not been fully integrated into classroom learning activities. The question this raises is why an innovation that has been present in schools in some form for around twenty years has not yet reached critical mass.

According to BECTA (2003) a 'barrier' is defined as any factor that prevents or restricts the teacher's use of ICT in the classroom.

To increase and improve the use of ICT in the classroom, a range of obstacles that prevent teachers from using ICT effectively, need to be overcome. In this study I am going to identify these barriers and examine their causes and effects and how teachers overcome them. Identification of the teacher's barriers is the first step to remove them Dawes (2002). Pelgrum (2001) reports on an international survey of teachers' perceived obstacles in using ICT and identify three major factors: lack of resources, lack of knowledge and skills and pedagogical difficulties to integrate technology in instruction.

As noted in BECTA (2003, p.1**)** the key barriers in using ICT are: "

- Lack of access to appropriate ICT equipment.
- Lack of time for training, exploration and preparation.
- Lack of models of good practice in ICT.
- Negative attitudes towards computers in education.
- Computer anxiety and a lack of confidence.
- Fear of change and a lack of personal change management skills.
- Unreliable equipment.
- Lack of technical, administrative and institutional support" **(p.1)**

According to the European Schoolnet report (2006, p.54) "the main factors which prevent teachers from making full use of ICT can be broadly grouped into three categories:

Table 2:4: The three categories which prevent teachers from making full use of ICT

European Schoolnet (2006, p.54).

Teacher-level factors	.Lack of teacher ICT skills
	.Lack of teacher confidence
	.Lack of pedagogical teacher training
	;Lack of follow-up of new ICT skills
	Lack of differentiated training programmes
School-level factors	.Absence of ICT infrastructure
	.Old or poorly maintained hardware
	.Lack of suitable educational software
	.Limited access to ICT
	.Limited project-related experience
	.Lack of ICT mainstreaming into school's strategy
System-level factors	.Rigid structure of traditional education systems
	.Traditional assessment
	.Restrictive curricula
	.Restricted organizational structure

A according to Scrimshaw (2004) there are four possible explanations:

1. Information and Communication Technology (ICT) is seen as incompatible with some teachers' wider educational beliefs.
2. There may be immovable social obstacles to greater levels of take-up.
3. There may be powerful but removable obstacles in schools to expansion of use.
4. The obstacles may be to do with the personal characteristics of some teachers.

One means of shedding some light on the barriers and complexities that obstruct teachers in using ICT in schools is to recognize that teachers' involvement with ICT is undoubtedly influenced by the working contexts in which they find themselves. Innovation and adaptation are costly in terms of the time needed to develop and establish new practices. In addition to the new interpersonal and pedagogic skills which teachers require to use ICT in their classrooms, other contextual factors which can act as barriers to using ICT include lack of confidence, experience, motivation, and training; access to resources and timetabled use of dedicated ICT classrooms; unreliability of equipment; classroom practices which clash with the culture of student exploration, collaboration, debate, and interactivity within which much technology-based activity is said to be situated Dawes (2001).

Schoolnet Africa (2006) in more concretely impact studies has identified the major barriers preventing more successful integration of ICT and achieving higher impact. They can be grouped under teacher level barriers (micro level), school level barriers (meso level) and system level barriers (macro level).On the micro level the lack of ICT skills of teachers and the updating of these skills is still a major barrier as it affects teachers' choice of a specific ICT much more than professional consideration. This, on the other hand influences the capacity of teachers to embrace new pedagogical practices with ICT. As mentioned beforehand there are other outside barriers that prevent teachers to embrace new technologies to the full extent.

On school level, ICT infrastructure and access to ICT is still a major issue. As often shown the availability of technology alone is not the only factor for successful integration of ICT, but its absence or poor quality due to insufficient maintenance is a crucial hindrance. Schools without sufficient ICT resources are clearly missing out on the extra educational opportunities ICT can offer. Other inherent barriers at school level are organizational set ups

which are linked to leadership issues and a strategy for ICT. The latest evidence shows that ICT strategies, in order to be effective, need to be integrated into the overall vision of the school. Moreover, where headmasters have used ICT to develop the school's values, teachers perceive a more positive impact of ICT. The evidence also proves the recurrent claim of reducing system level barriers mainly that of existing assessment and evaluation methods which do not take into account new competencies acquired by using ICT in learning. Teachers are under pressure in reaching the standard objectives and fear that schools using ICT will be less performing than traditional schools to explain barriers to the uptake of ICT by teachers in details, the researcher is going to divide it into sub-sections for each of the barriers or groups of barriers we identified. Following the description of the barriers and the extent to which they are acknowledged by the literature, there is an analysis of the relationships which appear to exist between the barriers, which, it is hoped, will help us to understand further the reasons why some teachers find it difficult to integrate ICT into their work Schoolnet Africa (2006)

Lack of teacher confidence and teachers' computer anxiety

Many teachers who do not consider being well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do. Larner and Timberlake (1995) found that teachers were worried about showing their pupils that they did not know how to use the equipment, and that it was the teachers who experienced this kind of anxiety who were less willing and / or able to make use of computers in their teaching. In addition, pupils' attitudes and expectations of their teachers' competence in ICT are likely to contribute to this teacher anxiety. Also Guha (2000) states that students, who on the whole experience daily interaction with a wide range of technology, are increasingly placing demands on teachers, expecting them to be knowledgeable in the area of computer usage.

Lack of teacher competence

A factor which is directly related to teacher confidence levels is that of teacher competence

Kirkwood (2000) state that in order to achieve high levels of teacher competence in ICT, there is a need to provide training, and perhaps unsurprisingly, there is a great deal of literature evidence to suggest that effective training is crucial if teachers are to implement ICT effectively in their teaching. If training is inadequate or inappropriate, then teachers will not be sufficiently prepared, and perhaps not sufficiently confident, to make full use of technology in and out of the classroom. The lack of teacher competence, then, together with the associated lack of quality training for teachers, can be seen as a barrier to teachers' use of ICT.

Lack of time for training

Kirkwood (2000) mentioned that the fact that expecting teachers to train in their own time caused a slow uptake in the training. According to BECTA (2004) Lack of time as a significant barrier, and suggesting that one way to overcome this would be to provide non-contact time for teachers to undertake ICT training during school hours.

Lack of pedagogical training

Finding from a series of case studies carried out by Veen (1993, p. 41**)** involving teachers with limited experience or training in the use of computers, the majority of those teachers' use of computers, "did little that could be described as exploiting the overwhelming educational teachers possibilities of information technology", and Veen suggested there was a need for them to have more control over the learning process of the students.

Lack of skills training

Having expressed the need for pedagogical training, there is evidence to suggest that there still is an important need for training teachers in specific ICT skills. According to Lee (1997) there are many teachers "of advanced age" will not have had any computer education when in college, and as a result are in need of computer skills training to allow them to make use of computers in their work, Snoeyink and Ertmer (2001) in order to solve this problem, they suggest that the first stage of training should focus on the basic operations of technology and software applications, and once teachers have acquired the basic skills, only then should they move on to pedagogical training, Veen (1993) also suggests that training should be differentiated according to teachers' experience and skills in using computers. In this way differing amounts of skills training could be delivered according to individual teachers' needs.

Lack of access to resources

Mumtaz (2000) points out that schools that have high quality ICT resources are enjoyed with a very good practice in the use of ICT. And those schools that have a lack of computers and software can seriously limit what teachers can do in the classroom with regard to the implementation of ICT. "Primary Schools – ICT and Standards", BECTA (2003) point out that those schools which were well resourced in ICT tended to have better achievements than schools with unsatisfactory levels of ICT. The lack of good ICT resources in a school then will not only prevent teachers from making good use of ICT in their teaching, but it is also likely to have a detrimental effect on pupils' achievement, BECTA (2003).

Poor organization of resources

Pelgrum (2001) makes the observation that if teachers at schools with low pupil: computer ratios are still complaining of a lack of computers, then it could be that those teachers and their school managers need to consider whether or not they are optimizing the use of the available equipment, suggesting that in some cases it is the organization of resources, rather than the physical lack of them, which is creating a barrier to the use of ICT by teachers. Farby and Higgs (1997) find out that numbers of computers alone do not necessarily ensure adequate access, and that it is important to locate the proper amount and right types of technology where teachers and students can effectively use them.

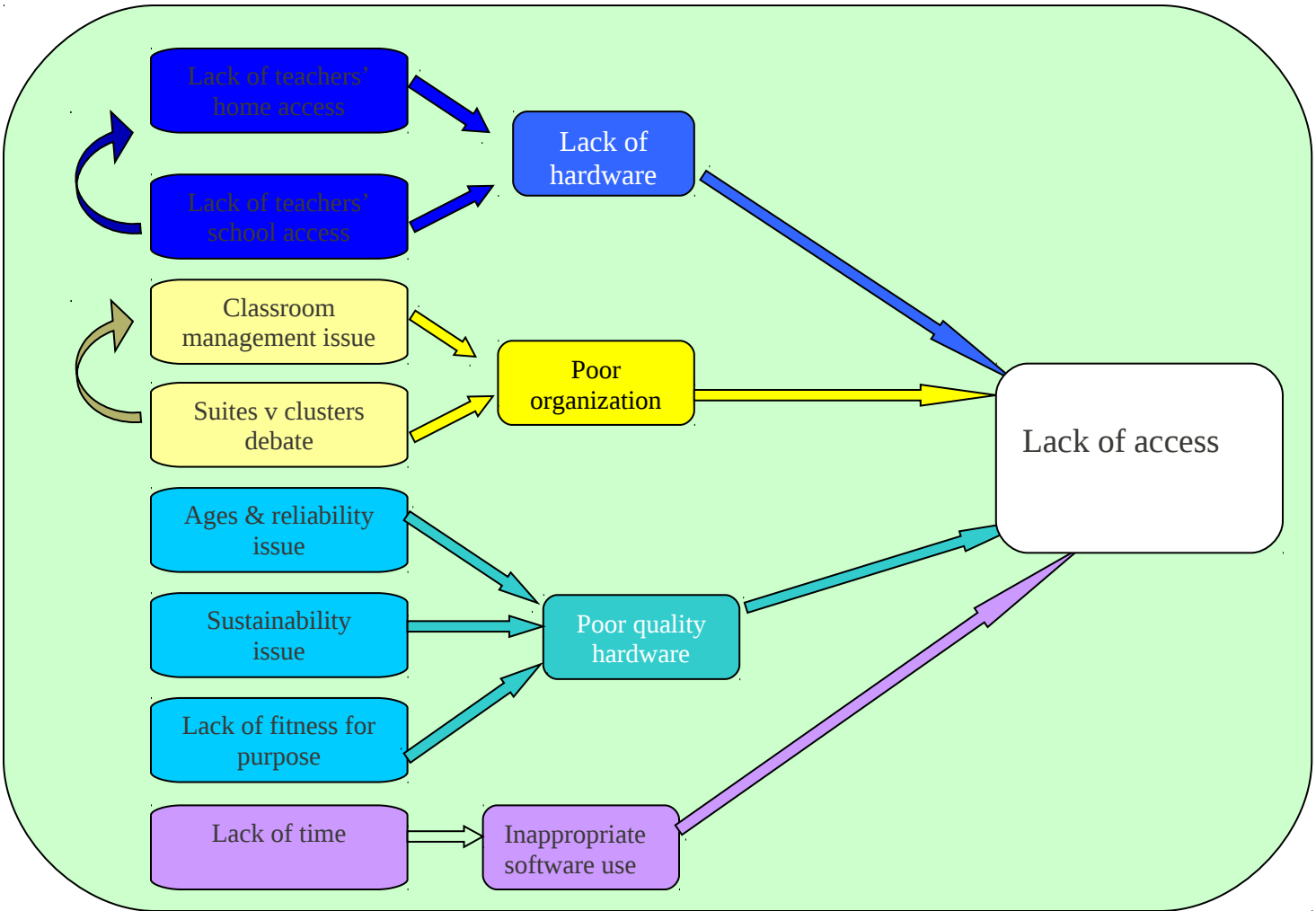

Figure 2.8: illustrate Issues relating to Access to resources barrier Adapted from BECTA (2004, p.22).

Lack of hardware

In a worldwide study of the obstacles to the integration of ICT in education Pelgrum (2001) identified 29 conditions that affected the implementation and use of instructional technology in education found that the most frequently mentioned problem when teachers were asked about obstacles to their use of ICT was the insufficient number of computers available to them.

Guha (2000) found similar results, with many teachers surveyed indicating that the number of computers in their classrooms was insufficient, and that if teachers were to continue to implement ICT into their work then they required the appropriate hardware and software to familiarize themselves with first, then guide their students accordingly. Interestingly, Guha also found that it was the teachers who used the technology most who were more likely to complain about a lack of equipment. This would suggest that as well as being a barrier to teachers' first use of ICT, it can also be a barrier to the further development of ICT in creative and innovative ways.

Ginsberg and McCormick (1998) conducted a survey of 1163 teachers to discern what barriers teachers encounter in using computers. The responses to their survey indicated that

issues surrounding computer hardware were the most serious barriers affecting implementation. Regarding hardware, teachers in both highly and less effective schools reported “serous” to “very serious” concern with “too few computers” and “too few printers.” Teachers in less effective schools also reported concern about “computer being too limited” Ginsberg and McCormick (1998, p2).

Inappropriate software

According to BECTA (2004, p.14**)** “ a number of respondents to the Becta survey suggested that although there might be an array of software now available for use in the classroom, much of this software is not appropriate or would not actually enhance a lesson in any way” . This idea is supported by Guha (2000) who found that poorly designed software, and a lack of time for teachers to design their own software, often cause teachers to “give up” and choose not to make use of ICT. Inappropriate software is also identified as a barrier in the research undertaken by the Centre for Guidance Studies Bosley and Moon (2003).Bosley and

Moon’s work was carried out with a focus on careers education and guidance, but their findings are worth considering when looking at ICT barriers in education as a whole. Bosley and Moon note that inappropriate software design can disengage the pupils from the intended learning processes, and as a result can create a barrier to ICT use. The authors also comment on other factors related to software which inhibit the use of ICT, such as the perceived high cost of software licenses, and also the lack of time available for staff to evaluate software.

Newhouse’s (1997, p.2) in evaluation of computer-saturated learning environment in part considers issues concerning teachers’ implementation strategies for computer in the classroom. He states that “One factor that is identified by teacher respondents in Newhouse’s study is the lack of availability and access to software that is subject content appropriate." This factor

perceived by teachers as being a serious barrier that has negative effect on their using computers in their classrooms. Ginsberg and McCormick (1998, p.2) list a number of teacher issue and potential barriers to implementation that are software related: “

- Matching courseware to the curriculum.”
- Evaluation, quality control.
- Acquisition, setting priorities.
- Security, placement.
- Appropriate use” (p.2).

Lack of personal access for teacher

One of the factors which contribute to the degree of a teacher’s confidence in using ICT in school is the amount of personal access to ICT that the teacher has ; Ross (1999) make a direct link between teachers’ use of ICT to accomplish their own personal goals and their confidence in making use of ICT in their teaching.

Lack of time

A problem that exists for teachers in many factors of their work is that of the lack of time available for them to complete given tasks, and teaching ICT is certainly an area that is affected by this. Stallard (1998) states that teachers are reluctant to embrace technology because of it is potential to shorten learning time for student .Stallard contends that teachers face a number of potential interruptions during the typical hours-long class and that, consequently, the actual time spent teaching and learning is shorten significantly .Hence if the implementation of computer technology involves “potential interruptions” to teaching and learning teachers may avoid using the technology. The Congressional Office of Technology cited in Bennet (1996) includes a list

of other conditional factors that make demands on teachers' time and affect individual teachers' decisions regarding implementing computer in the classroom: "…teachers who have taught with the computers agree that- at least initially- most uses of computers make teaching more challenging. individualized lessons matching software to the curriculum, scheduling student computer time, monitoring use , provide assistance, and troubleshooting- all adds burdens to the teacher's time …the net effect is increased demand on teacher's time and creativity … very few teachers have adequate time for planning and preparing to use technology" Bennett (1996,p.1).

Fabry and Higgs (1997) point out that, learning new skills in any profession requires time, but teachers have little time left after spending most of their day teaching, and with other commitments such as liaising with parents and attending staff meetings. Yet they do need that time to experiment with the technology, share their experiences with colleagues, and attend technology related in-service training programmes.

Technical problems

The barriers to teachers' ICT use caused by technical problems can be broadly split into two main areas.

Fear of things going wrong

A real concern for teachers when considering making use of ICT is the fear of equipment breaking down in a lesson, or that if they use the equipment they will do something wrong and cause damage to it themselves. In fact there are strong links between the barrier caused by a fear of doing damage to equipment, and the barrier caused by a lack of teacher confidence. This is highlighted by Bradley and Russell (1997), who note that a primary source of computer anxiety is the concern teachers have about damaging a computer's hardware or information base. This

anxiety is therefore likely to prevent such teachers from attempting to use the technology at all, even before there is a chance for any potential technical problems to occur. Cuban (2001) explain that if technical glitches occur weekly or a few times a month, then confidence in the technology's worth erodes, and this has a negative impact on the rate of teachers' take-up of ICT.

Lack of technical support

We have so far dealt with teachers' perceptions of how computers and technology can break down, and how this causes barriers to prevent them from considering using ICT, even before the potential faults could occur. Another barrier originates from actual breakdowns of equipment, and the subsequent disruption that these can cause. If there is a lack of technical support available in a school, then it is likely that preventative technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns BECTA (2004, p.16).Cuban (1999) supports this by pointing out that in the schools that cannot afford technicians; there are often software glitches and servers that crash, torpedoing lessons again and again. Once the problems occur, a lack of technical support may mean that equipment remains out of use for a longer period.

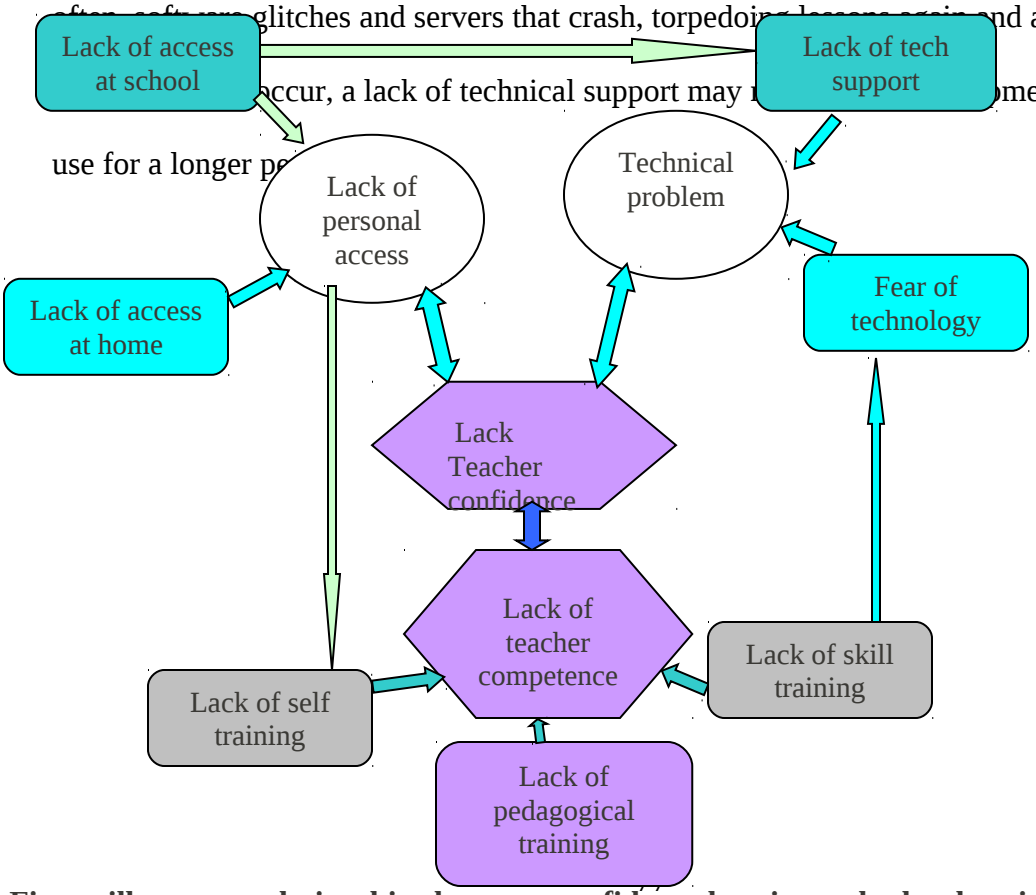

Figure 29: Figure illustrates relationships between confidence barrier and other barriers adapted from BECTA (2004, p.19).

Finally, nothing useful in a life can be achieved without obstructions or difficulties. From literary point of view, the weakest play is that one with little or no obstacles and vise versa. According to

Rogers (2003) getting new idea adopted, even when it has obvious advantages, is difficult. For any innovation to diffuse firstly it faces resistance. Accordingly for the teachers to get ready for e-learning are normally they face obstacles, particularly in the developing countries where there are many difficulties that stand in front of its way. The barriers can be infrastructures (hardware and software) , school environment and psychological factor such as : fear of technology , and lack of confidence as well as others such as ,economic ,culture and social barriers that impeded teachers from an early respond to –learning readiness in school.

Summary

This is a summary to show how the literature review addresses and meets the objectives of the study.

Firstly, in order to get a better understanding of what e-learning readiness mean I started, with Bowles (2003) and Wasseige (1999) an e-learning definitions and then continue with the four-stage model of Bowles (2003) to analyze, track and compare different journeys of e-learning readiness followed by what, Zemsky and Massy (2004) mentioned about e-learning promises . A

clear picture of e-learning will be obtained through understanding its advantages and disadvantages.

Secondly, understanding the constructivism philosophy and the learning theory, from Dewey (1916), Paiget (1973),Vygotsky (1978, 1978) and Bruner (1996) particularly in what they said about the teacher's role and the teaching concept. It presents the key to determine the teacher's role in contributing to e-learning readiness, in additions to Keller's (1983) ARCS motivation model where confidence is the key factor for teachers to use ICT in their classrooms.

Thirdly, in order to have a clear opinion why some teachers show an early response to e-learning while others do not, we need to let the teachers understand what change in education means Fullan (1991) .The same author also states that "educational change depends on what teachers do and think- it's as simple and as complex as that." For educational change to happen, it requires that teachers understand themselves and that they be understood by the others,(Fullan, 1991).Nisbet (1969) mentions that in order to consider change, we must understand stability and order which leads to identify where teachers are and how teachers access and cope with wanted and unwanted change.

Classrooms and schools become effective when (1) quality people (teachers) are recruited. (2) The work place is organized to stimulate and reward accomplishment. Change occurs around us every day .We observes the emergence of new technologies and new ideas which change or affect our perceptions to the world. We immerse ourselves in this process without even trying to understand the nature of these changes. Rogers' Diffusion of Innovations (2003) shows stages that teachers need to cope with and adapt to the new innovation which play an important role in justifying why some teachers responses to e-learning at an early stage while the others do not.

Understanding Ely's (1990, 1999) conditions of change also help in recognizing those who responses early from others.

Finally, to determine the barriers in the way of contributing to e-learning readiness at schools and understanding how teachers overcome it. Pelgrum (2001) reports on an international survey of teachers' perceived obstacles of using ICT and identifies three major factors namely: lack of resources, lack of knowledge and skills and pedagogical difficulties to integrate technology into instruction. Also BECTA (2003) regarding what the research says about barriers in the way of the use of ICT in teaching (Key barriers to using ICT). This is an over view of how the literature review addressed the objectives of the study. Sudanese the barriers abstract Sudanese secondary school teacher represented as the age the most of old generation are later responses or even resist to innovation, while those who have from five to ten years experience are hesitators and those who have 5 and less years of experience are highly risk and tries, the other barriers are absence of clear strategies of ICT implementation , this include ICT training, curriculum adaptation, then the financial support, time teachers loads.

2.28 The content and construct validation of the research instruments

In this section the focus will be on explaining how literature reviews leads to research instruments.

An attempt in this study is done to answer the following questions:

5. What is understood by e-learning readiness?
6. What are the factors contributing to e-learning readiness in schools?
7. Why do some teachers show an early response to e-learning readiness?
8. Why do some teachers show later response or resistance to e-learning readiness?
9. How do they overcome the barriers obstructing to e-learning readiness in schools?

Table 2.5 content and construct validation of the research instruments

Main and sub Research questions	**Interviews questions**	**Authors who addressed Related Literature**	**instruments**
<u>First research question:</u> What is understood by e-learning readiness? **Sub questions and headings :** • What is e-learning? • Why do we have e-learning? • E-learning principles: • E-learning readiness: • Innovations and e-learning undertakings • Advantages of e-learning: • Disadvantages of e-learning:	• What does the term e-leaning mean to you? • To what extent do you think e–learning is helpful, or not to improve teaching and learning and why? • To what extent are you ready to integrate e-learning in your teaching and describe your readiness?	**What is e-learning:** • (Bowles, 2003). • (Wasseige, 1999). • (Stubbs and Burnham, 1990). • (Wardca, 2003). • (Ron Kurtus, 2004). • (Rosenberg, 2005). **Why do we have e-learning?** • (Holmes and Gardner, 2006). **E-learning principles:**	Interviews and observations

		• (Bowles, 2003). **E-learning readiness:** • (Bowles, 2003). **Innovations and e-learning undertakings** • (Clarke 2003). • **(**Zemsky and Massy 2004). **Advantages of e-learning:** • (Wardca 2003). • (DelVecchio andLoughney, 2006). **Disadvantages of e-learning:** • (DelVecchio andLoughney, 2006)	
<u>Second research question:</u> What are the factors contributing to e-learning readiness in schools**?** **Sub questions and headings :** • Why schools have to adopt ICT? • ICT in schools: • Staff development and the adoption of innovations: • Teacher changes: • Teachers' ICT skills and understanding**:** • change in instructors' and learners' roles**:** • Constructivism learning theory: • E-learning and motivation.	• Have you recently attend any computer related training in your subject area and describe the activities during that training? • How your schools manage staff development? • To what extent does/ doesn't ICT infrastructures in your school support e-learning? • Have you ever use computer in your class? • Describe your role in your classes?	**Why schools have to adopt ICT?** • (Edwyn, 2001). **ICT in schools:** • (Leask and Pachler, 2005). • (Rosenberg, 2005). • (Kozma, 2004). **Staff development and the adoption of innovations:** • (Mouza, 2002). • (Hepp, Hinostroza, Laval and Reuben, 2004). • (McCarney, 2004). • (Farby and Higgs, 1997).	Interviews, observations and texts and documents analysis

		• (Guskey, 2002). • (Guskey, 1986). • (Wilson and Berne, 1999). • (Cohen and Ball, 1990). • (Fullan, 1999). • (Fullan, 1991). • (Huberman, 1995). **Teacher changes:** • (Cheng, 2001). • (Lee, 2002). • (Lee, 2001). • (Hall and Hord, 2001). • (Somekh, 1997). **Teachers' ICT skills and understanding:** • (BECTA, 2003). • Wheeler (2000). **change in instructors' and learners' roles:** • (Collins and Berge, 1996). • Wheeler (2000). **Constructivism learning theory:** • (Chan, 2006). • Charalambos, 2005). • (Dewey, 1916). • (Piaget, 1973). • (Vygotsky, 1978, 1978).	

		• (Bruner, 1996). • **(**Ornstein, and Hunkins, 1998). (Duffy and Cunningham, 1996). • **(**Tapscott, 1998). • (Epstein, 2002). **E-learning and motivation** • (Zhao and Cziko,2001). • (ITEC, 2004). • (Malone and Lepper, 1987). • (Keller, 1983; Keller and Suzuki, 1988). • (Keller, 1883). • (Weiner, 1974).	
<u>Third and fourth research question:</u> Why do some teachers show an early response to e-learning readiness while others show later response or resistance to it? **Sub questions and headings :** • Why are radical changes needed in schools? • Why do teachers need to understand the educational change: • change process model: • What are the stages that	• How long have you been teaching? • What do you feel when computer and internet technologies coming in education field? • What do you think computer can do in your teaching?	**Why are radical changes needed in schools?** • (UNESCO, 2005). • **(**Edwyn, 2001). **Why do teachers need to understand the educational change:** • (Fullan, 1991). • (Ellsworth, 2000). **change process model:** • (Fullan, 1991). **What are the stages that teachers need to go through as they learn about and**	Interviews, texts and documents analysis.

teachers need to go through as they learn about and adopt these innovative applications of technology? • Innovativeness and adoption categories. • Ely's eight conditions of change.		**adopt these innovative applications of technology?** • (Rogers, 2003). • (Hall and Loucks, 1979). **Innovativeness and adoption categories** • (Rogers, 2003). **Ely's eight conditions of change** • (Ely 1990, 1999).	
<u>Fifth research question:</u> How do teachers overcome the barriers obstructing to e-learning readiness in schools? **Sub questions and headings :** • **What barriers obstruct the use of ICT in teaching?** • Lack of teacher confidence and teachers' computer anxiety: • Lack of teacher competence • Lack of time for training • Lack of skills training • Lack of access to resources • Poor organization of resources • Lack of hardware. • inappropriate software • Lack of personal access for teacher	What are barriers that obstruct you from using (ICT) in your teaching? o Personal o Technical o Finial o Time 5. School policy. • What barriers do teachers in your school think affect their use of ICT? • To what extents does the whole school involved in, and supportive of, the process of integrating ICT? • To what extents Are ICT resources deployed so as to enable teachers to access them easily and integrate them	**What barriers obstruct the use of ICT in teaching?** • (Ginsberg and McCormick, 1998). • (BECTA, 2003). • (Dawes, 2002). • (Pelgrum, 2001). • (Schoolnet Africa, 2006). • (Scrimshaw, 2004). **Lack of teacher confidence and teachers' computer anxiety:** • (Larner and Timberlake, 1995). • (Guha, 2000). **Lack of teacher competence** • (Kirkwood, 2000). **Lack of time for training** • (Kirkwood, 2000).	Interviews, texts and documents analysis.

• Lack of time • Technical problems	effectively? • To what extent is your ICT training provision focused on pedagogy,? • To what extent is your ICT training provision differentiated by skill level? • To what extent is your ICT training provision arranged with sensitivity to teachers' workloads?	• (BECTA, 2004). **Lack of pedagogical training** • (Veen, 1993). **Lack of skills training** • (Lee, 1997). • (Veen, 1993). • (Snoeyink and Ertmer, 2001). **Lack of access to resources** • (Mumtaz, 2000). • (BECTA, 2003). **Poor organization of resources** • (Pelgrum, 2001). • (Farby and Higgs, 1997). **Lack of hardware** • (Pelgrum, 2001). • (Guha, 2000). • (Ginsbergand McCormick, 1998). **inappropriate software** • (BECTA 2004). • (Guha, 2000). • (Bosley and Moon, 2003). • (Newhouse's, 1997). • (Ginsbergand McCormick, 1998). **Lack of personal access for teacher**	

		• (Ross, 1999). **Lack of time** • (Stallard, 1998). • (Bennet, 1996). • **(**Fabry and Higgs, 1997). **Technical problems** • (Bradley and Russell, 1997). • (Cuban, 2001). • (Cuban, 1999). • (BECTA, 2004). •	

2.29 In summary,

<u>First research question:</u> what is understood by e-learning readiness?

The researcher provided what have been written about e-learning, conceptions and definitions.

Also I found out related literature that explained why it is importance to have e-learning in our life.

In addition, the focus will also be on literature that identifying the levels of teacher's e-learning readiness. Also taking into my consideration what authors said about advantages and disadvantages of e-leaning, for it is important to make clear image of e-learning.

To elicit a real understanding of what is the term "e-learning" meant to the participants of this study?

<u>Second research question:</u> What are the factors contributing to e-learning readiness in schools?

In this section, the researcher concentrated on the importance of ICT in education as general and special concern has given to ICT in school as it is one of indicators of school readiness. For that reason, the interviews were going to be conducted with interviewees, where they were going to reveal their ideas and feeling about the importance of ICT in their teaching. The researcher focus has been done on literature that addressed the importance of staff development aspect in contribute to schools readiness .Because of ICT effectiveness in pupils learning is dependent on the teachers being able to understand the pedagogy of using ICT as a learning tool, the effective instruments that will be used to collect the interviewee's ideas about the importance of staff development.

Also, the concern has been directed to teachers' awareness about the shift in their role from center of learning to facilitator due to the constructivism learning theory and particularly to the changes brought about introduction of ICT in education. The valuable

instrument in order to gain participants points of views are the observations of the teacher's practices in their real classes then, interviews will be conducted with interviewees looking for open responds to the above mentioned questions.

Third and fourth research question: Why do some teachers show an early response to e-learning readiness while others show later response or resistance to it?

To investigate why some teacher response an early to e-learning while other not, I started with literature that explained importance of understanding the change that occur in educational field, besides literature that explaining why change needed in schools.

To connect what has been mentioned in literature with participants ideas the interviews will be conducted. Also, taking into account what I have summarized from (Rogers, 2003) characteristics of both an earlier and later adopter as standard to be compare with interviewees responds.

Fifth research question: How do teachers overcome the barriers obstructing to e-learning readiness in schools?

In this part I collected and analyzed international documents and previous studies conducted about the barriers that obstruct teachers' responses to e-learning and considering them as benchmarks. Then, interviews were conducted with the interviewees to reveals their feeling and ideas about what actually obstruct them from responses to e-learning at their classes.

Finally, the above mentioned sentences briefly showed how literature reviews lead to research instruments.

Chapter three

Research Design and Methodology

Introduction

This chapter describes the research methods applied in this study; it includes data collection methods, the data collection instruments, the research population, the participants used in this study and data analysis methods.

Research Method

In this study, both quantitative and qualitative methods were used to collect data from the selected participants. These methods assisted in building a base on a complete understanding of the research problem. The use of both quantitative and qualitative methods together lead to a terminology known as mixed methods; in this study the qualitative method was used for triangulation of the data. Mixed methods of research are those studies or lines of inquiry that integrate one or more qualitative and quantitative techniques for data collection and/or analysis Borkan (2004).

Qualitative methods

Qualitative methods is defined as an inquiry process of understanding a social or human problem based on building a complex, holistic picture, formed in words, reporting detailed views of participants conducted in a natural setting Creswell (2007). It could also be defined as a multi-focus method, involving an interpretive, naturalistic approach to its subject matter Denzin and Lincoln (1994).Use of this method enabled to study things in their natural settings and related interpretations i.e. teacher's feelings while busy in their natural working environment, the differences in adopting ICT between teachers, and obstacles that hinder implementation of ICT in their classrooms Cohen and Morrison (2000). In this method,

secondary school teachers were observed while busy in their normal and daily activities. Interviews were similarly conducted to secondary school directors. With this method, sufficient data were collected leading to the understanding of why some Sudanese secondary school teachers responded earlier to e-learning technology compared to others who didn't and even to the extent of not using a computer in their classrooms.

Quantitative methods

In this method, data were collected through structured questionnaires purposely designed to 130 Sudanese secondary school teachers clearly answer the research questions and objectives.

Population and sampling

A population is a group of elements or cases, individual objects or events, that conform to specific criteria and to which we intend to generalize the results of the research McMillan and Schumacher (2001). In this study, the population used for was 1624 Sudanese secondary school teachers divided into subgroups from Khartoum state stratified according to localities. These localities were Omdurman, Khartoum and Bahari, the selection of the school come first with the respects to the type whether it is governmental: model school, public one or private out of these schools we randomly selected the teachers. Accordingly, 417 Male and 399 female teachers represented Omdurman, 477 male and 452 female teachers represented Khartoum, and 423 Male and 473 female teachers represented Bahari locality. From these localities, samples of 5% were randomly drawn from each subgroup (Table 3.1.) The research sample similarly included thirteen Sudanese secondary schools principals, representing decision makers. These strata permitted the comparison of subgroup results.

Stratified random sampling

A stratified random sampling is generally a common variation of simple random sampling. The population is divided into subgroups, or strata on the basis of variable chosen by the researcher, such as gender, age, or level of education. Once the population has been divided, samples are drawn randomly from each subgroup. The number of subject drawn is either proportional or non proportional. The proportional sample is based on the percentage of the subjects in the population that is present in each stratum. Sample size is the number of subjects in a study represented by N. the researcher must determine the size of the sample that provided sufficient data to answer the research questions. The general rule in determining sample size is to obtain a sufficient number to provide a credible result. In situations which random sample is selected, a size that is only a small percentage of the population can approximate the characteristics of the population satisfactorily. In this study, the sample size was randomly drawn out from Sudanese secondary school teacher in three localities in Khartoum state represent as following the total teachers in three localities were distributed as following table:

Table 0:3 Sample size of the studied population according to locality

Locality	Male teacher	Female teachers	Five % as from male	Five % as from female
Khartoum	477	452	24	22
Omdurman	417	399	21	20
Bahri	423	473	20	23
Total	1317	1324	65	65

Data Source Ministry of education Khartoum state record in academic year (2008-2009).

Data collection techniques

Observations

Semi-structured and participatory observations were conducted with each lesson assigned to two observers in order to explore the actual classroom practices. The observation worksheet was also conducted for this purpose and field notes taken with reference to the relevant variables described in the research framework, including how secondary school teachers used ICT in their daily teaching practices. The observed data was then triangulated with those collected from interviews conducted with secondary school teachers. In order to obtain participation from teachers for this study, special participatory forms were distributed in order to get their consent. In view of this, 130 Sudanese secondary school male and female teachers accepted to participate and were then observed in their actual classes while busy doing their normal routine of duties. All the observation work sheet was done before the start of lessons. Teachers participatory as well as classroom observations have been reported as advantageous. They include ability to gain insights and develop relationship with the participants, and provision of detailed information about the participants and their setting and collection of authentic and accurate data (Gay, 2003), Classroom observations on the other hand facilitated necessary clarifications and elaborations on the teacher's perspectives O'Donoghue (2007).

Interviews

Interview is a purposeful interaction between two or more people focused on one person trying to get required information or a face-to-face encounter between the researcher and participant on lives, experiences or situations Taylor and Bogdan, 1984; Gay (2003). Such interviews permit to researchers to obtain important data which could not be acquired from observation only Cohen and Morrison (2000). In this study, open ended questions, semi-

structured one-hr long interviews were conducted with thirteen Sudanese secondary school principals representing decision makers from three localities in Khartoum state. The objective was to capture the organizational factors of leadership, teachers believes and general school readiness to e-learning. A list of questions with reference to the relevant variables (i.e. the role of teacher training, school support, and innovations, teaching and learning, and roles of ICT and connectivity) guided the interviews. The interviews were conducted during and after collecting the questionnaires information from the teachers. The interviews were all audio-recorded and transcribed for further analysis or interpretation. The data gathered from these interviews were also triangulated with those from classroom observations.

Teacher Questionnaire

The general purpose of the questionnaire was to elicit direct judgments; obtain uniform, straightforward; and easy data for analysis. Questionnaire encompasses variety of instruments in which the subject responds to written questions to elicit reactions, belief and attitudes.

The researcher constructs a set of appropriate questions and asks the subjects to answer them. According to McMillan and Schumacher (2001), questionnaires can both be produced relatively rapidly and inexpensively and can easily be distributed simultaneously too many people. In this study, the questionnaire was designed to gather either qualitative or quantitative data and to elicit information from the 130 Sudanese secondary school teachers on their attitude towards e-learning readiness. The questionnaires were distributed to research samples according to the sample size distribution explained at earlier stage.

Piloting the questionnaire

Prior to the actual survey, the questionnaire was piloted on a group similar to the one that formed the population of this study. Since it was difficult to give exact number for the pilot

group, a pilot on about five % of final sample number that are thirteen Sudanese secondary male and female teachers from a total of 260 Sudanese secondary school teachers were conducted.

The piloting was done in order to achieve the following objectives:

- To test for length and completeness
- To check for ambiguity
- To check for clarity
- To eliminate questions leading to un-usable data.

After the researcher distributed the questionnaire for 13 teachers to achieve the above-mentioned objectives he realized that, the questionnaire was clear and comprehensive to the pilot group so it is valid for the study.

Research Matrix

Table 0:4 Matrix

Research Questions	**Data collection instrument**		
	Interview	**Questionnaire**	**Classroom Observation**
What is the relationship between the school connectivity and teacher attitudes towards e-learning	√	√	√
To what extents does the application of technology increase or decrease teachers effectiveness	√	√	√

What is the role of training in encouraging teachers towards e-learning?	√	√	√
What is the relationship between school support and teachers attitudes for e-learning?	√	√	
How does the school director encourage or discourage teacher in using technology in school.	√	√	

3.1 Translation

Supporting documents in languages other than English is becoming critical to ensure high data quality. Obtaining high quality data from Sudanese secondary school teachers where English is not their home language and where some of its members have a limited knowledge of English particularly computer terms which is not related to their specialization, leads me to translate the teacher questionnaire. In this study the instrument translated from English language to Arabic language using the parallel translating system. The translation of the instruments took 40 days. Concerning the translation of data collection instruments and supporting materials, in order to ensure that such documents translated from a source language into a target language are reliable, complete, accurate, and culturally appropriate. I made sure that the translated text conveys the intended meaning of the original text, the translation is deemed reliable. Translations that do not add any new information to the translated document and do not omit information provided in the source document are said to be complete. There are number of specialists in translation so the translation is accurate and free of spelling and grammatical errors. Cultural appropriateness is achieved when the message conveyed in the translated text is appropriate for the target population. In addition to meeting the aforementioned, the data collection instruments and related materials should also have semantic, conceptual, and normative equivalence.

Validity and Reliability

Validity is the best available approximation to the truth of a given proposition, inference, or conclusion. Validity is essential criterion for quantitative and qualitative paradigms in terms of credibility, neutrality or Confirmability, consistency or dependability and applicability or transferability Lincoln and Guba 1985; Cohen et al 2000; Trochim, 2001; Patton (2002). The researcher used content validity, the questionnaire was given to the specialist and expert's professor in the field to judge and determined the extent to which the questions are correct and clear and relevant to the objective of the study and assist in gaining the expected results of the study. They judged it and the rewritten and generated to the sample.

In this research, reliability of observation was achieved through replicates or double-coding Miles and Huberman (1994). Double coding was achieved by both researcher and his assistant doing the same job, in same time, in the same schools, observing the same teachers while doing their job in classroom.

The reliability of the questionnaires was assessed through **Cronbach's alpha analyses see table 3.3 below**, which showed that the instruments and the scales have internal consistency and reliability. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. However, there is actually no lower limit to the coefficient. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. Based upon the formula = rk / [1 + (k -1) r] where k is the number of items considered and r is the mean of the inter-item correlations the size of alpha is determined by both the number of items in the scale and the mean inter-item correlations. George and Mallery (2003) provide the following rules of thumb: "≥ .9 – Excellent, ≥ .8 – Good, ≥ .7 – Acceptable, ≥ .6 – Questionable, ≥ .5 – Poor, and ≤ .5 – Unacceptable" (p. 231). While increasing the value of alpha is partially dependent upon the number of items in the scale, it should be noted that this

has diminishing returns. It should also be noted that an alpha of .8 is probably a reasonable goal. It should also be noted that while a high value for Cronbach's alpha indicates good internal consistency of the items in the scale, it does not mean that the scale is undimensional. The researcher did generalizability analyses to ensure that individual teachers receive data that are reliable. Generalization analyses were also performed to ensure that individual teachers received reliable data. In this study, different data collection techniques were used (i.e. interviews, observations, and questionnaire) also meant to ensure validity. Additionally, triangulation was used to search for any convergence among multiple and different sources of information and form themes or categories in the study Creswell and Miller (2000). Although the size of participants in this research was small compared to the target population, it is expected that the data collected will be sufficient to give an overview of all target populations and populations.

Table 0:5 questionnaire reliability

No	**Research question**	**Cronbach's Alpha**	**N of questions**
1	Connectivity	0.981	5
2	Application	0.962	14
3	Training	0.720	5
4	school director	0.787	5
5	School support	0.725	12

3.7.1 Credibility

Credibility in any study is enhanced when strategies are put in place to check on the inequity of data and to allow for direct testing of findings and interpretations by the human sources from which they have come Lincoln and Guba (1985) ; O'Donoghue (2007).

In this study, credibility was enhanced by the extended period of data collection and triangulation as suggested by McMillan and Wergin (2002).

Transferability

Transferability refers to the extent by which results provide insights useful comparable to other settings. The various data collection instruments used in this study will enable judgments to be made about the transferability of the findings to other contexts including detailed analysis of questionnaires instruments, interviews and observations. This study were transfer to all Sudanese secondary school teachers, because they shared the same contents and with similar characteristics

Data Analysis

Descriptive and interpretive analysis was used to analyze qualitative data gathered through interviews. The data from semi structured interviews were analyzed using a coding schemes system which categorized the data into smaller clusters of similar content to allow for simple statistical analysis Nachmias and Frankfort-Nachmias (1996). A computer program, MSWord was used to categorize and group these data into smaller clusters according to the research questions. In this study, an inductive coding scheme was used for data analysis. In this scheme, data were transcribed from the recorded tables used to record participants' responses. This raw data from the transcripts, including the response from each of the interviews, were then organized into major coding sections according to the key themes. These were then grouped together in order to determine the main argument to each section. A computer spreadsheet program, MSExcel was used to organize the data into coding schemes. Data from the questionnaire and observation worksheets were analyzed using basic descriptive statistics and factor analysis, and reliability scale analysis using SPSS (Statistical Package for the Social Sciences).

Research timelines

Table 3:6 the research timelines

Activity	**Date**
Activity 1: Research Proposal	February to July 2007
Activity 2: Literature Review	April 2007 to October 2007
Activity 3: Research design and methods	November 2007
Activity 4: Development of Questionnaire + Translation. Observation worksheet design Interview design Piloting the questionnaire	 December 2007 January 2008 to March 2008 May 2008 to April 2008 June to the 1st of July 2008
Activity 5: * Preparation for Data collection * Data processing * Data capture * Data analysis and discussions	 June ----- October (2009)
Activity 6: * Conclusions * Recommendations * 1st complete draft * 2nd complete draft * Final submission	 November – December(2009)

Chapter four

Data analysis

In this chapter, different analytical approaches were used to analyse the data collected in order to reach valid and reliable information. They include:

- SPSS software programme for the analysis of questionnaires and worksheets observations.
- Inductive-coding for the analysis of interviews.
- *(in order to be familiar with the analysis and for more details see appendixes)*

Questionnaire

This section concerned the questionnaire analysis.

Correlation analysis of the factors

In this study area I did the correlation analysis in order to find out to what extent these factors were correlated to each other.

Table 4:7 Correlation analysis of the factors.(Correlations are significantly different at **: P ≤ 0.01 (2-tailed).)

Correlations

		Connectivity	Application	Training	School Director	Support
Connectivity	Pearson Correlation	1	.893**	.091	.122	.784**
	Sig. (2-tailed)		.000	.303	.168	.000
	N	130	130	130	130	130
Application	Pearson Correlation	.893**	1	.037	.010	.725**
	Sig. (2-tailed)	.000		.678	.909	.000
	N	130	130	130	130	130
Training	Pearson Correlation	.091	.037	1	.330**	.248**
	Sig. (2-tailed)	.303	.678		.000	.004
	N	130	130	130	130	130
School Director	Pearson Correlation	.122	.010	.330**	1	.359**
	Sig. (2-tailed)	.168	.909	.000		.000
	N	130	130	130	130	130
Support	Pearson Correlation	.784**	.725**	.248**	.359**	1
	Sig. (2-tailed)	.000	.000	.004	.000	
	N	130	130	130	130	130

As shown in Table 4.1: from correlations analysis of the factors, firstly, connectivity factor: was significantly corelated with application and school supports, secondly,

application factor was significantly correlated with and connectivity and school support; thirdly, training factor significantly correlated with school directors and school supports; fourthly, sschool director factor was significantly correlated with training, school supports.and, school support factor was strong corelated with all other factors.

General information

In this section, gender, regional areas and years of teaching experience are presented in Tables 4.3, 4.4 and 4.5. Results showed that 50% of the sampled population were male and 50% were female, indicating that gender was equally represented.

Table 0:8 Distribution of teachers according to gender.

Phrase	Frequency	Percentage %
Male	65	50
Female	65	50
Total	130	100

4.1.2 Sampling distribution according to location Khartoum state in Sudan

Results of sample distribution in three locations of Khartoum state are shown in Table 4.3. The data showed that of the total sampled population, 35.4% were from Khartoum, 31.5 % were from Omdurman, and 33.1% were from Bahri. The result indicated that the sampling distribution was adequately represented.

Table 0:9 Sample distrbution according study areas.

Phrase	Frequency	Percentage %
Khartoum	46	35.4
Omdurman	41	31.5
Bahri	43	33.1
Total	130	100

4.1.3 Years of teaching experience

In this section, sampling was classified according to years of teaching experience. This was conducted in order to establish whether there was any relationship between years of teaching experience and responsiveness of teachers towards e-learning. Results showed

variation between respondents' years of teaching experience and responsiveness towards ICT (Table 4.4). From this result it evident that the majority of secondary school teachers had teaching experience of between 1-5 years.

Table 4:10 Years of teaching experience

Phrase	Frequency	Percentage %
1 – 5 years	43	33.1
5 – 10 years	27	20.8
10 – 15 years	22	16.9
15 – 20 years	35	26.9
20 and more years	3	2.3
Total	130	100

4.1.4 Availability of computers and its effect on teachers' response to e-learning.

In this section, a survey was conducted to identify whether computer availability had any effect on Sudanese secondary school teachers' readiness towards e-learning (Table 4.5). From this result it is clear that majority of the secondary school teachers have no access to computers suggesting an obstacle to readiness towards ICT.

Table 0:11 Effect of the availability of computers for teachers'

Phrase	Frequency	Percentage %
In office	30	23.1
In house	25	19.2
In both office and house	11	8.5
No I haven't	64	49.2
Total	130	100

The relationship between connectivity and teachers' attitudes towards e-learning

This part of study was conducted to identify whether there was a relationship between school connectivity of different facilities (i.e. internet connections either at office or home and connectivity reliability) and attitudes of secondary school teachers towards e-learning (Table 4.6). This result indicated a positive attitude towards information and communication technology. Furthermore, the data suggest that, in principle, majority of secondary school

teachers significantly (Median = 4, χ^2 = 36.6) agreed that the use of e-mail significantly help in accessing scientific literature in form of books as references or Journal papers.

Table 4:12 the use of e-mail helps me to get many books and scientific references

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	29	22.3	36.615	0.000	4	Agree
Disagree	19	14.6				
Not sure	4	3.1				
Agree	33	25.4				
Strongly agree	45	34.6				
Total	130	100				

Effect of computer availability and access to Internet in teachers office on attitudes towards e-learning

In this section, a survey was conducted to determine the relationship between computer availability and access to internet in secondary school teacher's offices as well as motivation and views exchange with fellow secondary school teachers, scientists or researchers in areas of their speciality (Table 4.7). Results shows that of the total population sampled, 40% disagreed that office computer and internet availability encourage to exchange views with fellow teachers, scientists or researchers, 5.4% were not sure, 25.4% agreed and 30% strongly agreed. The data significantly (Median = 4, χ^2 = 23.2) indicated that majority of the sample agreed that, indeed, availability of a computer and access to internet in teachers offices encouraged exchange of views with fellow teachers, scientists or researchers in their specialty, thus, a positive attitude towards ICT were found as significantly differences were detected between group of teachers who thought that the availability of computer and access to the internet would encourage them towards e-learning.

Table 4:13 Effect of computer availability and access to Internet in teachers office on attitudes towards e-learning

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	29	22.3	23.231	0.000	4	Agree
Disagree	22	16.9				
Not sure	7	5.4				
Agree	33	25.4				
Strongly agree	39	30				
Total	130	100				

4.1.4.1 Effect of internet reliablilty on teaching process

In this section, a survey was conducted to find out whether information derived from the internet could be trusted in daily teaching process (Table 4.8). Results showed that 18.5% of the sampled population strongly disagreed on the reliability of information derived from the internet and may not assist them in teaching, 19.2% disagreed, 3.8% were not sure, 26.2% agreed and 32.3% strongly agreed. This result showed that majority of the secondary school teachers significantly (Median = 4, $\chi^2 = 29.5$) agreed that information derived from the internet was reliable and may assist them in teaching, similarly suggesting a positive teachers' attitude towards information and communication technology.

Table 0:14 Information derived from the Internet is reliable and may assist me in teaching.

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	24	18.5	29.462	0.000	4	Agree
Disagree	25	19.2				
Not sure	5	3.8				
Agree	34	26.2				

Strongly	42	32.3
agree		
Total	130	100

4.1.4.2 Effect of e-mail access on teaching methods

Teaching methods in secondary schools is one of the tools used by teachers to impart knowledge among pupils. In this section, a survey was conducted to check whether accessibilty to e-mail or internet improved the secondary school teaching methods (Table 4.9). Results indicated that of the population sampled, 13.8% strongly agreed, 22.3% disagreed, 3.8% were not sure, 06 % agreed that use of e-mail improved teacher's teaching methods. From these data, there was significant (Median = 4, χ^2 = 39.0) agreement amongst secondary school teachers that use of e-mail was greately improve their teaching methods, thus, indicating a positive attitude towards ICT.

Table 4:15 the use of e-mail helps to a greater extent in the follow-up my pupils duties at all times.

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly	18	13.8	39.000	0.000	4	Agree
disagree						
Disagree	29	22.3				
Not sure	5	3.8				
Agree	30	23.1				
Strongly	48	36.9				
agree						
Total	130	100				

4.1.4.3 Effect of e-mail on pupils follow-up

In secondary schools, monitoring students' movements and progress is fundamental in building their inteligence or academic and moral conduct in students. In this section, a study was conducted to investigate whether the use of e-mail assisted the secondary school teachers in making followup on the progress of their students (Table 4.10). In this study, results shows that 13.8% of the secondary school teachers strongly disagreed that use of e-mail assisted on the follow-up their students progress at all times, while 26.2% disagreed, 3.8% were not sure, 56.1% agreed. The secondary school teacher who strongly agreed were significantly greater (Median = 4, χ^2 = 31.9) relative the other groups, an indication of a positive attitude towards ICT.

Table 0:16 The use of e-mail helps to a greater extent in the follow-up my pupils duties at all times.

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	18	13.8	31.923	0.000	4	Agree
Disagree	34	26.2				
Not sure	5	3.8				
Agree	32	24.6				
Strongly agree	41	31.5				
Total	130	100				

4.1.5 : Effect of technology applications and its effectiveness in teachers teaching efficiency

In teaching environment, availability and proper application of technology is important in order to bring about effective teaching at schools. In this section, a survey was

conducted to investigate the effect of technology on teaching efficiency in secondary schools in Sudan. Results showed that of the total population surveyed, 55.6% indicated strong disagreement that ICT will lower teaching efficiency in secondary schools, 1.5% were not sure, 42.3% agreed (Table 4.11). The data indicated that majority of secondary school teachers significant (Median = 2, χ^2 = 33.3) disagreed that e-learning will add a new burden for the teacher, thus, reducing teaching effectiveness in secondary schools. This results also suggest a positive attitude to ICT.

Table 0:17 E-learning adds a new burden for the teacher

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	41	31.5	33.31	0.000	2	Disagree
Disagree	32	24.6				
Not sure	2	1.5				
Agree	24	18.5				
Strongly agree	31	23.8				
Total	130	100				

4.1.5.1 Effect of using computers in teaching easiness and saving time

In secondary schools, availability and use of computers may probably improve teaching time effort. In this research question, a survey was conducted to investigate whether use of computers in secondary schools did reduce both teachers' efforts and teaching time. It was observed that 21.5% of the secondary school teachers sampled strongly disagreed that use of computers in teaching will reduce teaching time and effort. However, 16.9% disagreed, 2.3% were not sure, 59.2% agreed (Table 4.12). This result showed significantly (Median = 4, χ^2 = 65.46) agreed that use of computers can reduce both teaching efforts and time in secondary schools.

Table 4:18 Effect of using computers in reducing the teaching effort and time

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	28	21.5	65.46	0.000	4	Agree
Disagree	22	16.9				
Not sure	3	2.3				
Agree	18	13.8				
Strongly agree	59	45.4				
Total	130	100				

4.1.5.2 Effect of e-learning on co-operative education

Cooperation in education is a very important tool in creating and maintaining coherent and active interaction amongst teachers in secondary schools. For secondary school education to be effective, technology and teachers must work together to provide challenging learning opportunities. In this research question, the effect of ICT on cooperative education was assessed. The data showed that majority of secondary school teachers significantly (Median = 2, χ^2 = 43.3) believes that there is strong relationship between e-learning and cooperative education (Table 4.13). This is because, of the total population sampled, 56.2 % disagreed that use of e-learning is not conducive to the cooperative education while, 1.5 % were not sure, 42.3 % agreed. The result suggests that cooperative education will not only increase the amount of teacher interaction around issues of curriculum and instruction but also will enable sharing of information and strategies dealing with technology, increased sense of friendship and better articulation of the secondary school curriculum.

Table 4:19 Effect of e-learning on cooperative education

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation

Strongly disagree	49	37.7	43.31	0.000	2	Disagree
Disagree	24	18.5				
Not sure	2	1.5				
Agree	25	19.2				
Strongly agree	30	23.1				
Total	130	100				

4.1.5.3 Effect of e-learning on the consolidation of pupils - teacher relationship

In secondary schools, student-teacher relationship forms an important foundation for better teaching and learning environment for improved knowledge. This research question seeks to identify whether application of e-learning in secondary schools can consolidate the relationship between students and their teachers (Table 4.14). This result suggest that majority of the secondary school teachers were significantly (Median = 4, $\chi^2 = 34.7$) in favour of the fact that, use of ICT consolidates the relationship between pupils and their teachers, thus, a positive response.

Table 4:20 Effect of e-learning on the consolidation of pupils – teacher relationships

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly disagree	27	20.8	34.7	0.000	4	Agree
Disagree	12	9.2				
Not sure	12	9.2				
Agree	31	23.8				
Strongly agree	48	36.9				
Total	130	100				

Effect of e-learning on the management of classrooms

Management of classrooms in secondary schools is viewed as a tool to create or maintain a conducive environment for learners. This research question aimed at investigating whether e-learning will facilitate secondary school teachers on the management of their classrooms. The results (Table 4.15) showed that 57.7 % of the secondary school teachers surveyed disagreed that use of e-learning is not helpful in the management of their classrooms, 4.6 % were not sure, 37.7% agreed. This result indicated that the majority of the secondary school teachers significantly (Median = 2, χ^2 = 27.5) disagreed in favour of the fact that, use of e-learning is very useful tool in classroom management in secondary schools.

Table 0:21 Effect of e-learning on the management of classrooms

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	42	32.3	27.5	0.000	2	Disagree
Disagree	33	25.4				
Not sure	6	4.6				
Agree	23	17.7				
Strongly agree	26	20				
Total	130	100				

4.1.5.4 Effect of e-learning on the completion of syllabus as scheduled

Completion of syllabus in secondary schools is very important to meet dealines and ensure education standards. In this study, an investigation was conducted to find out if to what extent does the application of e-learning affect on-time completion of syllabus. Results indicated that of the total secondary school teachers sampled, 56.9% disagreed, 3.8 % were not sure, 39.3 % agreed (Table 4.16). The data suggest that majority of the secondary school teachers significantly (Median = 2, χ^2 = 27.7) responded positively on the fact that use of e-learning does help to complete secondary school syllabus as scheduled.

Table 4:22 Effect of e-learning on the completion of the syllabus as scheduled

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	41	31.5	27.7	0.000	2	Disagree
Disagree	33	25.4				
Not sure	5	3.8				
Agree	24	18.5				
Strongly agree	27	20.8				
Total	130	100				

4.1.5.5 Effect of e-learning on pupil's standard

Improvement of students standards in secondary school is viewed by teachers as measure of efficiency and the extent to which knowledge was imparted to the students. In this research question, a survey was conducted to investigate whether use ICT did improve the standard of the students. Results showed that 53.1 % of the secondary school teachers sampled strongly that the use of e-learning leads to declined pupil's standard, 3.1 % were not sure, 43.8 % agreed (Table 4.17). The data significantly (Median = 2, χ^2 = 26.2) suggest that use of e-learning in secondary schools will definitely lead to improved standards of students.

Table 0:23 Effect of e-learning on the pupil's standard

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	39	30	26.2	0.000	2	Disagree
Disagree	30	23.1				
Not sure	4	3.1				
Agree	29	22.3				
Strongly agree	28	21.5				
Total	130	100				

4.1.5.6 Effect of ICT on the processes and preparation for material teaching

Before going to class for teaching, teachers have to prepare all the material required by the students to ensure easy and smooth transfer of knowledge to students in secondary schools. In order to see the effect of ICT on the processes and preparation for material teaching, data were collected from a population of secondary school teachers. Results showed that 23.1 % disagreed, 18.5 % were not sure, 58.5 % agreed (Table 4.18). This result significantly (Median = 4, χ^2 = 31.7) indicated that the majority of the secondary school teachers agreed that, ICT in secondary schools will imenserly contribute in facilitating the process of materials preparation especially on the scientific and updated information on the areas of their respective specializations.

Table 4:24 Effect of ICT on the processes and preparation for teaching material

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	6	4.6	31.692	0.000	4	Agree
Disagree	24	18.5				
Not sure	24	18.5				
Agree	30	23.1				
Strongly agree	46	35.4				
Total	130	100				

4.1.5.7 Effect of ICT application on the retrenchments of manpower

In this section, a survey was conducted to find out if by applying ICT in secondary schools will jeopardize teacher's jobs or lead to their retrenchments. As shown in (Table 4.19), 64.6 % of the total population sampled disagreed that the application of ICT in teaching increases unemployment. However, 19.2 % were not sure, 16.2 % agreed. This

result significantly (Median = 2, χ^2 = 45.4) suggests that application of ICT in teaching will not lead to retrenchments or reduced recruitment of manpower in secondary schools.

Table 0:25 Effect of application of ICT in teaching on the recruitment of manpower.

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	33	25.4	45.4	0.000	2	Disagree
Disagree	51	39.2				
Not sure	25	19.2				
Agree	14	10.8				
Strongly agree	7	5.4				
Total	130	100				

4.1.5.8 Effect of ICT on the evaluation of student's achievement

In secondary schools, evaluation of students can sometimes be very tedious especially during the examination periods or seasons. Anything that could assist teachers in the students' evaluation process will enormously reduce pressure on teachers. In this section, a survey was conducted to evaluate the effect of using ICT in the students' evaluation process. From this survey results showed that 29.3% of the surveyed secondary school teachers, strongly disagreed that ICT facilitated the students evaluation process, 4.6 % were not sure, and 66.2% agreed (Table 4.20). From this result, the majority of the secondary school teachers significantly (Median = 4, χ^2 = 51.9) agreed in favour of the fact that application of ICT in teaching does facilitate the students evaluation process.

Table 2620 Effect of ICT on the evaluation of students' achievements

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	8	6.2	51.923	0.000	4	Agree
Disagree	36	23.1				
Not sure	6	4.6				
Agree	39	30				
Strongly agree	47	36.2				
Total	130	100				

Effect of ICT on the facilitation of administrative functions

Smooth administration in secondary schools is an important aspect of in ensuring peaceful working environment in education systems. Does ICT facilitate administrative functions in secondary schools? In this section, a survey was conducted to evaluate the effect of ICT on administrative functions. Results showed that 28.4 % disagreed, while 3.1 % were not sure, 68.5 % agreed (Table 4.21). This result indicated that, the majority of the secondary schools teachers significantly (Median = 4, χ^2 = 53.0) agreed that ICT will indeed facilitate the administrative functions by maintenance of students records.

Table 0:27: Effect of ICT on the facilitation of administrative functions

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	12	9.2	53.000	0.000	4	Agree
Disagree	25	19.2				
Not sure	4	3.1				
Agree	42	32.3				
Strongly agree	47	36.2				
Total	130	100				

How does teachers benefit from the available facilities at their schools and classes during the implemintation of ICT?

In this research question, the respondents were asked how they used the available resources at school and in classes to implement the ICT. Results showed that of total sampled population 49.2% indicated that they never use the available facilities at school to produce electronic educational programs, while 7.7% rarely, 4.6% were not sure, 34.6% sometimes and 3.8% always use facilities available at school to produce electronic educational programs (Table 4.22). The observed result significantly (Median = 1, χ^2 = 111.6) indicated that majority of the secondary school teachers sampled, they never used the facilities available at schools and in classes to produce electronic educational programs.

Table 0:28: Use of ICT facilities available at school to produce electronic educational programs

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Never	64	49.2	111.615	0.000	1	Never
Rarely	10	7.7				
Not sure	6	4.6				
Sometime	45	34.6				
Always	5	3.8				
Total	130	100				

4.1.5.9 Use of electronic devices to improve teaching and students satisfaction

In this section, the data was collected to investigate whether secondary school teachers use electronic devices in their daily teaching. The results showed that of the total population sampled, 50% never used electronic devices to improve their daily teaching and students satisfaction, whereas 7.7% rarely, 5.4 % were not sure, 34.6.% sometimes and 2.3% always used electronic devices (Table 4.23). This result significantly (Median = 1, χ^2 =

111.5) indicated that majority of the secondary school teachers never used electronic devices to improve their daily teaching and students satisfaction.

Table 0:29: Effect of using electronic devices to improve teaching and students satisfaction

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Never	65	50	116.462	0.000	1	Never
Rarely	10	7.7				
Not sure	7	5.4				
Sometime	45	34.6				
Always	3	2.3				
Total	130	100				

4.1.5.10 How the participants performed their teaching and administrative tasks

In this section, information was collected from participants, in order to identify whether they used traditional or technological media to achieve their tasks. As shown in (Table 4.24), of the total secondary school teachers sampled, 45.4% never carried out all teaching and administrative tasks via electronic means, 8.5% rarely, 4.6 % were not sure, 36.2.% sometimes, and 5.4% always carry out all teaching and administrative tasks via electronic means. This result significantly (Median = 1, χ^2 = 111.5) suggests that majority of the secondary school teachers never carried out their teaching and administrative tasks via electronic means.

Table 0:30: I carry out all teaching and administrative tasks via electronic means

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Never	59	45.4	96.8	0.000	1	Never
Rarely	11	8.5				
Not sure	6	4.6				
Sometime	47	36.2				
Always	7	5.4				
Total	130	100				

4.1.7.1 Effect of criteria used on the selection of teachers to join ICT training

In this section, a survey was conducted in order to find whether participant's responsiveness to e-learning was related to the criteria used by secondary schools policymaker's in selecting secondary school teachers for ICT training in Sudan. Results showed that 15.4 % strongly disagreed that the selection of teachers for ICT training on the basis of certain principles (i.e. teaching burden, functional class, management vision, the type of educational material) reduced training chances for teachers, while 9.2% were not sure, 75.4 % agreed (Table 4.25). This result significantly (Median = 5, χ^2 = 128.3) indicated that the majority of the secondary school teachers strongly agreed that selection of teachers for training on ICT on the basis of certain principles will certainly narrow the chances of many of the teachers for training. However, majority of these teachers have significant positive attitude towards ICT.

Table 0:31: Effect of criteria used on the selection of teachers to join ICT training

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly disagree	11	8.5	128.308	0.000	5	Strongly agree
Disagree	9	6.9				
Not sure	12	9.2				
Agree	21	16.2				
Strongly agree	77	59.2				
Total	130	100				

4.1.7.2 Effect of designed computer training courses on the availability of employment.

In order to identify the teacher's attitudes towards the technology, a survey was conducted in secondary schools to find out whether computer training courses supported by the ministry of education aimed at improving their teaching standards or put them at risk of unemployment. The data revealed that of the total respondents, 57.7% strongly disagreed that designed computer training courses aimed at reducing manpower, 10.8 % were not sure, 31.5 % a agreed (Table 4.26).This result significantly (Median = 2, χ^2 = 19.5**) suggest that majority of the secondary school teachers did not believe that designed computer training lead to risk of unemployment.

Table 0:32: Designed computer training courses increased risk of unemployment

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	34	26.2	19.462	0.001	2	Disagree
Disagree	41	31.5				
Not sure	14	10.8				
Agree	18	13.8				
Strongly agree	23	17.7				
Total	130	100				

4.1.7.3 Designed computer training courses aim at integrating ICT in teaching

In order to identify the objectives and the types of training course suitable for secondary school teachers, a survey was conducted to assess whether the computer training courses supported by the ministry of education aimed at integrating technology in education system and improving their teaching standards, or, it is just traditional training. Results

showed that 56.9 % disagreed, 20% were not sure, 23 % agreed that designed computer training courses aim at integrating ICT in teaching (Table 4.27). This result significantly (Median = 2, χ^2 = 26.4) indicated that in most secondary schools there is no any strategic plans for the implementation ICT in teaching.

Table 0:33: Designed computer training courses aim at integrating ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	38	29.2	26.385	0.000	2	Disagree
Disagree	36	27.7				
Not sure	26	20				
Agree	25	19.2				
Strongly agree	5	3.8				
Total	130	100				

4.1.7.4 Computer designed training courses aimed at improving the teaching methodology

In order to identify whether there were well designed computer related training course or just computer basic skills training course, a survey was conducted to assess whether computer training courses supported by the ministry of education aimed at improving the teaching methodology. Results showed that of the total population sampled, 56.9 % disagreed, 17.7 % were not sure, 25.3 % agreed that computer designed training courses improved teachers' teaching methodology (Table 4.28). This result significantly (Median = 2, χ^2 = 28.6) indicated that majority of the secondary school teachers disagreed that computer designed training course aim at improving their teaching methodology.

Table 0:34: Computer designed training course aimed at improving teachers' teaching methodology

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	38	29.2	26.846	0.000	2	Disagree
Disagree	36	27.7				
Not sure	23	17.7				
Agree	28	21.5				
Strongly agree	5	3.8				
Total	130	100				

Designed computer training courses aimed at providing teachers with basic computer skills

In this research question, information was collected to find out whether the computer training course offered to the secondary school teachers, aimed at providing them with computer basic skills. Results indicated that 16.9 % disagreed, 11.5 % were not sure, and 71.6 % agreed that designed training courses on computer aim at providing teachers with basic computer skills (Table 4.29). This result significantly (Median = 4, χ^2 = 57.2) suggest that majority of the secondary school teachers feels that the designed computer training courses provided teachers are limited to basic computer skills only.

Table 0:35 Designed computer training courses aim at providing teachers with basic computer skills

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	5	3.8	57.231	0.000	4	Agree
Disagree	17	13.1				
Not sure	15	11.5				
Agree	48	36.9				
Strongly agree	45	34.6				
Total	130	100				

4.1.8 How does the school director encourage or discourage teachers in using ICT in school

Information was collected on the relationship between the schools principals and the teacher's responses to e-learning.

The school principal's and material supports for the staff to implement ICT in their teaching

In this section, teachers support by secondary Principles for ICT implement was assessed. The data showed, 99.3 % of the secondary school teachers disagree that the school administration support materially for the introduction of ICT, 0.7 % were not sure, 0.0 % agreed (Table 4.30). This result significantly (Median = 1, χ^2 = 117.0) indicated that, the school administration did not give any material support for the introduction of ICT in teaching. Lack of material support to teacher led to low morale in ICT implementation in secondary schools.

Table 0:36 Effect of material support by the school administration on the introduction of ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	99	76.2	116.969	0.000	1	Strongly disagree
Disagree	30	23.1				
Not sure	1	0.7				
Agree	0	0				
Strongly agree	0	0				
Total	130	100				

4.1.8.1 The school administration and staff's morall support for the introduction of e-learning in teaching

In this section, a survey was conducted to assess the role of secondary school Principals on staff moral support to implement ICT. Results showed that of total population sampled, 97 % disagreed, 1.4 % were not sure, and 1.6 % agreed that the school administration give moral support for the introduction of ICT in teaching (Table 4.31). This result significantly (Median = 1, χ^2 = 275.2) indicated that, majority of the secondary school teachers felt that the school administration did not give any moral support to the teachers for the introduction of ICT in their daily teaching.

Table 0:37: Effect of moral support by the school administration on the introduction of ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	99	76.2	275.2	0.000	1	Strongly disagree
Disagree	27	20.8				
Not sure	2	1.5				
Agree	1	0.8				
Strongly agree	1	0.8				
Total	130	100				

4.1.8.2 Effect of permission by the school administration on the introduction of ICT in school

In this section, data was collected to assess the principal's attitude to permit ICT in secondary schools' environment. Results showed that from the total population sampled, 5.3 % disagreed, 1.6 % were not sure, and 93.1 % agreed that the school administration does not permit the introduction of e-learning in teaching (Table 4.32). This result significantly (Median = 5, χ^2 = 202.8) suggest that the school administration does not permit the

introduction of ICT in teaching, thus, discouraging the teachers from implementing such technology at schools.

Table 0:38: Effect of permission by the school administration on the introduction of ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	2	1.5	202.8	0.000	5	Strongly agree
Disagree	5	3.8				
Not sure	2	1.5				
Agree	35	26.9				
Strongly agree	86	66.2				
Total	130	100				

The effect of school director on the use of local network for meetings invitation

In this section, the data was collected to assess the principal's attitude towards use of local network on meetings invitation. Results showed that, 95.4 % disagreed, 1.5 % was not sure, 3.1 % agreed on the use local network for meetings invitation (Table 4.33). This result significantly (Median = 1, χ^2 = 182.6) indicated that the school director did not use the local network for meetings invitation, again, discouraging the teachers from implementing ICT at schools.

Table 0:39: The direct of our school uses the local network for meeting invitations

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	97	74.6	182.554	0.000	1	Strongly disagree
Disagree	27	20.8				
Not sure	2	1.5				
Agree	4	3.1				

Strongly agree	0	0
Total	130	100

Effect of using e-mail for academic and administrative purposes.

In research question, data was collected to assess the principal's attitude towards use of ICT for both academic and administrative purposes at school. The results showed that of the total population sampled, 97.7 % disagreed, 2.3 % were not sure, and 0.0 % agreed that the school director used e-mail for both academic and administrative purposes (Table 4.34). This result (Median = 1, χ^2 = 99.2) significantly showed that, majority of the secondary school teachers denies that the school director uses e-mail for both academic and administrative purposes.

Table 0:40: Effect of using e-mail for academic and administrative purposes

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly disagree	94	72.3	99.246	0.000	1	Strongly disagree
Disagree	33	25.4				
Not sure	3	2.3				
Agree	0	0				
Strongly agree	0	0				
Total	130	100				

4.1.9 What is the relationship between school support and teachers attitudes for e-learning?

This section the participants questioned about the relationship between the school support and their responses level to e-learning.

Spplying of electonically individual educational programs at school will help to solve the problem of shortage of teachers

In order to assess the effect of ICT supply on the problem of teachers' shortage, a study was conducted in Sudanese secondary schools and whether supporting schools with electronic education program assisted in solving the problem of teacher's shortage. Results indicated that 40.8 % disagreed, 5.4% were not sure, and 53.8 % agreed that by providing secondary schools with individual electronic educational programs will solve the problem of shortage of teachers (Table 4.35). This result significantly (Median = 4, χ^2 = 21.2) indicated that majority of the secondary school teachers agreed that by electronically providing schools with individual educational programs will helps to solve the problem of shtage of teachers, thus, a positive attitudes towards ICT.

Table 0:41: Providing school with electronically individual educational programs helps to solve the problem of teacher shortages.

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	23	17.7	21.154	0.000	4	Agree
Disagree	30	23.1				
Not sure	7	5.4				
Agree	34	26.2				
Strongly agree	36	27.7				
Total	130	100				

4.1.9.1 Schools readiness for the introduction of e-learning at secondary schools

In this section, data were collected in order assess schools readiness towards ICT. The data showed that, 21.6 % disagreed, 6.9 % were not sure, 71.5 % agreed (Table 4.36). This result significantly (Median = 4, χ^2 = 65.8) indicated that majority of the teachers agreed

that the time was appropriate for the introduction of ICT in secondary schools, thus, showing a positive attitude towards ICT.

Table 0:42: School readiness for the introduction of e-learning at secondary schools

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	8	6.2	65.769	0.000	4	Agree
Disagree	20	15.4				
Not sure	9	6.9				
Agree	36	27.7				
Strongly agree	57	43.8				
Total	130	100				

4.1.9.2 The strategy for the implementation of ICT in teaching

Strategic planning in the implementation of ICT in secondary schools is very important in establishing a sustainable knowledge base for both teachers and students. In this research question, an investigation was conducted to find out whether teachers in various secondary schools have strategic plans in place for the implementation of ICT. Results showed that of the total population sampled, 82.2 % disagreed, 10.8 % were not sure, 7 % agreed that their schools has developed plans for the implementation of ICT in teaching (Table 4.37). This result significantly (Median = 2, χ^2 = 107.1) showed that there was no any strategic plans developed for the implementation of ICT in teaching, thus, representing one of the barriers to most effective e-learning in Sudanese secondary schools.

Table 0:43: Development of strategic plans for the implementation of ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation

Strongly disagree	63	48.5	107.154	0.000	2	Disagree
Disagree	44	33.8				
Not sure	14	10.8				
Agree	8	6.2				
Strongly agree	1	0.8				
Total	130	100				

4.1.9.3 Classes in schools are equipped to encourage the use of e-learning

Equipping secondary school with appropriate packages and tools for ICT is one way of encouraging learning process in students. In this section, assessment was conducted to see whether classrooms were sufficiently equipped to encourage implementation of ICT in secondary schools. Results have indicated that of the total population sampled, 94.6 % disagreed, 0.8 % were not sure, and 4.6 % agreed that classes are equipped to encourage the use of ICT in secondary schools (Table 4.38). This result significantly (Median = 1, χ^2 = 224.5) indicated that most of the Sudanese secondary school classrooms are not adequately equipped to cope with e-learning innovations.

Table 0:44: Classes in schools are equipped to encourage the use of e-learning

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly disagree	90	69.2	224.462	0.000	1	Strongly disagree
Disagree	33	25.4				
Not sure	1	0.8				
Agree	5	3.8				
Strongly	1	0.8				

agree		
Total	130	100

4.1.9.4 Effect of classroom size on the implementation of ICT in teaching

Proper number of pupils in classrooms is essential for proper management and knowledge dissemination to students in secondary schools. In this section, a survey was conducted to assess whether number of students and equipments in classrooms encouraged the implementation of ICT. Results showed that shows that of the total population sampled, 95.3 % disagreed, 1.6 % was not sure, and 3.1% agreed that the number of students in classroom coincides with the equipment available, which helps the use of information and technology in teaching (Table 4.39). This result significantly (Median = 1, χ^2 = 134.3) indicated that the majority of the secondary school teachers believes that population of students in Sudanese secondary school classrooms and the available equipments obstruct the implementation of ICT in teaching.

Table 0:45 Effect of classroom size and equipments on the implementation of ICT in teaching

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	83	63.8	134.308	0.000	1	Strongly disagree
Disagree	41	31.5				
Not sure	2	1.6				
Agree	4	3.1				
Strongly agree	0	0				
Total	130	100				

4.1.9.5 Computer helps in the extraction of accurate and fast results

Computer technology supports student performance of an authentic task. In this research question, a survey was conducted to assess whether the computer technology assist in fast achievement in administration tasks such as the extraction of accurate and fast results.

As shown in (Table 4.40), 25.4 % disagreed that computer helps in the extraction of accurate and fast results, whereas 6.9 % were not sure, 67.7 % agreed. This result significantly (Median = 4, χ^2 = 47.6) showed that majority of the secondary school teachers agreed that computer technology helps in the extraction of accurate and fast results secondary schools.

Table 0:46 Computer helps in the extraction of accurate and fast results

Phrase	**Frequency**	**Percentage %**	**Chi square**	**Significant**	**Median**	**Interpretation**
Strongly disagree	9	6.9	47.615	0.000	4	Agree
Disagree	24	18.5				
Not sure	9	6.9				
Agree	42	32.3				
Strongly agree	46	35.4				
Total	130	100				

Effect of e-learning on the promotion of school and the student parents relationship

The relationship between the school and students parents is very important in building mental capacity of the student. In this section, an investigation was conducted to assess whether the ICT promotes the relationship between the school and the pupil's parents. Results showed that of the total population sampled, 25.4 % disagreed, 6.2 % were not sure, 68.4 % agreed (Table 4.41).This result significantly (Median = 4, χ^2 = 49.0) suggest ICT can promote the relationship between the school and the pupil's parents.

Table 0:47: Effect of e-learning on the promotion of school and the student parent's relationship

Phrase	Frequency	Percentage . %	Chi square	Significant	Median	Interpretation
Strongly disagree	11	8.5	49.000	0.000	4	Agree
Disagree	22	16.9				
Not sure	8	6.2				
Agree	41	31.5				
Strongly agree	48	36.9				
Total	130	100				

4.1.9.6 Effect of high cost of computer hardware on the use of ICT

Computer hardware price is one of the factors that can affect the smooth implementation of ICT in schools. In this section, a survey was conducted to assess whether the high cost of computer hardware limited the use of ICT in secondary schools. Results showed that of the total population surveyed, 4.6% disagreed, 1.5 % were not sure, 93.9 % agreed (Table 4.42). This result significantly (Median = 5, χ^2 = 138.7) suggests that high cost of computer hardwares hindered the use of ICT by teachers in secondary schools.

Table 0:48: Effect of high cost of computer hardware on the use of ICT

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	0	0	138.677	0.000	5	Strongly agree
Disagree	6	4.6				
Not sure	2	1.5				
Agree	36	27.7				
Strongly agree	86	66.2				
Total	130	100				

4.1.9.7 Effect of scarcity of specialized and effective education program on the use ICT in secondary schools

In this section, assessment was conducted to find out whether lack of effective educational program limited the use of ICT by teachers in secondary schools. Results showed that of the total population assessed, 0.7 % disagreed, 3.1 % were not sure, 96.2% agreed (Table 4.43). This result significantly (Median = 5, χ^2 = 142.1) suggests that scarcity of specialized and effective educational programs limits the use e-learning in secondary schools.

Table 0:49: Effect of scarcity of specialized and effective educational programs on the use of ICT in secondary schools.

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	0	0	142.062	0.000	5	Strongly agree
Disagree	1	0.7				
Not sure	4	3.1				
Agree	40	30.8				
Strongly agree	85	65.4				
Total	130	100				

4.1.9.8 Effect of high cost of regular maintenance of equipments on the use of ICT in the secondary schools

Investigation was conducted to find out whether the regular maintenance costs of ICT equipments limited the use of ICT by secondary school teachers. Results showed that of the total population investigated, 1.6 % disagreed, 3.1 % were not sure, 95.3 % agreed (Table 4.44). This result significantly (Median = 5, χ^2 = 250.2) suggests that high cost of regular maintenance of equipments limited the use of e-learning by teachers in secondary schools.

Table 0:50: Effect of high cost of regular maintenance of equipments on the use of ICT in secondary schools

Phrase	Frequency	Percentage %	Chi square	Significant	Median	Interpretation
Strongly disagree	1	0.8	250.154	0.000	5	Strongly agree
Disagree	1	0.8				
Not sure	4	3.1				
Agree	29	22.3				
Strongly agree	95	73.0				
Total	130	100				

Classroom observation worksheet:

General information about the secondary schools

General information was collected from 13 Sudanese secondary schools through the observation worksheet. The aim was to observe teachers while teaching in their classes for the purpose of understanding several factors in their working environment in relation to the schools readiness towards ICT.

Location and distribution of the observed secondary schools in Sudan

As shown in Table 4.45, a total of 13 secondary schools participated in this study. These include 5 (or 38.4%) from Khartoum, 4 (or 30.8%) from Omdurman and 4 (or 30.8%) from Bahri location. This distribution indicated that most secondary schools which participated in this study were located in Khartoum where most families were middle income earners. The presence of this class of families in Khartoum suggest that apart from being

suitable for ICT, there was also a computer laboratory, relative to the others Sudanese secondary schools where not even a textbook for students was not available.

Table 0:51: Location and distribution of the observed secondary schools in Sudan

Location	Frequency	Percentage %
Khartoum	5	38.4
Omdurman	4	30.8
Bahri	4	30.8
Total	13	100

Location and distrbution of the observed secondary schools according to areas

In Table 4.46, 13 secondary schools were similarly observed according to geographical areas in Sudan. Of the thirteen secondary schools participated in this study, five (or 38.4%) were from urban areas, four (or 30.8%) were from rural areas, and four (or 30.8%) were from the city areas. This indicated that in some Sudanese secondary schools that participated in this study were from the inner cities where there were councils, which not only acted as the schools fund providers but also facilitated solving many of the teacher's problems as opposed to the countryside secondary schools.

Table 0:52: Location and distribution of the observed secondary school according to areas

Location Area	Frequency	Percentage %
Urban	5	38.4
Rural	4	30.8
City	4	30.8
Total	13	100

4.2.3 Relationship between secondary school connectivity and teachers attitudes towards ICT

In this study area, teachers were observed while teaching in their classes in order to assess the relationship between school connectivity (i.e. connection to internet, intranet and electricity) with teachers attitudes towards ICT.

Effect of electricity connection in secondary schools

Connecting power to secondary schools i.e. electricity is very important for proper operation and functioning of ICT accessories. In this section, a survey was conducted to assess the electricity connection in Sudanese secondary schools Results showed that there was connection to electrical power in all participated schools, which indicating that electricity was not a problem, suggesting that power as a factor was not an obstruction to ICT implementation by the Sudanese secondary school teachers.

School's network connection

Assessment was made on the effect of network connection in the Sudanese secondary schools that participated in this study (Table 4.47). Results revealed that of the surveyed secondary schools, twelve (i.e. 92.3%) were disconnected from internet, while only one (i.e. 7.7%) of the surveyed secondary schools were connected to internet. This result indicated that most Sudanese secondary schools were disconnected to internet, suggesting that disconnection to internet obstructed secondary school teachers from responding to ICT in Sudan. Although some secondary school teachers have their own laptops which were wirelessly connected to internet, they never used it in their classrooms, suggesting that other factors could be involved other than internet alone.

Table 0:53: Schools network connection

Phrase	Frequency	Percentage %
Stand alone	12	92.3

Internet	1	7.7
Total	13	100

Learning activity

In order to assess the learning activity in Sudanese secondary schools, data were collected .Results showed that all Sudanese secondary schools stayed offline, indicating that teachers in these schools did not use the internet in their classes, suggesting that internet connectivity represented a response barrier towards ICT in all secondary schools in Sudan.

Effect of technology application on the teacher's effectiveness

Information was collected through observation worksheet instrument, to assess the relationship between technology application and teacher's efficiency**.**

Effect of technology application on teacher's effectiveness

In secondary schools, teacher's efficiency is necessary for gauging knowledge and skills advancement amongst students. In this section, the teachers were observed while teaching in their classrooms, in order to identify the extent at which they apply the ICT (i.e. open sources, office programmed, and/or CDs) in teaching. As shown in (Table 4.48), of the thirteen secondary schools, five (i.e. 38.5%) applied CDs in teaching and learning process represent, while eight (i.e. 61.5 %) schools did not use any application programme. This result suggests that most secondary schools did not use any application programs in their teaching and learning process due to the lack such application programs Sudanese secondary schools.

Table 0:54 Effect of technology application on teacher's effectiveness.

Phrase	**Frequency**	**Percentage %**
CDs	5	38.5
None	8	61.5
Total	13	100

How were existing computers being used

Assessment was conducted to find out how teachers were making use of the existing computers in their secondary schools. Results showed that of the thirteen Sudanese secondary schools, two (i.e. 15.4%) used the existing computers as a teaching tool, while eleven (i.e. 84.6 %) used the existing computers as administrative tools (Table 4.49). This result indicated that most secondary schools in Sudan used the existing computers for administrative rather than teaching purposes. It was also observed that although the government supplied 10 computers in all the secondary schools based in Khartoum, they were however locked in stores, suggesting that there were other factors obstructing the secondary school teachers from using the existing computers in their daily teaching process.

Table 0:49: How were existing computers being used?

Phrase	**Frequency**	**Percentage %**
Teaching tool	2	15.4
Administration tools	11	84.6
Total	13	100

4.2.4.1 Effect of using multimedia on information presentation

Regarding the use of multimedia, the information was collected on the extent at which the secondary school teachers use a variety of media (i.e. data projectors, computer, whiteboards and blackboards) to present information**.** Results showed that of the surveyed secondary schools, eight (or 38.5%) teachers insufficiently used multimedia to present information, while five (or 61.5%) teachers sufficiently used multimedia to present information to their students (Table 4.50). This result indicated that most secondary schools teachers in Sudan insufficiently used multimedia for information presentation to their students, thus, later response to ICT.

Table 0:50: The teacher uses a variety of media to present information

Phrase	Frequency	Percentage %
Insufficient	8	38.5
Sufficient	5	61.5
Total	13	100

4.2.4.2 Provides learners with important website address related to the areas of their specialization

A survey was conducted to collected information regarding the extent at which secondary school teachers guide their students to benefit from the internet in relation to their academic subjects. Of the thirteen secondary school teachers surveyed, nine (or 69.3 %) teachers did not support their pupils with important websites addresses related to their specializations, while four (or 30.7 %) teachers supported their students with important websites addresses related to their specializations (Table 4.51). This result indicated that most secondary school teachers in Sudan don't support their students with important websites addresses related to their specializations, suggesting that most secondary school teachers don't care about new technologies and its value in supporting their students with different resource materials.

Table 0:51: Provides learners with important website address related to their areas of specialization

Phrase	Frequency	Percentage %
Insufficient	9	69.3
Sufficient	4	30.7
Total	13	100

Use educational software as support resource

In order to assess the use of educational software a survey was conducted to collect information regarding the extent at which the secondary school teachers use related support software for teaching. Results showed that of the thirteen surveyed secondary school

teachers, nine(or 69.3%) insuffienciently used educational support software as a resource material; while four (or 30.7%) teachers suffienciently used educational support software as resource material (Table 4.52). This result clearly indicated that most secondary school teachers in Sudan did not use educational software as support resource in their schools, thus, obstructing most secondary school teachers from an early response to ICT.

Table 0:55: Use educational software as supported resources

Phrase	Frequency	Percentage %
Insufficient	9	69.3
Sufficient	4	30.7
Total	13	100

4.2.4.3 The extent to which teachers use internet access as teaching resource.

A study was conducted to collect information regarding the extent at which teachers use internet access as additional teaching resource. Results shows that of the 13 secondary schools teachers surveyed, eight (or 61.5%) teachers insufficiently used the internet as teaching resource; while five (or 38.5%) teachers sufficiently used the internet as teaching resource (Table 4.53). This result indicated that most secondary school teachers in Sudan insufficiently used the internet as teaching resource, suggesting that most of the secondary schools surveyed were disconnected from the internet, thus, acting as a barrier towards ICT.

Table 0:53: The extent to which teachers use internet as teaching resource

Phrase	Frequency	Percentage %
Insufficient	8	61.5
Sufficient	5	38.5
Total	13	100

4.2.5 The role of training in encouraging teachers towards ICT

The teacher trained in using CDs as resources for teaching

In this section, a survey was conducted to collect information to decide whether the surveyed secondary school teachers were well trained to use CDs as resources for teaching and the extent to which their training affected schools readiness towards ICT. (Table 4.54) Results showed that of the 13 secondary schools surveyed in Sudan, seven (or 53.8%) secondary schools insufficiently used CDs in their classrooms, five (or 38.5%) schools used it sufficiently, while one (or 7.7%) teacher was proficient in using CDs as a resource for teaching. This indicated that most Sudanese secondary schools were untrained in using e-learning tools suggesting one of the serious factors affecting responsive implementation to ICT in education systems.

Table 0:56: Are teachers well trained in using CDs as resource for teaching?

Phrase	Frequency	Percentage %
Insufficient	7	53.8
Sufficient	5	38.5
Proficient	1	7.7
Total	13	100

Are teachers trained in using data projectors in teaching

In this survey, the information was collected to decide whether secondary school teachers were well trained in using data projectors in their teaching and to identify the effectiveness on the use media in their daily teaching, consequently, on the schools readiness towards ICT. Results showed that shows that seven (or 53.8%) secondary schools insufficiently used data projectors in teaching, while six (or 46.2%) schools used data projectors sufficiently (Table 4.55). The data indicated that the most Sudanese secondary schools not only insufficiently used data projectors in teaching, but were also untrained in using ICT media; therefore, representing one of the serious factors impeding secondary school teachers in responsively implementing ICT in education systems.

Table 0:57: the teacher were trained in using data projectors in teaching

Phrase	Frequency	Percentage %

Insufficient	7	53.8
Sufficient	6	46.2
Total	13	100

4.2.5 What is the relationship between school support and teachers attitudes for e-learning?

A survey was conducted to collect information regarding the relationship between the school supports such as: classroom layout, availability of computers, computer/students ratio, and variety of media, availability of computer laboratories, computer lab technicians, and the availability of software in relation to teacher's readiness to ICT.

Class-room layout

Data was collected regarding the relationship between classroom layout and its effect on schools readiness towards ICT. It was observed that all secondary schools in Sudan have school bus layouts classrooms, which was unfortunately incompatible to e-learning, suggesting reconstruction to suit the ICT setting techniques.

Numbers of computer in schools

In this questionnaire, a study was conducted to observe the relationship between the number of computers in the classroom and its effect on schools readiness to ICT. Results showed that of the total secondary schools assessed, that five (or 38.5%) have ten computers, while one (or 7.7%) secondary school have five computers (Table 4.56). This result indicated that most secondary schools owned ten computers distributed by the government, suggesting that numbers of computers in secondary schools were not a barrier to teachers' responsiveness to ICT in Sudan.

Table 0:56 Numbers of computers in schools.

No of computers	Frequency	Percentage %
1----------5	1	7.7
6----------10	5	38.5
11--------15	3	23.1

16---------20	3	23.1
21---------25	1	7.7
Total	13	100

4.2.6.1 Computer ratio per learner in schools

To determine the relationship between the ratio of computers to the students and its effect on schools readiness to e-learning a survey was conducted. Results show that of the thirteen secondary schools surveyed, four (or 30.8%) schools have one computer to every 30 students 30:1, While one (or 7.7 %) school had one computer to every ten students

10:1, table 4.57.This result indicated that most secondary schools have 1 computer to every 30 pupils.

Table 0:57Computer ratio per learner in schools.

Phrase	No of schools	Percentage %
1/15	2	15.4
1/17	1	7.7
1/20	2	15.4
1/22	1	15.4
1/25	1	7.7
1/30	4	30.8
1/10	1	7.7
Total	13	100

The number of pupils in the classroom

In order to assess the relationship between the number of the students in a classroom and its effect on the schools readiness to e-learning data was collected. Results indicate that of the thirteen secondary schools assessed, seven (or 53.8 %) secondary schools have 50 to 60 pupils in their classroom, while two (or 15.4%) schools have between 60 or more students in their classroom (Table 4.58 This result clearly indicate that most participated Schools have between 50 to 60 pupils at their classroom suggesting that number of students in a classroom is a barrier for earlier response to e-learning in Sudan.

Table 0:58The number of pupils in the classroom

Phrase	Frequency	Percentage %
40 – 50	4	30.8
50 – 60	7	53.8
60 and more	2	15.4
Total	13	100

Analysis of Sudanese secondary school principals interviews

Introduction

In this section, the schools principals were assessed as one of the important factors affecting secondary schools readiness towards ICT in Sudan.

What the relationship between the school connectivity and teacher attitudes towards e-learning?

Generally, all participants expressed their interest and willingness to response to e-learning. However, almost all of them expressed their dissatisfaction about not been adequately informed about e-learning. All the interviewees pointed out that e-learning will provide teachers with easy access to a variety of ICT learning materials. Additionally, they strongly linked their later responses towards ICT to absence of internet connection in secondary schools in Sudan.

To what extent does the application of technology increase or decrease teacher's effectiveness?

Most of participants referred to the positive effects of e-learning such as motivating students, providing opportunities for constructive learning, enriching learning with activities that reflect different learning styles, and making learning more student-centred**.** However, all of them shared the views that it is not necessary for a teacher to have knowledge about e-learning in order to be effective. In the participants' view, ICT is a useful tool for teachers who want to advance and enrich their teaching style.

Only one participant claimed that e-learning will decrease efficiency, because of the time wasted during preparation and operation of the computers, facing the screen instead of facing the pupils, taking care about how, lessons technically executed, not about students understanding and feedback. Most participants suggested that in-service teachers should receive training on how to integrate e-learning into teaching. Nevertheless, all but one

expressed their interest to learn more about e-learning programme and try to integrate it into classroom lessons.

What the role of training in encouraging teachers towards e-learning?

According to the participants, the first and most vital factor for successful integration of e-learning is for teachers to receive training on how to integrate e-learning into their teaching. All participants pointed out that the training should be in school hours and should focus on specific examples of how e-learning can be used in teaching.

What is the relationship between school support and teachers attitudes towards e-learning?

All participants regarded the provision of adequate technical support as the important factor. All participants expressed their dissatisfaction with the current situation where technical support was not provided. The lack of technical support and maintenance seems to de-motivate most participants towards use of e-learning in their teaching. Almost all of them expressed their concern that e-learning might not be embraced by teachers due to the lack of technical and pedagogical support.

Chapter five Data discussion

Introduction

In this chapter, data collected using different research instruments, are discussed and triangulated with each other, in order to pick up the research findings.

Relationship between secondary school connectivity and teacher's attitude towards ICT

Table5:58 The questionnaire questions that answered the above research question

Phrases	Strongly Disagree %	Disagree %	Unsure %	Agree %	Strongly Agree %	Median	Indicators
Use of e-mail will help in getting books and scientific references	22.3	14.6	3.1	25.4	34.6	4	Agree
Availability of computers and Internet in offices will encourage exchange of views with other scientists and researchers in relevant specialities	22.3	16.9	5.4	25.4	30	4	Agree
Information derived from the Internet is reliable and may assist in teaching process	18.5	19.2	3.8	26.2	32.3	4	Agree
Use of e-mail helps to a greater extent to improve teaching methods by the secondary school teachers	13.8	22.3	3.8	23.1	36.9	4	Agree

Use of e-mail helps to a greater extent in the follow-up of students duties at all times.	13.8	26.2	3.8	24.6	31.5	4	Agree

As shown in Table 5.1, between 30% and 36.9% of all the secondary school teachers strongly agreed to all questions, that is, use of e-mail improved to a greater extent the teaching methods, while between 13.8% to 22.3% strongly disagreed to all statements related to the same question. Overall, there was strong relationship between school connectivity and teacher's attitudes towards ICT. These result suggests that connectivity (i.e. internet as well as intranet or local networks) in all secondary schools in Sudan, teachers will not only have positive attitudes towards e-learning, but will also be motivated and, thus, readily implement the ICT. Additionally, all secondary school principals similarly expressed their interest and willingness to respond to ICT. However, these secondary school teachers and principals expressed their dissatisfaction since they were not adequately informed about ICT, hence, denying them easy access to a variety of ICT learning materials, strongly linking their late response towards ICT to the absence of internet connection in their schools.

Observation made to secondary school teachers during teaching in classrooms in order to assess if there was relationship between school **connectivity** (i.e. internet, intranet and electricity) with teachers attitudes towards ICT. Results showed that absence of electricity and ICT connectivity caused a serious demoralization of secondary school teachers and principals towards ICT responsiveness in Sudan. Although some of the secondary school teachers have their own laptops and wirelessly connected with the internet, they nevertheless used it in their classes suggesting that most secondary school teachers in Sudan always stayed offline. In all, disconnection to internet represented a serious barrier to secondary school teachers to earlier response towards e-learning in Sudan. Similarly, lack of adequate

information on ICT and its role in increasing teacher's efficiency and pupil's performance added more barriers in such schools.

Effect of technology application on teacher's effectiveness

Table 5:59 Effect of technology application on teachers effectiveness

Phrases	Strongly Disagree %	Disagree %	Unsure %	Agree %	Strongly Agree %	Median	Indicators
E-learning adds a new burden to the teacher	31.5	24.6	1.5	18.5	23.8	2	Disagree
Use of computers in teaching reduces the time and effort	21.5	16.9	2.3	13.8	45.4	4	Agree
Use of e-learning is not conducive to the cooperative education	37.7	18.5	1.5	19.2	23.1	2	Disagree
Use of e-learning helps to consolidate the relationship between students and their teachers	20.8	9.2	9.2	23.8	36.9	4	Agree
Use of e-learning is not helpful in classroom management	32.3	25.4	4.6	17.7	20	2	Disagree
Use of e-learning does not help to complete school syllabus as scheduled	31.5	25.4	3.8	18.5	20.8	2	Disagree
Use of e-learning leads to decline of the students standard.	30	23.1	3.1	22.3	21.5	2	Disagree
e-learning facilitates the	4.6	18.5	18.5	23.1	35.4	4	Agree

process of preparing materials for scientific and updated information in the area of their specialization							
Application of modern ICT in teaching reduces the recruitment of manpower	25.4	39.2	19.2	10.8	5.4	2	Disagree
E-learning contribute to facilitate the process of evaluating students achievement	6.2	23.1	4.6	30	36.2	4	Agree
E-learning helps in the maintenance of records of students and facilitates the administrative functions	9.2	19.2	3.1	32.3	36.2	4	Agree

As indicated in Table 5.2, majority of the secondary school teachers in Sudan disagreed to the negative statements such as: ICT adds a burden on teachers, is not conducive to the cooperative education, is not helpful in classroom management, does not help to complete the syllabus as scheduled, leads to decline of the pupil's standard, reduces the recruitment of manpower (Table 5.2). However, majority of secondary school teachers also agreed to all positive statements such as: the use of computers in teaching reduces the time and efforts, helps to consolidate the relationship between pupils and their teachers, contribute in facilitating the process of preparing materials for the scientific and updated information and keep abreast of scientific development in the area of specialization, facilitate the process of evaluating pupil's achievement, helps in the maintenance of records of students and facilitates the administrative functions. This indicates that, application of ICT in secondary school in

Sudan will increase teacher's efficiency and represents one of the important factors that affecting teacher's attitudes towards e-learning**.** Furthermore, most of respondents showed that ICT implementation have tangible benefits such as students motivating, providing opportunities for enriching learning with activities that reflect the different learning styles, and making it more student-centered**.** In contrast, all of them shared the view that it is not necessary for a teacher to have ICT knowledge in order to be effective. In view of this, e-learning is a useful tool for teachers who want to enrich their teaching style. In addition, only one participant claimed that e-learning will decrease her efficiency, simply because of time wasted during preparation and operating the computer, facing the screen instead of facing the students, taking care about how, lessons are technically executed, not about pupils understanding and feedback. It was therefore suggested that in-service teachers should receive training on how to integrate e-learning into teaching. Nevertheless, all school principals, but one expressed their interest to learn more about e-learning programme and try to integrate it into his lesson .In addition to that, application of technology increased teacher's efficiency. There are many factors affecting application of ICT in secondary schools, consequently, affecting their attitudes and teaching efficiency, this include:

- Absence of application programs as teaching resources such as: open sources, office program and CDs.
- Present but unused computers in most of the Sudanese secondary schools, limited the teachers access to computers in teaching purposes making the job less accurate and fast relative to when computers were available and accessible. Most of the good computers though, were used for administrative functions. Unfortunately, less accurate and slow teaching process was not because of lack of computers at school, but because they were locked up in the secondary school stores, even though many of the secondary schools in Sudan received at least 10 computers each from the

government. This led to a belief that there were other factors hindering teachers from using computers in their teaching beside the number of computers.

- Sudanese secondary schools teachers insufficiently used different media such as data projectors, computer, whiteboards and blackboards to present information (Table 5.2) this result indicated that absence of multimedia in most of these secondary schools represented a serious factor for slower response to ICT in education process.
- Lack of adequate information on ICT and its effective role in increasing teacher's efficiency among secondary school teachers in Sudan, resulted in misleading their pupils and negligence of the important roles of ICT in advancing students performance.
- Sudanese secondary school teacher's insuffienciently used educational software as support resources (Table 5.2). This indicated that absence of educational software was a barrier to most of the secondary school teachers in Sudan from an early response to e-learning.
- Sudanese secondary schools teachers insufficiently used the internet as teaching resources (Table 5.2). This result indicated that most secondary schools were disconnected from the internet access suggesting the observed slow response to ICT.

Role of training in encouraging teachers towards ICT

Table 5:60 Thes questionnaire that answered the above research question

Phrases	Strongly Disagree %	Disagree %	Unsure %	Agree %	Strongly Agree %	Median	Indicators
Selection of teachers for training on ICT based on certain principles (i.e. teaching	8.5	6.9	9.2	16.2	59.2	5	Strongly agree

burden, functional class, management vision, the type of educational material) reduced opportunities for teachers training							
Designed computer training courses aimed at reducing manpower (increased unemployment)	26.2	31.5	10.8	13.8	17.7	2	Disagree
Designed computer training courses aimed at integrating information technology in teaching	29.2	27.7	20	19.2	3.8	2	Disagree
Designed computer training course aimed at improved .teaching methodology	29.2	27.7	17.7	21.5	3.8	2	Disagree
Designed computer training courses provided teachers with basic computer skills	3.8	13.1	11.5	36.9	34.6	4	Agree

As shown in this questionnaire analysis (Table 5.3), selection of teachers for training in e-learning on the basis of certain principles (i.e. teaching burden, functional class, management vision, and the type of education material) reduced the training opportunities for many teachers (Table 5.3), thus discouraging secondary school teachers towards e-learning. Additionally, there was significant disagreement that the designed computer training courses aimed at integrating information technology in the teaching process, was inadequate for them to integrate the ICT in the teaching process (Table 5.3). In this study, even though majority of the secondary school teachers similarly disagreed that the designed computer training courses

aimed at reducing manpower (i.e. increased unemployment**),** they nevertheless have positive attitudes towards technology although the strategy used, the content and objectives of the training did not cope with teacher's requirements to quickly adapt and implement the ICT in their classes. This findings suggest that the first and foremost factor for successful integration of e-learning in the teaching process, is for teachers to receive training during working hours on how to integrate e-learning into their teaching (Table 5.3). With regard to whether the training on technology encouraged or discouraged teachers towards e-learning, It was found that majority of secondary school teachers, were untrained in using e-learning tools such as: CDs, data projector and whiteboards as teaching resources, thus, representing one of the most critical factors that hinder the secondary school teachers in implementing and responding appropriately to e-learning in the education process

Does the secondary school director encourage or discourage teachers in using ICT in school

Table 5:61 the questionnaire that answered the above research question

Phrases	Strongly Disagree %	Disagree %	Unsure %	Agree %	Strongly Agree %	Median	Indicators
The school administration give material support for the introduction of ICT in teaching	76.2	23.1	0.8	0	0	1	Strongly disagreed
The school administration give moral support for the introduction of ICT in teaching	76.2	20.8	1.5	0.8	0.8	1	Strongly disagreed
The school administration	1.5	3.8	1.5	26.9	66.2	5	Strongly

does not permit the introduction of e-learning in teaching							agreed
The school director used the local network for meeting invitations	74.6	20.8	1.5	3.1	0.0	1	Strongly disagreed
The school director used e-mail for the academic and administrative purposes.	72.3	25.4	2.3	0.0	0.0	1	Strongly disagreed

From questionnaire analysis (Table 5.4), it is clear that, majority of the participants disagreed that the school administration supported the teachers neither materially nor morally for the introduction of e-learning in the teaching process thus, discouraging teachers in using ICT in teaching. Furthermore it was generally agreed that the school administration does not permit the introduction of e-learning in the teaching process. However, most secondary school teachers disagreed that school director uses e-mail for academic and administrative purposes, thus, representing one of the factors leading to slower response to e-learning readiness by secondary school teachers in Sudan.

Relationship between school support and teachers attitudes towards e-learning

Table 5:62 The questionnaire that answered the above research question

Phrases	Strongly Disagree %	Disagree %	Unsure %	Agree %	Strongly Agree %	Median	Indicators
Provision of individual educational programs electronically helps to solve the problem of shortage of	17.7	23.1	5.4	26.2	27.7	4	Agreed

teachers							
The time is appropriate for the introduction of e-learning in secondary schools	6.2	15.4	6.9	27.7	43.8	4	Agreed
Secondary schools have developed plans for the implementation of ICT in teaching	48.5	33.8	10.8	6.2	0.8	2	Disagreed
Classes in secondary schools are equipped to encourage the use of e-learning	69.2	25.4	0.8	3.8	0.8	1	Strongly disagreed
The number of students in the classrooms coincides with the equipment available, which helps the use of information technology in teaching	63.8	31.5	1.5	3.1	0.0	1	Strongly disagreed
Computer helps in the extraction of accurate and fast results	6.9	18.5	6.9	32.3	35.4	4	Agreed
E-learning helps to promote the relationship between the school and the student parents	8.5	16.9	6.2	31.5	36.9	4	Agreed
High costs of computer hardwares, hinder the use of e-learning	0.0	4.6	1.5	27.7	66.2	5	Strongly agreed
The scarcity of specialized and effective educational programs limits the use e-learning.	0.0	0.8	3.1	30.8	65.4	5	Strongly agreed
The high cost of regular maintenance equipment, limits the use of e-learning	0.8	0.8	3.1	22.3	73.1	5	Strongly agreed

In this questionnaire analysis (Table 5.5), majority of the secondary school teachers agreed that provision of individual educational programs electronically, will significantly help to solve shortage of teachers in most secondary schools in Sudan, thus, a strong relationship between school supports and teachers' attitudes for e-learning. Additionally, it was generally agreed that time is appropriate for the introduction of e-learning in secondary schools, computer helps in the extraction of accurate and fast results, e-learning helps to promote the relationship between the school and the pupil's parents; the high cost of computer hardware, hindered the use of e-learning, the scarcity of specialized and effective educational programs limited the use e-learning, and the high cost of regular maintenance equipment, limits the use of e-learning. However, there were also significant disagreements that; schools have developed plans for the implementation of ICT in teaching; the classroom at their schools were equipped to encourage the use of e-learning, and the number of pupils in the classroom coincides with the equipment available, which helps the use of information technology in teaching (Table 5.5). These findings indicated that secondary schools in Sudan faces many difficulties, i.e. obstructed teachers' readiness towards ICT related to the support services such as: the number of pupils in classroom, lack of equipments, scarcity of specialized and effective educational programs, and high costs of computer hardware and regular maintenance equipments.

All secondary school teachers in Sudan expressed their dissatisfaction with regard to the current situation where technical support services were not provided, suggesting why most of these teachers are de-motivated towards use of ICT in their teaching programs (Table 5.5). In addition, all secondary schools in Sudan have school bus layouts classrooms, a constraint to application of e-learning, as a result, there is lack of support

such as lack of infrastructures that suits e-learning setting such as classroom layout, lack of multimedia, technical support services, and lack of educational software programs. In this study, it was also shown that, the ratio of computer student ratio was 1:30 in majority of secondary schools in Sudan since the number of students per classroom were between 50 to 60, suggesting a serious barrier to both teachers and students responsiveness towards e-learning.

Chapter six

Summary of findings, conclusions and recommendations

Introduction

This chapter presents a summary of findings, proposed recommendations and conclusions drawn from this study. It also shows areas of immediate action as well as areas which requires further study. The findings, recommendations and conclusions drawn herein

will provide a great input to improve and implement ICT in secondary schools and the overall education system in Sudan.

Summary of findings

This section presents a summary of findings emanating from the previous chapters, in line with the purpose, objectives and research questions.

Finding 1: The relationship between the school connectivity and teachers' attitudes towards e-learning?

From this research question, it was found that there was significantly strong relationship between school connectivity and teacher's attitudes towards e-learning. This finding suggests that connecting secondary school teachers to both internet and intranet (i.e. local networks) access will definitely bring a great impact in the readiness of secondary school teachers towards e-learning in Sudan. However, although majority of secondary school teachers in Sudan showed positive attitude towards ICT, lack of internet access resulted into a very narrow chance to engage on implementing and integrating ICT in secondary schools and the overall educational system in Sudan. It was therefore concluded that lack of reliable access to internet and intranet facilities in secondary schools was the reason of poor readiness towards ICT for teachers in Sudan.

Finding 2: ICT and teacher's effectiveness

From this research question, it was established that application of e-learning in Sudanese secondary schools was significantly related with increased teachers' efficiency. Furthermore, application of e-learning in secondary schools represented one of the most important motivation and opportunities to both teachers and students. Although availability of reliable access to ICT showed an increase in the effectiveness of secondary school teachers, there were many factors that affected their attitudes and teaching efficiency. These factors include:

- Lack of teaching resources and application program such as: of open sources, office program and CDs.
- Misuse and mismanagement of computers in secondary schools.
- Absence of strategic implementation in computer training in secondary schools
- Lack of multimedia.
- Lack of adequate information on ICT and its effective role in increasing secondary school teacher's efficiency.
- Lack of educational softwares in the overall education system in Sudan
- Lack of access or frequent dicsconnection to internet and intranet facilities.

This finding suggest that for increased secondary school teachers effectiveness in ICT, authories have to deal with such anti-effectiveness factors along with provision of conducive environment to enable internet and intranet access to both teachers and students in Sudanese secondary schools.

Finding 3: The role of training in encouraging teachers towards e-learning?

In this research question, secondary school teachers showed a significant positive attitude towards ICT even though the strategy used, content and objectives of current training did not cope with teacher's requirements to adapt and implement the ICT in their classes. This finding was supported by the significantly strong correlation observed between the training and teachers' attitudes towards e-learning**.** There was a general agreement that for successful integration of e-learning in secondary schools, teachers must be trained on how to integrate e-learning into their teaching curriculum, and especially so during working hours. This finding was not a surprise because majority of secondary school teachers were untrained in the use of ICT facilities (i.e. CDs, data projector and whiteboards), most probably because teachers did not have enough time outside their normal duties to attend ICT training sessions. It is

worthwhile to note that lack of trained teachers with secondary schools has serious consequences on costs if external sources are hired to provide ICT training to both students and teachers in Sudan.

Finding 4: The relationship between the school director and teacher using ICT in school

From this research question, the result showed that significantly affected teacher's readiness towards ICT. For example, there was a significantly strong correlation between the secondary school director and teacher in the use of ICT in school in the sense that school directors caused later readiness of teachers towards ICT. This finding suggests that school directors should fully participate in encouraging and facilitating secondary school teachers to acquire ICT.

Finding 5: the relationship between school support and teachers attitude towards e-learning

In this research question, results showed that many problems existing in the Sudanese secondary schools significantly deterred the teachers' readiness to ICT. Some of these problems include: presence of large numbers of pupils in classrooms, lack of equipments, suitable and relevant infrastructures, specialized and effective educational programs, and high cost of computer hardwares and their related maintenance. While acknowledging that provision of adequate technical support was an important factor affecting their readiness to ICT, there was however, significant dissatisfaction with the current situation where technical support was not provided. These problems seem to de-motivate most participants towards use ICT in their daily teaching routines.

Conclusion

This study provides a theoretical and practical base for planning and implementation of ICT in secondary schools for teachers and heads of secondary schools. It is therefore

concluded that provision of ICT facilities in Sudanese secondary schools will specifically provide morale and confidence to both learners and teachers readiness towards e-learning. The ICT facilities which significantly affected the readiness to ICT could consistently be used by policy makers to predict adoption and readiness towards technological innovations in secondary schools and the overall education system in Sudan. Additionally, consequences emanating from ICT should not be viewed as a challenge rather than a hindrance or curtailment to readiness towards e-learning. To increase the rate of adoption of ICT by the academic lecturers, it is advisable to concentrate on strategic implementation that addresses the variables found to be statistically significant in this study. Low readiness towards ICT by most Sudanese secondary school teachers was due to lack of training, infrastructures and reliable access to ICT facilities as well as lack of new teaching methods.

Recommendations

In this study it is recommended that

- Policy direction is made by policy makers to strategically incorporate ICT into education curriculum and while encouraging secondary school teachers to use new technologies in their classrooms.
- Government should make a policy statement along with financial support on a national mission on the introduction of ICT and its use in secondary schools as well as strategic partnerships with industries, private sectors and non-governmental organizations (NGOs). In view of such policy, greater benefits will be accrued to secondary schools, teachers and the overall country of Sudan.
- Sudanese citizens aspiring to become teachers should be provided with a pre-service ICT training in both local and international universities and colleges, before they are certified as professional educators. It was noted that pre-service training offered less

costs implications, provided more skills and created high confidence to teachers compared to in–service training.

- Secondary School libraries and media teachers should be provided, not only to the utilization of ICT in education but most importantly, for the integration of e-learning into the teaching curriculum and learning process.
- School librarians should be involved in ICT at their schools and trained in ICT facilities skills to properly guide learners with information on how to use library resources and how to retrieval information to improve their knowledge**.**
- Information resources should not be seen only in isolation, but from a holistic perspective.
- The heads secondary schools should be well informed on the role of ICT in education curriculum so that they may fully participate in motivating teachers to ICT in conducting their daily school duties, and, in so doing, encourage their students.
- Community should be encouraged to use electronic mail (i.e. both asynchronous and synchronous communication systems) an important social outcome of ICT implementation programmes in secondary schools.

- **For successful implementation of ICT in Sudanese secondary schools the following are crucial:**

1. There should be a clear strategy for implementing e-learning.
2. Provide regular seminars and course on the technological practices in education.
3. Consolidated and continuous training i.e.computer related.
4. All secondary schools should have access to both internet and intranet.
5. Provide adequate ICT infrastructure at all secondary schools
6. Ensure proper technical support from the school and from outside sources

7. Provide schools with technician for regular maintenance.
8. Ensure support for secondary school management
9. Practice new skills and update old ones.
10. Provide constant motivation to secondary school teachers.
11. Introduce ICT as subject in secondary school curriculum.

6.5 Recommendation for further research

The focus of this study has been the Sudanese secondary school teachers' readiness towards e-learning. It is therefore recommended that further studies should be done in others areas such as:

- The effect of ICT on secondary schools curriculum and its impact on government education policies.
- E-training and teachers competencies towards e-learning.
- What are the current approaches to the design of e-learning activities and how can these is developed in the future to ensure that we are using sound pedagogical models?
- How is technology changing learners' experience of learning? What role do they want it to play?
- How can new technologies support learner's performance and learning process and management in school so help raise standards?

- How can e-learning technologies help learners to collaborate, mentor and learn informally from one another? What role can new mobile and wireless technologies play in this?
- Does the use of collaborative technologies promote greater: motivation, participation, equality of contribution?
- How can technologies be used to assess learning needs for all students (e.g. in relation to knowledge representation, media and format, access, language, etc.)?
- How do effective teacher training in ICT improve teaching and learning?
- How e-learning make meaningful learning experience for user and the class?