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The impact of ICT in public and private universities in Sudan
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By

Dr Samia Satti Osman Mohamed Nour

(January 30, 2014)

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Abstract

This paper examines the impacts of ICT in public and private Sudanese universities. We verify the first and third hypotheses that the use of ICT facilitates connection, networks and collaboration within public and private universities in Sudan, with local, regional and international institutions. We support the second hypothesis that the use of ICT enhances access, production and dissemination of knowledge in Sudanese universities. We support the fourth hypothesis that the use of ICT introduces a 'creative-destruction' effect by providing opportunities for knowledge production, building connection and organizational changes; but simultaneously also creates hazards to knowledge production and building disconnection for those who do not share the knowledge in public and private Sudanese universities. We show that the most important advantages linked to using the Internet for enhancing production, creation and transfer of knowledge include the increase of digital knowledge for academic and researchers, the rapid quantitative and qualitative increase in transferring information, the development of new models for disseminating and distributing electronic information, and the increase of free access to electronic publications for academic purposes. We find that the main problem related to using the Internet is the lack of a regular budget for university libraries to pay for licenses and access to scientific and technical information.

Key words: ICT, ICT demand, ICT impacts, public-private universities, knowledge, Sudan.

JEL Classification: O10, O12, O30

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The Impact of ICT in Public and Private Universities in Sudan

1. Introduction

This paper discusses the importance and impact of ICT in the transformation and production of knowledge in Sudan, notably in public and private Sudanese universities where there is a steady increase in the use of ICT compared to other poor developing countries.

Given the relatively few studies that focus on the interaction between ICT and knowledge, this paper fills the gap in the literature by focusing on Sudan as a new case study and using new primary data on the impact of ICT in transformation and production of knowledge. Different from the limited scope of analysis presented in Nour (2002; 2006), this paper provides more comprehensive analysis of the role of ICT in enhancing knowledge production and transformation in Sudanese universities using the most up-to-date and relevant data.

The aim of this paper is twofold; first, to examine the use of ICT at Sudanese universities and, second, to explain the role of ICT in facilitating transformation, connection, access to, production and dissemination of knowledge in Sudanese universities. The impact of the use of ICT, its potential opportunities and challenges are also discussed. The paper aims to test four hypotheses: (1) the use of ICT facilitates connection within knowledge institutions, namely in Sudanese universities. (2) The use of ICT enhances access, production and the dissemination of knowledge in Sudanese universities. (3) The use of ICT facilitates collaboration between Sudanese universities and international universities. (4) The use of ICT has both positive and negative effects by providing opportunities for the positive transformation and production of knowledge by building connections and organizational changes, but simultaneously also creating negative effect and hazards to transformations and knowledge production by creating disconnection for those who do not know how to use ICT in Sudanese universities and knowledge institutions.

This paper consists of four sections: Section 1 presents an introduction, Section 2 reviews and discusses the literature on the significance and impact of ICT. Section 3 explains the data and methodology, examines the hypotheses and shows the main results concerning the potential opportunities and challenges that the use and impact of ICT is introducing in transformation and production of knowledge in Sudanese universities. Section 4 provides the conclusions.

2. Review of Theoretical and Empirical Literature

The rapid progress in Information and Communications Technologies (ICT) and their impact on the global knowledge economy have intensified in recent years, leading to a new economic system characterized by intensive knowledge production that has attracted a great deal of interest. It has also increased debate on the effects of ICT and the economic opportunities and challenges that ICT imposes on the production and dissemination of knowledge in the global economy, particularly for the developing countries.

The continuous move towards globalization has recently made information and communication technologies one of the most important factors in achieving success as well as in seeking new markets, improving quality, providing better and faster customer service and bringing the flexibility needed to make changes quickly.

The impact of technical changes in knowledge production, economic growth and development has received particular interest in the literature on economic growth. Many recent studies have shed light on the impact of ICT on knowledge production, economic growth, productivity, employment, organization of work, competition and human capital development.

While the impact of technological progress in general is difficult to measure, the recent theoretical and empirical literature has used indicators to approximate its effect on economic growth and investigate the positive and negative impact (opportunities and challenges) that ICT has had on the global economy. Some recent studies, for example, have used an index of investment or expenditures on ICT, IT, computers and computer equipment and provided robust results showing the various influences on economic growth and development (cf. Jorgenson and Stiroh, 1995; Phojola, 2000; 2001), productivity (cf. Hitt and Brynjolfsson, 1996; Brynjolfsson and Yang, 1996), employment, work organization (cf. Bresnahan, Hitt and Brynjolfsson, 1999) and skills upgrading (cf. Acemoglu, 1998; Hwang, 2000). One interesting finding confirms the importance of ICT for enhancing economic growth not only directly but also indirectly through the production of knowledge and the complementary relationships between ICT, human capital/skills and skills upgrading. For instance, several studies use indicators to examine the complementary relationships between technological progress (as measured by ICT) and human capital (as measured by the increasing utilization of better-educated workers) (cf. Goldin and Katz, 1998; Bresnahan *et al.*, 1999; Autor, Katz and Krueger, 1998; Acemoglu, 1998). Some of these studies explain the relationship between ICT, IT or computer use and skills upgrading defined by increase

either in the incidences of training (cf. Bresnahan, 1999) or the share of highly skilled workers (cf. Autor, Katz and Krueger, 1998; Bresnahan, 1999; Hwang, 2000).

On the other hand, various studies discuss the hazards ICT creates for economic development. Most of this literature is based on the idea that technical change is a creative process that creates opportunities for development, while also imposing certain restrictions on development. For example, several studies have highlighted the negative impact and implications of the increasing use of IT or ICT on employment and the labour market (cf. Bound and Johnson, 1992; Berman Bound and Griliches, 1994; Freeman and Soete, 1985; 1994; 1997; Acemoglu, 1998; Aghion and Howitt, 1998; Autor, Katz and Krueger, 1998).

It has also been hypothesized that ICT could have adverse effects in the developing world because greater advantages will accrue to the industrialized world from global competitiveness than to the developing world, thus making it hard for less-developed countries to compete on the international market. Furthermore, the rapid evolution of ICT will make it harder for developing countries to bridge the already-widening gap between the developed and developing world. ICT, by increasing inequality in income distribution and thus adding to the poverty of the poor, will have adverse results on the status of the poor. ICT may intensify competition and thus widen the existing digital divide between the developed and developing worlds. The literature indicates a growing but limited effect of ICT diffusion in developing countries due to a lack of investment in the complementary infrastructure such as education, skills and technical skills. (cf. Pohjola, 2002; Kenny, 2002; Nour, 2002b; 2006).

Several studies discuss the role of ICT in enhancing knowledge.² For instance, Smith (2000) indicates four approaches to the knowledge economy, in particular, the argument for the positive role of ICT in knowledge "... Finally, there are those who argue that the knowledge economy rests on technological changes within ICT, since innovation in computing and communications changes both physical constraints and costs in the collection and dissemination of information. So for some, the rise of ICT technologies and the complex of ICT industries are coterminous with the move to a knowledge society. Foray and Lundvall (1996) argue a more sophisticated view: "Even if we should not take the ICT revolution as synonymous with the advent of the knowledge-based economy, both phenomena are strongly interrelated ... the ICT system gives the knowledge-based economy a new and different technological base which radically changes the conditions for the production and distribution of knowledge as well as its coupling to the production system." Then there is the role of ICT.

² See for instance, Quah (2001), Pohjola (2001) and Smith (2000).

Knowledge refers to understanding and competence. It is clear that ICT is making major changes to our ability to handle data and information. It is sometimes argued that there is a distinction between knowledge and information, and that the data analysed by ICT is not knowledge in itself and that ICT does not therefore necessarily create knowledge or even extend knowledge. However this distinction between information and knowledge seems to be either a mistake or at least overstated since neither information nor data can exist in the absence of background concepts and a knowledge referent. Nevertheless, ICTs are primarily an information management and distribution resource. An important question that follows is how an information resource relates to the production and use of knowledge in society. Foray and Lundvall are almost certainly right when claiming that ICT is playing a new role in knowledge production and distribution but this is a re-organization of the technical and financial terms on which a resource (information) is available. It does not in itself expand the realms of accessible knowledge, let alone justify talking about a new mode of economic or social functioning. There is an empirical issue here as well, of course. If knowledge is a crucial input and ICT is basic to its production, then seeing that the ICT revolution has been under way for at least twenty-five years, there ought to be some robust relationship between ICT production, ICT investment and the growth of output and productivity. A series of studies have failed to demonstrate such a link.³

More recent literature show the general use of ICT in Africa, some studies particularly focus on the use, impact and role of ICT in enhancing higher education institutions in Africa.⁴

3. Research Methodology and Results:

To examine the four hypotheses on the impacts of ICT across Sudanese universities presented above, this section uses the descriptive approach and primary data based on the university survey (2009), which was drawn from 10 public and private Sudanese universities.⁵ The data

³ This literature on the impact of ICT began in the late 1980s. For an early example, see Martin Neil Bailey and Robert Gordon, (1988) 'The productivity slowdown, measurement issues and the explosion of computer power', *Brookings Papers on Economic Activity*, 2: 347-423. A recent contribution is Jorgensen, D., and Stiroh, K., (1999) 'Information technology and growth', *American Economic Review*: 109-116. For a comprehensive discussion, see Daniel Sichel, (1997) *The Computer Revolution. An Economic Perspective*, Washington: Brookings Institution.

⁴ See for example, *Telecommunications Policy* (2005) 29(7): James Hodge; Alison Gillwald; Patricia K. McCormick; Gillian Marcelle; and Banji Oyelaran-Oyeyinka and Kaushalesh Lal. See also Ahwireng-Obeng (2000), Durrant (2004), Unwin (2004), Olukoshi and Zeleza (2004), Beebe *et-al.* (2003), Adei (2003), Radwan (2003), Thairu (2003), Massingue (2003), Oyeyinka and Adeya (2003), Mutagahywa (2003) and Mwenechanya (2003).

⁵ The university survey includes students, academic teaching and support staffs affiliated to 10 public and private universities. The five public universities are: Khartoum University (KU), Sudan University of Science and Technology (SUST), Juba University (JU), Al-zaim Al-azhari University (AAU) and Omdurman Islamic University (OIU). The five private universities are: Computerman University (CMU), University of Medical Sciences and Technology (UMST), Sudan International University (SIU), Sudan Academy for Banking and Financial Studies (SABFS) and Ahfad University for Women (AUW). The university survey was distributed after translation of the English version into the Arabic language in order to increase the response rate. The selection of the individuals was on a random basis, the coverage of individual in the survey is more comprehensive and includes both males (50%) and females (50%) whose age's limit is 20-70 years old. Since ICT is widely used amongst the youth population, the coverage in the university survey was focused on the youth population. The university survey indicates a total response rate of 85%, for all the survey including all academic teaching staffs, support staffs and students.

from the university survey provides information particularly useful for presenting interesting public-private comparative analysis to elaborate ICT role to enhance connection and transformation in Sudanese universities from public-private perspectives and from academic teaching staffs, support staffs and students' perspectives.

3.1 Internet, Connection, Networks and Communication

The results of the university survey indicate that the Internet facilitates connection, networks and communication inside the institutions, with other institutions in Sudan, with regional and international institutions. The importance of the effect with regards to connection varies from all, public and private universities academic teaching staffs, support staffs and students' perspectives, as we explain below, see Table 1 below.

For example, from all universities academic teaching staffs' perspective, Internet facilitates connection, networks and communication inside the institution, this is followed by equivalent effect in facilitating connection with regional and international institutions and finally, the effect in facilitating connection with other institutions in Sudan is also mentioned, but somewhat surprising with somewhat less importance.⁶ From the public universities academic teaching staffs' perspective, Internet facilitates connection, networks and communication inside the institution and similarly connection with international institutions, this is followed by connection with regional institutions and finally with other institutions in Sudan respectively.⁷ Whereas from the private universities academic teaching staffs' perspective, Internet facilitates connection, networks and communication inside the institution, this is followed by connection with regional institutions, connection with other institutions in Sudan, and finally connection with international institutions respectively.⁸ From the support staffs' perspective, Internet highly facilitates connection, networks and communication inside the institution, which is higher than the equivalent effects in facilitating connection with other institutions in Sudan and connection with regional and international institutions.⁹ From the students' perspective, Internet facilitates connection, networks and communication inside the institution, but somewhat surprising it is with

The weighted response rates were: 81%, 82%, 77%, 100% and 100% for all universities academic teaching staffs, for public universities academic teaching staffs, for private universities academic teaching staffs, for the support staffs and for students respectively.

⁶ As indicated by 64%, 60%, 60%, 54% of the respondent all universities academic staffs respectively.

⁷ As indicated by 61%, 61%, 58%, 52% of respondent public universities academic staffs respectively.

⁸ As reported by 76%, 71%, 65%, 59% of respondent private universities academic staffs respectively.

⁹ As indicated by 80%, 60%, 60%, 60% of the respondent support staffs respectively.

somewhat less importance than the higher equivalent effects in facilitating connection with other institutions in Sudan and connection with regional and with international institutions.¹⁰

One interesting observation from our findings is that both public and private universities agree on the importance and value of Internet for facilitating connection and internal networks inside the institutions. The importance and value of Internet for facilitating connection and internal networks inside the institutions is higher in the private universities compared to public universities, which may not be surprising in view of the fact that private universities most probably have developed and owned more favourable ICT infrastructure and managed to provide more facilities and therefore more conducive environment for promoting good connection and internal networks. Another interpretation is that promotion of internal connection and network is probably used by these private universities to compete with other universities in attracting more qualified academic teaching and support staffs and qualified students.

Another interesting observation from our finding is that both the support staffs and students agree on the fact that the effect of Internet in facilitating external network is equivalent regardless of the nature of the different external institutions. However their points of view differ in the fact that the support staffs value the effect of Internet in facilitating internal connection and networks higher than the external networks, whereas, students present an opposite point of view and value the effect of Internet in facilitating external connection and networks more than internal networks. This result is plausible in view of the fact that support staffs most probably are more concerned with internal connection inside their institutions, whereas students most probably are more interested in broadening their connection, namely external connection with other international, regional and local institutions in Sudan. From the students' perspective strong connection and network with external institution is probably required for increasing and enhancing educational, learning and research skills for students.

Table (1) - Internet, Connection, Networks and Communication in Sudanese Universities

	All	Public	Private	Students	Support staff
Inside the institution	64%	61%	76%	65%	80%
with other institutions in Sudan	54%	52%	65%	69%	60%
with regional institutions	60%	58%	71%	69%	60%
with international institutions	60%	61%	59%	69%	60%
Number of respondents	80	63	17	5	26

Source: Own calculation based on the University survey (2009).

¹⁰ As reported by 65%, 69%, 69%, 69% of the respondent students respectively.

3. 3. ICT (Internet) Impacts: opportunities and challenges:

The results of the university survey indicate that from all universities academic teaching staffs, support staffs and students' perspectives Internet leads to several positive impacts, opportunities and advantages, but also leads to other negative impacts, challenges and difficulties. This section explains first the opportunities and advantages and then the challenges and difficulties, see Tables 2-3 and Figures 1-8 below.

3. 3.1. ICT (Internet) opportunities and advantages:

From all universities academic teaching staff, support staff and students' perspectives the Internet leads to many positive impacts, opportunities and advantages- see Table 2 below.

From all universities academic teaching staffs' perspective the Internet provides many opportunities and advantages for facilitating connection and transformation and enhancing the production, creation and transfer of knowledge. For instance, the top opportunities and advantages include increasing digital knowledge for academic and researchers by finding information that was earlier not available or accessible, rapid quantitative (in number) and qualitative (efficiency and speed) increase in transferring available information and development of a new model for disseminating and distributing electronic information, where the information moved towards the user.¹¹ In addition to increase creation and transfer of knowledge, increase possibility of introduction of research outside academic fields, increase free access to electronic publications for academic purposes and create linkage and contact between people with common interests in different activities related to increase of knowledge.¹² Other advantageous are improve intellectual capacity that was earlier not available, increase possibility of digital and electronic dissemination of old documents not only for dissemination of scientific culture, but also for preserving original and rare documents and preserve of heritage for future generations, encourage and increase process of integration in world and international knowledge, develop social capability and so acquisition of knowledge and learning new skills from others and facilitate preparation of unlimited copies with cheap price in the Internet instantaneously without having affecting the quality with the possibility of rapid transferring copies to any place in the world.¹³ In addition to introduction of the use of new ways and modern techniques for improving quality and efficiency of education and scientific research and introduction of important change in techniques and technologies of distribution, dissemination, evaluation and storage of data and

¹¹ As indicated by 95%, 94%, 91% of the respondent all universities academic staffs respectively.

¹² As reported by 90% of the respondent all universities academic staffs.

¹³ As indicated by 89% of the respondent all universities academic staffs.

information electronically or digitally.¹⁴ In addition to increase the use of long distance learning, training and education, introduction of change in the role of libraries by the use of the digital documents, introduction of change in the role of workers in the libraries from the traditional roles in the traditional system to the new role to advice users for the use of electronic data, information and documents, save of time and easy performance of work related to production and transfer of knowledge, encourage knowledge about other cultures and facilitate contact between academic teaching staffs colleagues and students in academic institutions.¹⁵ Furthermore, it increases integration of higher education and research sector in implementation, assessment and regulation of ICT sector, facilitates introduction of the world for production of knowledge and academic works conducted by Sudanese and reduces the need for the users to use the services of information professional to have direct access to information/data.¹⁶ In addition it reduces monopoly in creation of knowledge earlier dominated by universities and researchers, increase possibility of electronic dissemination of academic documents and for commercial benefits and facilitate transfer of protected materials in the Internet and facilitate digital networks and the use of materials across borders.¹⁷ In addition to introduction of change by reducing the use of written paper, reduce the need for the users to go to a library or documentation centre to have direct access to information/data and facilitate management of Intellectual Properties Rights (IPRs) and preventing piracy.¹⁸

From the support staffs' perspective the top opportunities and advantages, include increasing digital knowledge for academic and researchers by finding information that was earlier not available or accessible and rapid quantitative (in number) and qualitative (efficiency and speed) increase in transferring available information, improve intellectual capacity that was earlier not available. In addition all opportunities and advantages for facilitating and enhancing connection, transformation, creation and transfer of knowledge that highlighted above by academic teaching staffs are also highlighted by support staffs.¹⁹

From the students' perspectives the top advantage and opportunities include rapid quantitative (in number) and qualitative (efficiency and speed) increase in transferring available information, improve intellectual capacity that was earlier not available and development of a new model for disseminating and distributing electronic information, where the information moved towards the user. This is followed by increase integration of higher

¹⁴ As reported by 88% of the respondent all universities academic staffs.

¹⁵ As indicated by 86% of the respondent all universities academic staffs.

¹⁶ As reported by 85% of academic staffs in all the respondent universities.

¹⁷ As indicated by 84% of the respondent all universities academic staffs.

¹⁸ As reported by 79%, 78%, 74% of the respondent all universities academic staffs respectively.

¹⁹ As reported by 80% 60% and % 40% of the respondent support staffs respectively.

education and research sector in implementation, assessment and regulation of ICT sector and increase possibility of introduction of research outside academic fields. In addition to increase creation and transfer of knowledge, introduction of change in the role of libraries by the use of the digital documents and develop social capability and so acquisition of knowledge and learning new skills from others. Moreover, all opportunities and advantages for facilitating and enhancing connection, transformation, creation and transfer of knowledge that highlighted above by academic teaching staffs are also highlighted by students.²⁰

One interesting observation from our findings is that both public and private universities agree on the importance and value of Internet for providing many opportunities and advantageous for facilitating creation and transfer of knowledge in the Sudanese universities. The importance and value of Internet for providing many opportunities and advantageous for facilitating creation and transfer of knowledge is higher in the private universities compared to public universities, which may not be surprising in view of the fact that private universities most probably have developed and owned more favourable ICT infrastructure and managed to provide more facilities and therefore more conducive environment for providing many opportunities and advantageous for facilitating creation and transfer of knowledge. Another interpretation is that promotion of opportunities and advantageous of Internet for facilitating creation and transfer of knowledge is probably used by these private universities to compete with other universities in attracting more qualified academic teaching and support staffs and qualified students. The only exception is related to the importance of Internet in increasing integration in the world and international knowledge, as the public universities values it higher than the private universities. This is probably because, majority of the public universities are elder and have already established a good reputation and relationship with the world and international knowledge institutions whereas the majority of the private universities –probably except Ahfad- are relatively younger and only recently started to build reputation and relationship with the world and international knowledge.

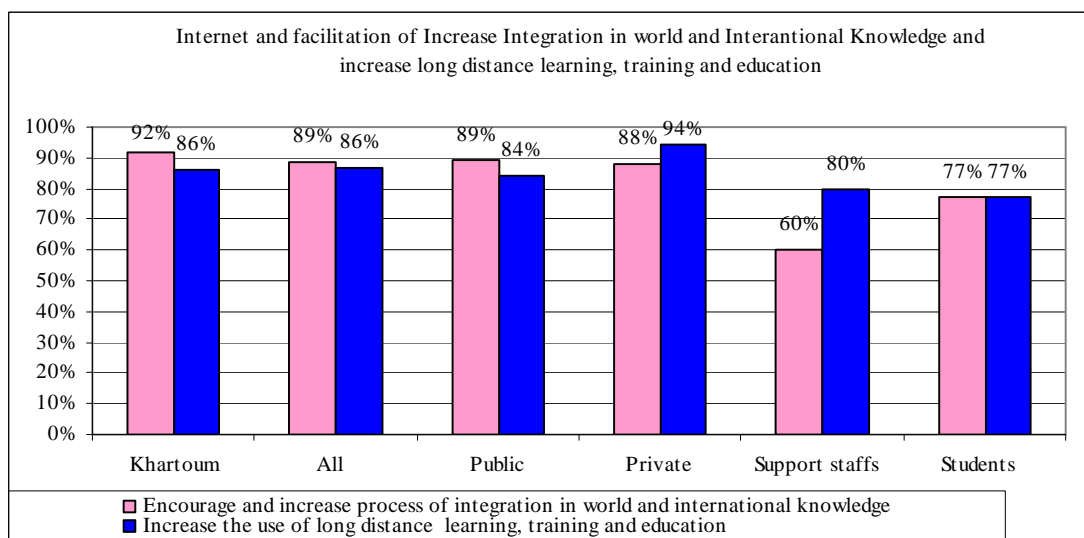
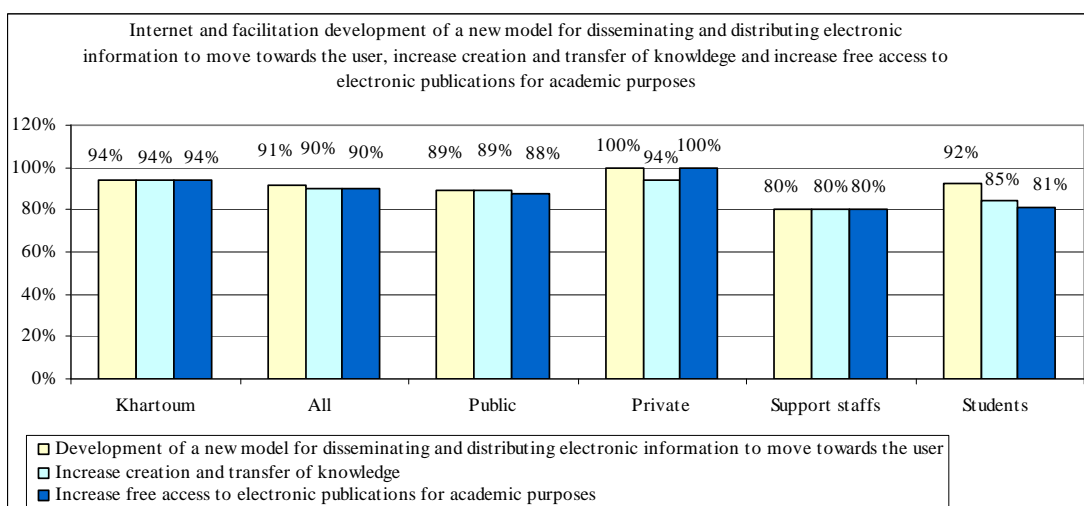
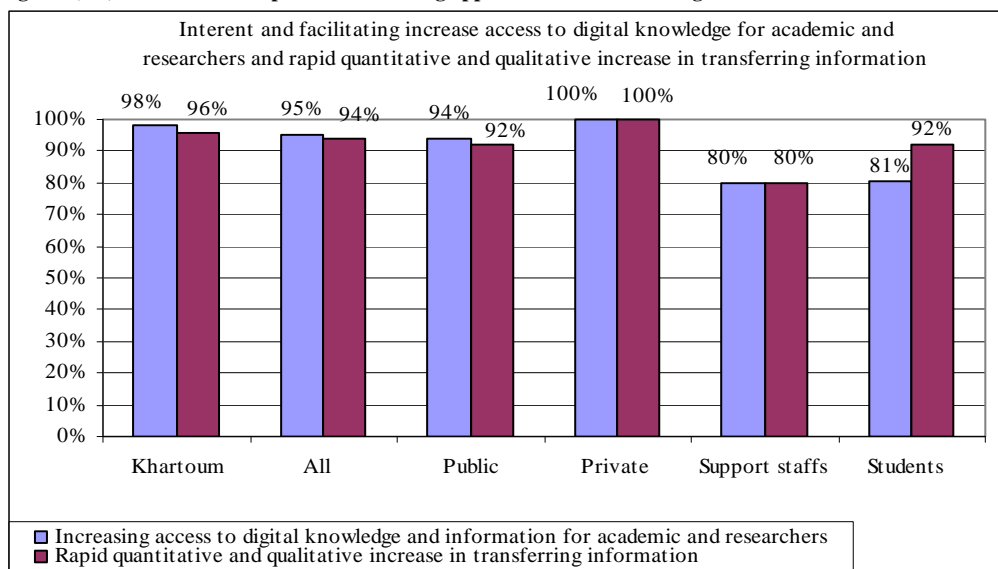
²⁰ As indicated by 92%, 88%, 85%, 81%, 77%, 73%, 69% and 62% of the respondent students respectively.

Table (2)- The impacts, opportunities and advantages of the use of Internet in facilitating creation and transfer of knowledge

Internet opportunities/ advantages	All	Public	Private	Support staffs	Students
Increasing digital knowledge for academic and researchers by finding information that was earlier not available or accessible.	95%	94%	100%	80%	81%
Rapid quantitative (in number) and qualitative (efficiency and speed) increase in transferring available information	94%	92%	100%	80%	92%
Development of a new model for disseminating and distributing electronic information, where the information moved towards the user.	91%	89%	100%	80%	92%
Increase creation and transfer of knowledge	90%	89%	94%	80%	85%
Increase possibility of introduction of research outside academic fields	90%	88%	100%	60%	88%
Increase free access to electronic publications for academic purposes	90%	88%	100%	80%	81%
Create linkage and contact between people with common interests in different activities related to increase of knowledge	90%	88%	100%	80%	77%
Improve intellectual capacity that was earlier not available	89%	89%	88%	80%	92%
Increase possibility of digital and electronic dissemination of old documents not only for dissemination of scientific culture, but also for preserving original and rare documents and preserve of heritage for future generations	89%	86%	100%	60%	77%
Encourage and increase process of integration in world international knowledge	89%	89%	88%	60%	77%
Develop social capability and so acquisition of knowledge and learning new skills from others	89%	86%	100%	80%	85%
Facilitate preparation of unlimited copies with cheap price in the Internet instantaneously without having affecting the quality with the possibility of rapid transferring copies to any place in the world	89%	86%	100%	80%	73%
Introduction of the use of new ways and modern techniques for improving quality and efficiency of education and scientific research	88%	84%	100%	60%	81%
Introduction of important change in techniques and technologies of distribution, dissemination, evaluation and storage of data and information electronically or digitally.	88%	84%	100%	80%	81%
Increase the use of long distance learning, training and education	86%	84%	94%	80%	77%
Introduction of change in the role of libraries by the use of the digital documents.	86%	83%	100%	80%	85%
Introduction of change in the role of workers in the libraries from the traditional roles in the traditional system to the new role to advice users for the use electronic data, information and documents.	86%	83%	100%	80%	77%
Save of time and easy performance of work related to production and transfer of knowledge	86%	84%	94%	80%	77%
Encourage knowledge about other cultures	86%	84%	94%	80%	77%
Facilitate contact between academic teaching staffs colleagues and students in academic institutions	86%	84%	94%	60%	77%
Increase integration of higher education and research sector in implementation, assessment and regulation of ICT sector	85%	83%	94%	60%	88%
Facilitate introduction of the world for production of knowledge and academic works conducted by Sudanese	85%	84%	88%	60%	81%
Reduce the need for the users to use the services of an information professional to have direct access to information/data.	85%	83%	94%	80%	77%
Reduce monopoly in creation of knowledge earlier dominated by universities and researchers	84%	80%	100%	80%	81%
Increase possibility of electronic dissemination of academic documents and for commercial benefits	84%	80%	100%	80%	81%
Facilitate transfer of protected materials in the Internet and digital networks and the use of materials across borders.	84%	81%	94%	80%	77%
Introduction of change by reducing the use of written paper	79%	75%	94%	40%	62%
Reduce the need for the users to go to a library or documentation centre to have direct access to information/data.	78%	75%	88%	60%	73%
Facilitate management of Intellectual Properties Rights (IPRs) and preventing piracy.	74%	70%	88%	80%	69%
Number of respondents	80	63	17	5	26

Source: Own calculation based on the University survey (2009).

Figures (1-3)- Internet and impacts in facilitating opportunities and advantages for creation and transfer of knowledge



Source: Own calculation based on the University survey (2009).

3. 3.2 *ICT (Internet) challenges, problems and difficulties:*

From all universities academic teaching staffs, support staffs and students' perspectives Internet leads to some other negative impacts, challenges and difficulties- see Table 3 below.

From all universities academic teaching staffs' perspectives the top problem related to the use of Internet is the lack of or inadequate regular budget adequate for universities libraries to pay for access to scientific and technical information, author's rights and have licenses or subscriptions.²¹ This is followed by the difficulty of regular access to Internet, inadequate or lack of the required technical skills, creation of isolation for illiterate who do not know how to use the Internet and increase training for workers in the libraries to enable them to own adequate knowledge for the electronic use and distribution of information and for redirecting information from producers to users. In addition to the problem of easy change and adjustment of original documents and impacts on author's moral and financial rights and impacts on hindering management of Intellectual Properties Rights (IPRs) and preventing piracy for academic documents when transferring adjusted unoriginal documents for users. In addition to the problem of increase worry of families of waste of time of their children on Internet, SMS, video, welfare and entertainments facilities.²² In addition to increase worry of institutions of waste of working time of their workers on Internet, personal e-mail and use for personal purposes, difficulties of correcting and controlling the digital and electronic documents in digital and electronic libraries and the problem of access to scientific and technical information for creation and transfer of knowledge. In addition to the difficulties of increase training and knowledge for users to ensure relevant use of the electronic information, increase demand for technical and engineering education related to ICT and the problem of lack of clear objectives and strategic planning.²³ Other difficulties include lack of assessment policies and evaluation programmes and difficulty of distinction between original and unoriginal documents and risk for users to use wrong unreliable information.²⁴ In addition to the problem of high costs of acquiring licenses for access to electronic libraries for individuals and institutions, difficulty of overcoming the problem of high costs paid for using information, creating gap (related to training and financial ability to communicate) between those who own and those who do not own the Internet technology and limited and lack of modern available references.²⁵ In addition to the problem of lack of enthusiasm for the use of Internet to improve and increase efficiency and promotion of institutions of higher education

²¹ As indicated by 88% of the respondent all universities academic staffs.

²² As reported by 84% of the respondent all universities academic staffs.

²³ As indicated by 83% of the respondent all universities academic staffs.

²⁴ As reported by 81%, 80% of the respondent all universities academic staffs respectively.

²⁵ As indicated by 79% of the respondent all universities academic staffs.

and scientific research due to limited electronic knowledge and wide spread of electronic illiteracy, difficulty of overcoming the problem of copyrights and obstacle to dissemination and use of these sources and difficulties of preventing programmes of spy and spread of viruses.²⁶ Other problems include poor or lack of services offered to users, lack of enthusiasm for electronic publications, risk of spread of electronic piracy, lack of access to credit cards and lack of security in their use and inadequate electronic capacity.²⁷

From the support staffs' perspectives the top problems related to the use of Internet include lack of or inadequate regular budget adequate for universities libraries to pay for access to scientific and technical information, author's rights and have licenses or subscriptions) and the problem of access to scientific and technical information for creation and transfer of knowledge, in addition to, lack of clear objectives and strategic planning, lack of enthusiasm for the use of Internet to improve and increase efficiency and promotion of institutions of higher education and scientific research due to limited electronic knowledge and wide spread of electronic illiteracy and lack of access to credit cards and lack of security in their use. In addition all problems and difficulties hindering the use of ICT for facilitating connections and transformation and enhancing the production and transfer of knowledge that highlighted above by academic teaching staffs are also highlighted by support staffs.²⁸

From the students' perspective the top problem related to the use of Internet is the problem of access to scientific and technical information for creation and transfer of knowledge, in addition to lack of or inadequate regular budget adequate for universities libraries to pay for access to scientific and technical information, author's rights and have licenses or subscriptions, lack of enthusiasm for the use of Internet to improve and increase efficiency and promotion of institutions of higher education and scientific research due to limited electronic knowledge and wide spread of electronic illiteracy and creating gap (related to training and financial ability to communicate) between those who own and those who do not own the Internet technology. In addition all problems and difficulties hindering the use of ICT for facilitating connections and transformation and enhancing the production and transfer of knowledge that highlighted above by academic teaching staffs are also highlighted by students.²⁹

One interesting observation from our findings is that both public and private universities agree on availability of several problems and challenges related to the use of

²⁶ As indicated by 77% of the respondent all universities academic staffs.

²⁷ As reported by 75%, 74%, 74%, 70%, 68% of the respondent all universities academic staffs respectively.

²⁸ As indicated by 80%, 60% and 40% of the respondent support staffs respectively.

²⁹ As indicated by 88% 77%, 73%, 69%, 65%, 62%, 58%, 58%, 58%, 58%, and 54% of the respondent students respectively.

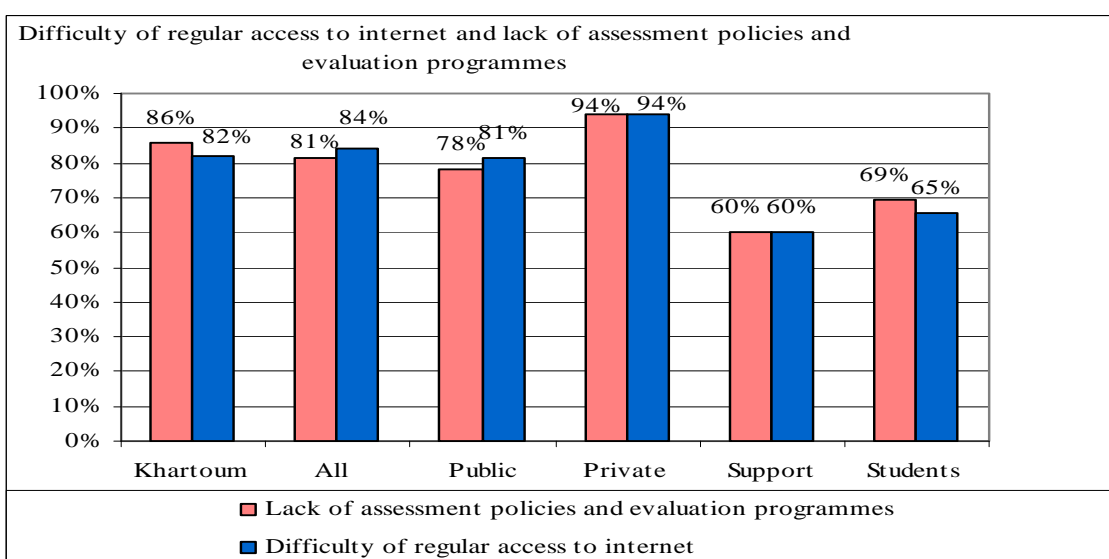
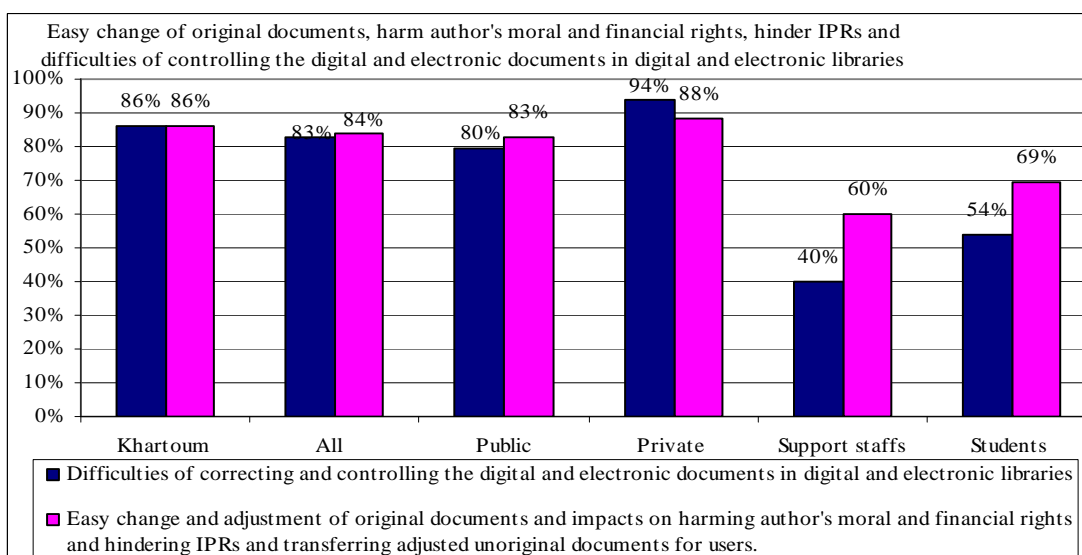
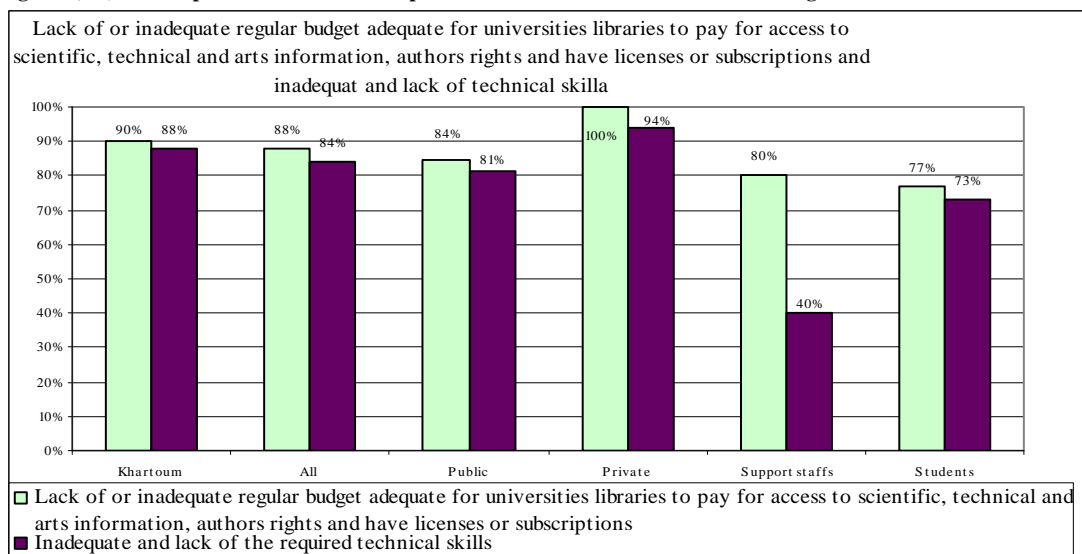
Internet that hindering the creation and transfer of knowledge in the Sudanese universities. The complaint about most of these problems and difficulties and their corresponding implications in hindering the creation and transfer of knowledge is higher in the private universities compared to public universities. This is somewhat surprising in view of the fact that private universities most probably have developed and owned more favourable ICT infrastructure and managed to provide more facilities and therefore more conducive environment for meeting the challenges, solving the problems and difficulties hindering creation and transfer of knowledge.

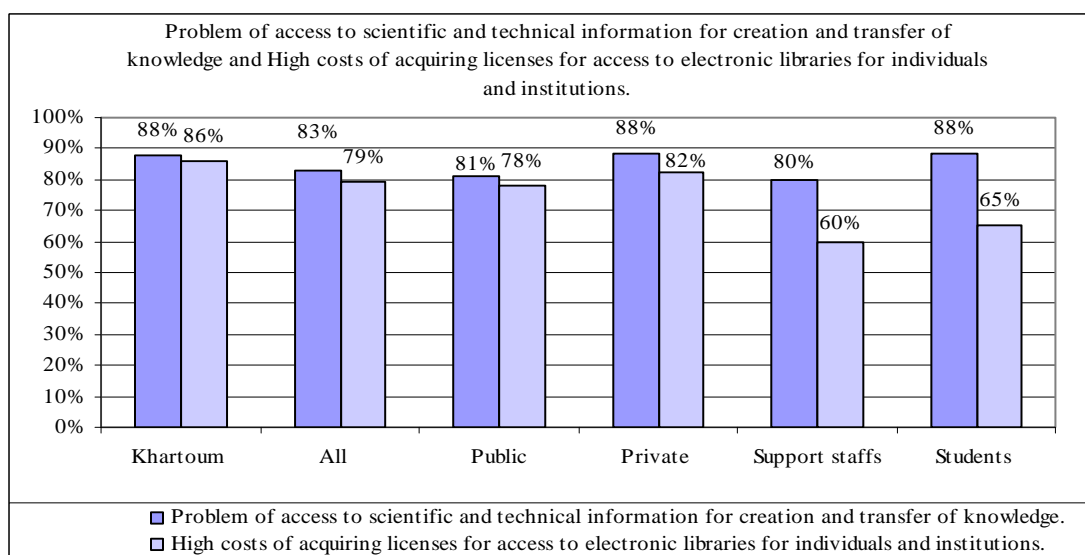
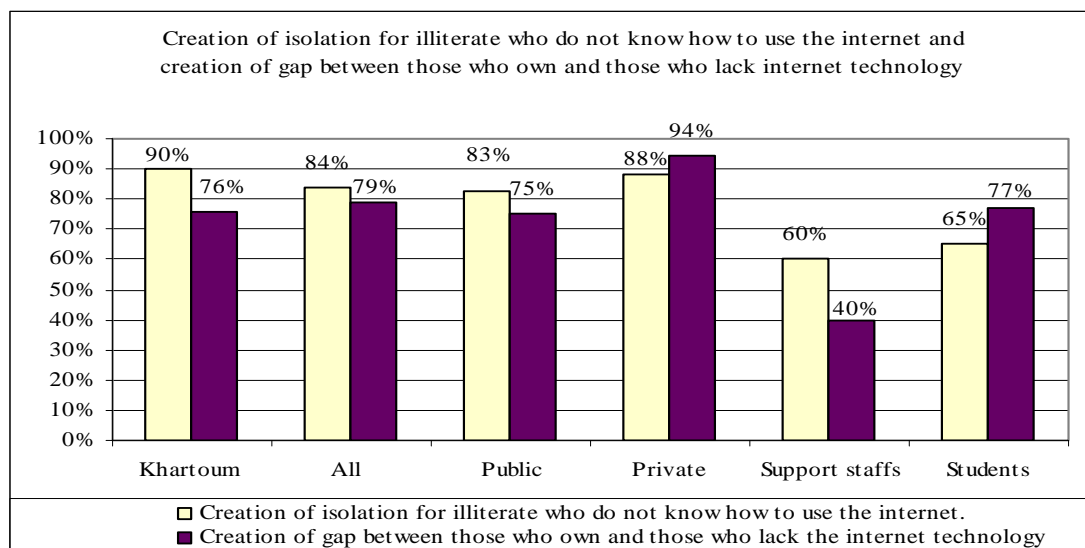
Table (3)- The impacts of difficulties and problems for the use of Internet in hindering creation and transfer of knowledge

Internet challenges/ difficulties	All	Public	Private	Support staffs	Students
Lack of or inadequate regular budget adequate for universities libraries to pay for access to scientific and technical information, author's rights and have licenses or subscriptions.	88%	84%	100%	80%	77%
Difficulty of regular access to Internet	84%	81%	94%	60%	65%
Inadequate and lack of the required technical skills	84%	81%	94%	40%	73%
Creation of isolation for illiterate who do not know how to use the Internet.	84%	83%	88%	60%	65%
Increase training for workers in the libraries to enable them to own adequate knowledge for the electronic use and distribution of information and for redirecting information from producers to users	84%	80%	100%	80%	73%
Easy change and adjustment of original documents and impacts on author's moral and financial rights and impacts on hindering management of Intellectual Properties Rights (IPRs) and preventing piracy for academic documents when transferring adjusted unoriginal documents for users.	84%	83%	88%	60%	69%
Increase worry of families of waste of time of their children on Internet, SMS, video, welfare and entertainments facilities	84%	83%	88%	40%	73%
Increase worry of institutions of waste of working time of their workers on Internet, personal e-mail and use for personal purposes.	83%	83%	82%	60%	69%
Difficulties of correcting and controlling the digital and electronic documents in digital and electronic libraries	83%	80%	94%	40%	54%
Problem of access to scientific and technical information for creation and transfer of knowledge.	83%	81%	88%	80%	88%
Increase training and knowledge for users to ensure relevant use of the electronic information.	83%	80%	94%	60%	69%
Increase demand for technical and engineering education related to ICT	83%	80%	94%	80%	73%
Lack of clear objectives and strategic planning	83%	81%	88%	80%	58%
Lack of assessment policies and evaluation programmes	81%	78%	94%	60%	69%
Difficulty of distinction between original and unoriginal documents and risk for users to use wrong unreliable information.	80%	81%	76%	60%	73%
High costs of acquiring licenses for access to electronic libraries for individuals and institutions.	79%	78%	82%	60%	65%
Difficulty of overcoming the problem of high costs paid for using information.	79%	78%	82%	60%	69%
Creating gap (related to training and financial ability to communicate) between those who own and those who do not own the Internet technology	79%	75%	94%	40%	77%
Limited and lack of modern available references	79%	75%	94%	60%	58%
Lack of enthusiasm for the use of Internet to improve and increase efficiency and promotion of institutions of higher education and scientific research due to limited electronic knowledge and wide spread of electronic illiteracy	77%	72%	94%	80%	77%
Difficulty of overcoming the problem of copyrights and obstacle to dissemination and use of these sources.	77%	78%	71%	60%	65%
Difficulties of preventing programmes of spy and spread of viruses	77%	73%	88%	80%	65%
Poor or lack of services offered to users	75%	73%	82%	40%	58%
Lack of enthusiasm for electronic publications	74%	70%	88%	60%	62%
Risk of spread of electronic piracy	74%	72%	82%	60%	65%
Lack of access to credit cards and lack of security in their use	70%	72%	65%	80%	65%
Inadequate electronic capacity	68%	67%	71%	40%	58%
Number of respondents	80	63	17	5	26

Source: Own calculation based on the University survey (2009).

Figures (4-8)- The impacts of difficulties and problems for the use of Internet in hindering creation and transfer of knowledge





Source: Own calculation based on the University survey (2009).

4. Conclusions

This paper focused on the impact of ICT in connections, transformations, creation and transfer of knowledge in Sudan, taking 10 public and private universities as an example of institutions of higher education in Sudan. It uses new primary data and fills the gap in the literature by focusing on Sudan as a new case study.

Two hypotheses about how the use of ICT facilitates connections within knowledge institutions and collaboration between universities, in this case between Sudanese universities and universities worldwide, and the integration of Sudanese universities in the system of global knowledge production were verified. The results of the Sudanese universities Survey of 2009 indicate that the Internet facilitates connections, networks and communication within institutions (Sudanese universities), with others in Sudan, with regional and international

institutions. The second hypothesis that the use of ICT was found to enhance access, production and dissemination of knowledge was confirmed, and Sudanese universities' academic teaching staff, support staff and students thought that the most important advantages the Internet brought were providing information that was previously not available or accessible and a rapid quantitative and qualitative increase in transfers of available information. In addition, the development of a new model to disseminate and distribute electronic information, whereby the information moved towards the user, increases the creation and transfer of knowledge. They valued the increase in the free access they had to electronic publications for academic purposes. All Sudanese universities academic teaching, support staff and students put the lack of a regular budget for university libraries to access scientific and technical information, authors' rights and have licences or subscriptions as a major concern. A final hypothesis, that the use of ICT introduces positive and negative effects by providing opportunities for transformations and knowledge production but simultaneously also creating hazards to transformations and knowledge production in Sudanese universities was also confirmed: the positive transformation is building connections and organizational changes, while the negative transformation: is disconnection for those who do not share the knowledge accessed and/or do not know how to use ICT.

ICT introduces opportunities and challenges for the creation and transfer of knowledge. One of these challenges is that ICT has the capacity to lead to disconnection and the marginalization of some people. Disconnection implies difficulty in getting connections due to problems on both the supply and demand sides. On the supply side, disconnection is caused by poor availability, inefficiency and the irregular supply of ICT services. On the demand side, disconnection means an inability to connect that is probably due to both poverty and, therefore, the lack of opportunity to have access to ICT and of adequate skills and knowledge about how to use ICT. This implies that disconnection can lead to the creation of gaps and the marginalization of some who are poor and lacking access and others who may lack the skills and knowledge required to use ICT. The major ethical and political implications are that ICT, by causing disconnection, has the potential to add a new form of marginalization and thus add to the already existing inequalities between different social groups in Sudan. The major policy recommendation on the demand side is to increase subsidies for the poor to facilitate their access to ICT and to increase literacy rates, skills and knowledge about ICT in order to improve access to it. The major suggestion on the supply side is increased availability, sustainability and efficiency of ICT services.

The findings here suggest that ICT is leading to significant transformation by facilitating connections in the creation and transfer of knowledge in Sudanese universities. ICT supports scientific research activities, improves the acquisition of knowledge, supports the restructuring of administration and the modernization of Sudanese universities, facilitates access to electronic publications, online courses and distance learning, helps solve problematic access to limited members in enrolment through distance education, bridges the knowledge divide by improving accessibility to scientific and technical information, and facilitates internal and external connections, South-South and South-North collaboration and the transfer of knowledge. In the future, ICT has the potential to continue playing an important role by facilitating connections and the creation and transfer of knowledge in Sudanese universities provided that they manage to overcome the difficulties on the supply and demand sides. In particular, improved skills, training and knowledge about ICT and better availability, sustainability and efficiency of ICT infrastructure are needed (cf. Durrant 2004). In addition there needs to be increased government spending on the development of ICT infrastructure in higher education and subsidies for an adequate regular budget for university libraries to pay for licences, subscriptions and access to scientific and technical information. However, there are political and ethical issues related to government spending on ICT. As for the political issue, justifying the commitment of the Sudanese government to spending on the development of ICT for the universities is easy because the universities relate to the elite and their positions of power. When the Sudanese government spends money on ICT, it is sponsoring its own elite. In addition to the political issue, there is also an ethical issue. If the Sudanese government spends scarce resources (i.e. money for development) on the development of ICT for universities, it thereby reduces the amount it has available to address important issues such as poverty and health. This is a disadvantage of ICT, as government spending on ICT takes money away from other urgent target groups (i.e. the poor). The major implication here is that more spending on ICT means less spending on social developments, such as health and poverty reduction. Poverty will continue to increase and the poor will continue to suffer. The challenge, therefore, is how to strike the right balance when allocating government funds to different priorities. Our major policy recommendation is to encourage private-sector involvement in ICT and to focus government spending on ICT more towards the beneficiaries of the poor by upgrading their skills and offering them more education and employment opportunities, which could contribute to achieving UN Millennium Development Goal (MDG) of halving the number of people living

in poverty by 2015. The general conclusion is, however, that there are more advantages than disadvantages to using ICT in Sudanese universities.

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