The Impact of Information and Communication Technology (ICT) on Education in Egypt

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ABSTRACT

Egypt's government has articulated a vision of an information society in which widespread access to technology can nurture human capital, improve government services, promote Egyptian culture, and support economic growth, and the ICT sector has been targeted as a vehicle for this growth and social development, through improvement of education.

The paper aims to study the impact of ICT on education in Egypt and the challenges of use the ICT in education. The paper provides literature review of the importance of ICT on education and presents Egypt's ICT policies and initiatives for education, introduces the ICT projects in education by Government of Egypt, then discusses the Egypt's experience on ICT on education and finally analyses the impact of ICT on education.

Keywords: ICT, Education, Egypt

Introduction

Information and communication Technology (ICT) is a necessary tool offers a lot of opportunities such as the use of software facilitating learning, the access to networks or communicating by video conferencing, technologies facilitating people's functional independence and social inclusion, and also the transfer of knowledge between all the interested parties and collaborative decision making. Egypt has developed a great interest in the information industry and made national plans to upgrade the economy in terms of infrastructure and training, and created free zones such as "Smart Village".

Egypt faces significant challenges in harnessing its education system to promote its Development plans. A national ICT policy has been adopted by the Ministry of Communication and Information Technology, of which education is one priority.

The objective of the study is to address the impact of various uses of ICT on education and the challenges in implementing the ICT on education. This paper is divided into five key parts. The first part provides literature review of the importance of ICT on education. The second part presents Egypt's ICT policies and initiatives for education. Part Three introduces the ICT projects in education by Government of Egypt. Part Four discusses the Egypt's experience on ICT in education. Part five presents the methodology to analyze the impact of ICT on education in Egypt, then part six shows conclusion.

Part One: Literature Review of the Importance of ICT on Education

The new theories of growth state that education and technological innovations play a leading role in the explanation of economic growth. Lucas and Howitt emphasized the importance of the skills of the human resources and of the educational system in the discovery and adoption of the new technology. The simultaneous analysis of these two growth factors (education and ICT), became then a major topic for both the economists and the decision-makers of the economic policy.[1]

In addition, since the labor and the capital factors are not enough to explain economic growth, it becomes necessary to talk about other factors within the framework of endogenous growth. Benhabib and Spiegel have revived a more "technological" vision of the role of education in economic growth, which had been developed in an embryonic way by Nelson and Phelps. These authors also stress that, in an economy with a technical progress, the level of education affects the long-term growth through its effects on the adaptation speed to the technological change.[2]

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[1] Neffati, Mohamed & Lobna Besbes (2013). Correlation ICT-Education and Economic Growth Case of the Arab Economies, *International Journal of Economics, Finance and Management,* VOL. 2, NO. 1, March, http://www.ejournalofbusiness.org. p.5.
[2] **Ibid.,** p.6.

A strong debate was animated by international experts and analysts about the impact of ICT on education. The ICT has many advantages over the educational process. Berman, Bound and Thing were very much interested in the impact of the technological change on the gaps of competence noticed in the labor markets in case when the technological changes have an impact on the skills of the working force. Tardif maintains that new technology enables the school students to improve their capacity of solving problems and to use meta-cognitive strategies. On this basis, ICT allows the motivation of the learner and foster school success. The effort of integration of ICT would have an interest elsewhere only when technology helps either the teacher to improve his pedagogy or the learner to establish a better link with knowledge.[1]

The UNESCO report shows that education is crucial to the long-term economic and social development since it helps to fight against poverty and automates people by equipping them with the knowledge, competence and confidence they need to exploit their productive efforts and forge a better future. This report also ensures a high priority to the use of ICT for a fairer and more pluralist development in education, aiming at the improvement of knowledge, the exchange of education as a merchandize and globalizing it in cultural diversity implications. The impact of education on growth passes by technical progress, notably the strong correlation between education and ICT.[2]

The Strategic Educational ICT Policy Rationales

National ICT policies can serve several important functions. Strategic policies can provide a rationale, a set of goals, and a vision for how education systems might be with the introduction of ICT and how students, teachers, parents, and the general population might benefit from its use in schools.[3]

An analysis of national ICT policy statements identifies four alternative, somewhat-related rationales that are used to justify the investment of funds on educational ICT. These high-level statements can be thought of as "strategic policies", as follows:-

Support economic growth. A particularly common rationale for investment in educational ICT is the role it can play in preparing a future workforce and supporting economic development. The key to this policy approach is an articulation of specific ways that the educational deployment of ICT can support these broad economic goals, lest the connections between the two be hollow platitudes. For example, a major economic goal for most countries is sustainable economic growth. Economists attribute such growth to increases in productivity, which can include the absorption or more productive equipment, more skilled and productive workforce, and the creation

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[1] Neffati, Mohamed & Lobna Besbes: **Op.cit.**, p.7.

[2] UNESCO (2003). *Meta-survey on the use of technologies in education in Asia and the Pacific*. Paris: UNESCO, p. 30.

[3] Kozma, Robert B., Comparative Analysis of Policies for ICT in Education, the *International Handbook on Information Technology in Education,* Center for Technology in Learning SRI International, p. 15.

of new knowledge. Corresponding education policies can connect the use of ICT to the development of students' ICT skills which can be applied in the workforce, to develop their capacity to use technology to solve complex real-world problems that can contribute to productivity, and to their development of new kinds of "21st century" and lifelong learning skills which support knowledge creation, innovation, and entrepreneurialism in a "knowledge economy".[1]

Promote social development. Other countries have focused more on the potential social impact of ICT and governments have justified ICT investments with policies that promote their use to share knowledge, foster cultural creativity, increase democratic participation, make government services more widely available, and enhance social cohesion and the integration of different cultural groups and individuals with different abilities. Within education, socially-oriented policies offer the prospect of connections between classrooms across cultures, increased parental participation, student access to specialized educational services, and the delivery of educational services to remote populations.[2]

Advance education reform. ICT can play a particularly important role in supporting education reform and transformation. The kinds of education reforms that have been associated with the introduction of ICT include curriculum reforms that emphasize high levels of understanding of key concepts within subject areas and the ability to apply these concepts to solve complex, real-world problems. Other curriculum reforms emphasize what are sometimes called "21st century skills", qualities that prepare students for the knowledge economy, such as creativity, information management, communication, collaboration, and the ability to direct one's own work and learning. ICT-related pedagogical changes treat the students as active agents who are engaged in collaborative projects that solve complex, real world-like problems or in sustained investigations and interactions that generate new ideas by building on and extending the ideas of others.[3]

Support education management. Some countries advocate the use of ICT to improve the management efficiencies or accountability of schools or the education system, more generally. Consequently, these policies emphasize computer-based testing and the use of digital data and management systems,

Multiple rationales. These four policy rationales are not mutually exclusive. Indeed, a number of countries have used two or more of these rationales together in mutually reinforcing ways.[4]

The adoption of information and communication technologies (ICT) in education worldwide include: increased quality of learning through access to more— and more effective—learning resources; more student-centered, active, and

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[1] Kozma, R. (2005). National Policies that Connect ICT-Based Education Reform to Economic and Social Development, *Human Technology,* An Interdisciplinary Journal on Humans in ICT Environments, Center for Technology in Learning, USA, Volume 1 (2), October, pp. 117-118.

[2] **Ibid.,** p.120.

[3] Bransford, J., Brown, A., & Cocking, R. (2000). *How people learn: Brain, mind, experience, and school* (2nd ed.). Washington, DC: National Academic Press, p.15.

[4] Kozma, R. (2005). **Op.cit.,** p.122.

constructivist learning environments; improved critical thinking and analytical skills; enhanced productivity through classroom and system management tools and increased student motivation, student productivity, and learner independence. At a broader level, national ICT in education policies and strategic plans are often linked to such ambitious development goals as: supporting economic growth; promoting social development; advancing education reforms, including promotion of 21st century skills; and supporting education management.[1]

Part Two: Egypt's ICT Policies and Initiatives for Education

The Egyptian government identified information and communication technology (ICT) as a national development priority in 1999, a new Egyptian Ministry of Communications and Information Technology (MCIT) was established as the first step towards executing the national project for a technological renaissance to achieve the 'Egyptian Information Society', which aims to offer individuals, businesses and communities the opportunity to harness the benefits of ICT within the boundaries of national priorities and issues. MCIT was entrusted with developing and improving the telecommunication infrastructure, and preparing the National Communications and Information Technology Plan (NCITP). MCIT's strategy concentrates on building partnerships with the private sector via working groups to produce new initiatives and projects for the ICT market, so we notice the increase of ICT contribution to GDP (see figure 1).[2]
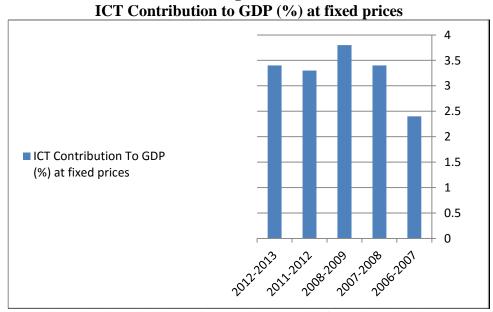
Figure 1
ICT Contribution to GDP (%) at fixed prices

Source: By author using data of Ministry of communication and information technology- Egypt

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[1] Pouezevara, Sarah, Sabry William Mekhael and Niamh Darcy (2014). **P**lanning and Evaluating ICT in Education Programs Using the Four Dimensions of Sustainability: A Program Evaluation from Egypt, RTI International, USA, *International Journal of Education and Development using Information and Communication Technology, (IJEDICT),* Vol. 10, Issue 2, p.127.
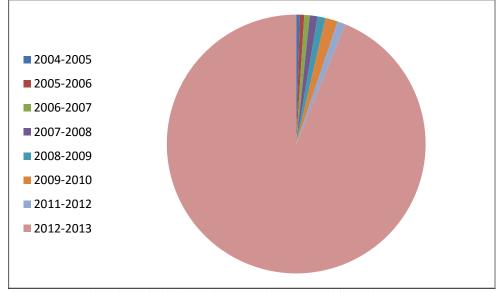
[2] Hamdy, Amr (2007). **ICT in Education in Egypt,** Egypt Country Report, June**,** www.infodev.org. pp. 7-9

According to the World Competitiveness Report of the World Economic Forum, Egypt is ranked 5th of 59 countries in terms of having investment in infrastructure as a priority for the government (see figure 2). Such growing acceptance let investments in ICT become a major research issue for academia and industry because these investments often are reflected in other sectors as well as have an effective role in improving the overall infrastructure of different sectors. The government is sustaining its ongoing economic and institutional reforms, infrastructure development and global integration to enhancing Egypt's competitiveness globally and in the region.[1]

Figure 2
ICT Investments (Million Egyptian pound)

Source: By author using data of Ministry of communication and information technology- Egypt

ICT had a major contribution in restructuring government services as well as supporting through collaborative projects sectors such as education and health. Moreover, the ICT sector in Egypt had increased revenues (see figure 3).[2]
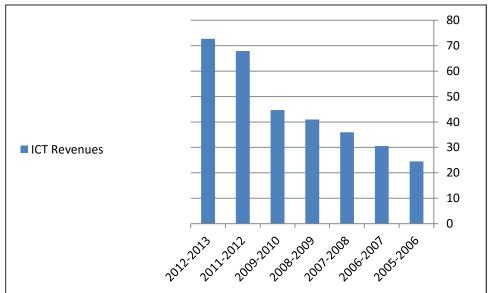
Figure 3
ICT Revenues (Million Egyptian pound)

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[1] Kamel, Sherif, Dina Rateb, Mohamed El-Tawil (2009). The Impact of ICT Investments on Economic Development in Egypt, *The Electronic Journal on Information Systems in Developing Countries EJISDC*, vol. 36, no. 1, http://www.ejisdc.org, p.8.

[2] Ibid., p.9.

Source: By author using data of Ministry of communication and information technology- Egypt

ICT National Policy in education

The National ICT policy in the area of education is jointly co-ordinated by MCIT and the Ministry of Education. The plans up to 2015 are as follows:[1]

 Integrating technology at schools
• Providing a computer, data show, and wide screen connected to the Internet for each class
• Providing computer labs in schools at the rate of one lab for every 15 classes
 Introducing developed educational software
• Developing the production of software on scientific bases and linking it to curricula.
 Providing electronic educational services
• Uploading the entire primary, preparatory, and public secondary schools curricula on the Internet.
• Extending virtual classes for effective transmission to include a class at least in each educational directorate
 Establishing the infrastructure of the information technology
• Increasing the capacity of the international Internet of the ministry to allow the biggest possible number of people to log onto the ministry site, and to make use of the provided services especially the electronic education
• Expanding the tools of linking the Internet to the "E1 circles" (Internet connectivity) that are specialized for exchanging information among schools, administrations, educational directorates, and the ministry to avoid overcrowding
• Expanding the use of ADSL (broadband) and leased lines in addition to what is available now in (dial-up) circles to help schools log onto the Internet
 Distance-training national net
• Upgrading the equipment of the distance-training national net (video conference)
• Using video streaming to include rooms in schools

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[1] *Hamdy, Amr*: **Op.cit.,** p.15.

• Using distance interactive learning for testing the standards of those attending the training sessions in the video-conference halls, and for an active participation with the lecturer

    Training the educational cadres

• Aiming for most teachers to earn the international computer driver's license (ICDL)
• Training teachers to use ICTs in preparing and conducting lessons

    Co-projects with donors

• Extending the use of loans and grants from donors, whether local or foreign, to enhance the educational process
• Setting contracting protocols and agreements with international companies such as Microsoft, Cisco, Intel, and Oracle to help enhance the educational process through upgrading the programmes and training teachers to use modern technology
• Co-operating with the World Bank, European Union, US Aid, and African Aid (among others) to provide schools with the sets and the technological equipment, that will improve the educational process

Egypt's ICT initiatives for education

    The Egypt Education Initiative EEI and the Egyptian Information Society Initiative included many programs targeted at specific populations and sectors, including rural and disadvantaged communities. Programs aimed to: increase access to ICT-related services, improve ICT competencies, promote innovation in IT, and expand access to educational opportunities through e-learning. More recently, the convergence of government policies and private sector support for ICT in education in Egypt offers new and promising opportunities. All ICT in education efforts have been shaped by the Ministry of Education MOE's guiding principles of standards-based content, active learning methodology, and integration of ICT, assessment, and learning materials. The five-year MOE National Strategic Plan for Pre-University Education Reform in Egypt, 2007/08–2011/12, reflected government and citizen aspirations for better education. A new strategy covering the period 2012–2017 aims at investing in Egyptian potential and achieving digital citizenship through innovative technology applications.[1]

    There are several ICT programmes that are running in education. The objective of the (EEI), is to improve education in Egypt through effective use of ICT. The EEI focuses on four tracks: pre-university education; higher education; lifelong learning; and e-learning industry development. The first phase of the EEI aims to benefit 820000 students in 2000 schools and over 300 colleges through provision of technological infrastructure and high-speed Internet access. The initiative supports Egypt's overall education reform efforts and maximizes the potential for collaborative PPPs to achieve their goals. The initiative is a partnership between not only the local public and private sectors but also multinational IT companies, donors and the World Economic Forum.[2]

Part Three: The ICT Projects in Education by Government of Egypt

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[1] Pouezevara et al. **Op.cit.** p. 136.

[2] MCIT (n.d.a) *ICT: An enabling tool for Egypt's socioeconomic development.* [Online]. http://www.mcit.gov.eg/FeatureDetailes. aspx?id=gAIHJ+nz0aE= [2007, February 6].

First: Current ICT Projects in education: Ministry of Education[1]

- *Ministry of Education Multimedia Laboratories*

Computer labs have been established in all public and experimental schools for the projection of multimedia programmes using computers as a teaching aid. TV and video sets, enlargement projectors, and interactive CD-Roms and drivers have been provided for the kindergarten and primary stages.

- *Knowledge Sources Network*

Twenty-seven "distance training halls" and 127 schools are using the Internet through direct contact. Over 4,000 schools use the services of electronic mail through the network of the Ministry of Education. A central "electronic library" has been set up with of CDROMs, videotapes, and books with teaching aids. All schools participating in the project can benefit from the remote access to the central library. The Internet services are being expanded to reach 4 Mbps to enable a large number of sites and schools to exchange files and share screens by sound, text, and pictures.

- *GLOBE*

Global Learning and Observations (GLOBE) is an international project that aims to promote recognition of relevant environmental issues inside and out of schools. It aims to raise awareness of the environmental changes in the world today, provide knowledge, and give students a new vision.

- *Seed*

This project is a part of the Intel initiative for creativity in learning, which aims for cooperation in education all over the world in the fields of engineering, mathematics, science, and technology learning.

- *NEPAD e-Schools Project*

This project focuses on providing end-to-end ICT solutions that will connect schools across Africa to the NEPAD e-Schools Network and the Internet. Solutions include the provision of content and learning material and the establishment of health points at schools. Egypt is the sixth country in Africa to launch the project after Uganda, Ghana, Lesotho, Kenya, and Rwanda, and the first in North Africa.

- *Mtandao Afrika (MAF)*

MAF is a collaborative programme for youth to form teams and develop educational Web sites. It is implemented in collaboration with SchoolNet Africa and AGENT Consulting. Within the framework of the project, basic ICT training for over 400 participants from 10 governorates was conducted in 2006 under the auspices of the Ministry of Education.

- *Josoor Arabia*

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[1] Hamdy, Amr: **Op.cit.** pp 17-20.

The programme aims at promoting Arabic-language content on the Internet. The programme is implemented in collaboration with SchoolNet Africa and AGENT Consulting.

- *Global Teenager Project*

This is a collaborative learning programme addressing secondary school students and operating in a number of schools in Egypt.

- *Virtual Egyptian Chinese School Project*

The project aims to teach Arabic to a selected group of students in China, and Chinese to students in Egypt through distant learning

- *The Electronic Educational Project*

The project aims to establish a new educational environment that provides distinguished education. The project started with three subjects: mathematics, English, and science. The project has a focus on activating self-learning principle and co-assessment, in addition to facilitating the publication of distinguished educational works whether they belong to students, teachers, or schools.

- *Information Technology in Schools*

Information technology in schools brought computers, software, and computer training to 14 schools, affecting 39,000 students in Egypt. The programme also trained teachers to incorporate information technology into their lesson plans and created an online network that allows teachers to exchange lesson plan ideas and to access information on general ICT use.

- *Training for Development*

Training has two components related to ICT. The first is a video-conference distance learning centre that has been established to link 27 sites in all governorates and Luxor City in order to provide learning facilities in remote areas. This has reduced the cost and increased the number of female teachers. Over 370,000 individuals have been trained through 274 training courses and 47 special programmes on practice and assessment. The second component is a training centre on networks and multimedia which has been established in Al Haram to provide training for all the personnel in the field of education on using networks each in their own field of specialization. In addition, all teachers are encouraged to take the ICDL certificate by making it a prerequisite for future promotions.

- *Production of Educational Aids*

One hundred and thirty-eight multimedia programmes have been produced for different stages of education, 75 films using computer graphics system have been made, and five multimedia programmes have been produced for students with special needs, including a visual dictionary for the deaf.

- *The iEARN project*

Participating schools were involved in a variety of iEARN projects on the environment, civic education, global issues and human rights. The emphasis is on upgrading student computer/Internet skills, English language ability and exposure to real-life, authentic texts and themes. Projects are focused on learner-centered teaching, co-operative and interactive learning and development of life skills – critical thinking, problem solving, conflict resolution and teambuilding.[1]

Second: Current ICT Projects in education: Higher Ministry of Education[2]

- *Information and Communications Technology Project (ICTP)*

The ICTP has established a digital library that now provides all public universities with on-line academic and research content and full access to over 22,000 international journals in almost all subjects to faculty and students.

- *Faculties of Education Project (FOEP)*

The FOEP sub-project has progressed well to improve the infrastructure of the faculties of education through the provision of labs, equipment, and Internet connectivity. Training programmes are being implemented in all faculties of education.

Third: Current ICT Projects: Public Agencies Educational Satellite Channels[3]

The Centre of Technological Development and Decision-Making Support have produced 68 multimedia films. 9,478 schools, 27 educational directorates, 239 educational administrative units, and 25 mobile technological teams have been equipped with receivers of the transmission of educational satellite channels for use in schools of remote areas. In addition, in an attempt to make use of all potentials of the Egyptian Satellite (Nile Sat), the thematic educational programmes have occupied 7 satellite channels.

- *The Children's Library Project*

The project was prompted by Bibliotheca Alexandrina with the aim of developing interest in the bookmaking process, including printing and binding, alongside encouraging children to gain a wider literary experience.

Part Four: The Egypt's Experience on ICT in Education

ICT is used to improve the delivery of and access to education. This approach can improve education on the margin by increasing the efficiency by which instruction is distributed but it need not involve fundamental change. In the second approach, ICT is the focus of learning. By learning ICT skills, students become better prepared for work that increasingly involves the use of ICT. So ICT can be used to improve student understanding, increase the quality of education, and thereby increase the

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[1] MCIT (n.d.b) *Egypt Education Initiative.* [Online]. http://www.mcit.gov.eg/FeatureDetailes. aspx?id=+ByyBPv/e1I= [2007, February 2]

[2] MCIT (2005) *Egypt's information society.* [Online]. www.egyptatwsis.com.eg/White_Paper_Final.pdf [2007, February 20].

[3] Beckstrom, M., Croasdale, H., Riad, S.M. & Kamel, M.M. (n.d.) *Assessment of Egypt's e-learning readiness.* [Online]. http://www.ltss.bris.ac.uk/events/egypt/ellen/readiness.doc [2007, February 2].

impact of education on the economy. With this approaches, knowledge creation, technology, technological innovativeness, and knowledge sharing can contribute to the transformation of the education system but this needs ICT's infrastructure (see figure 4).[1]

Figure 4
Subscription of mobile cellular, fixed telephone and used internet

Source: By author using data of the World Bank database

The use of ICT in the classroom provides the ability to cut cost, while reaching a wider audience through tools such as the World Wide Web and video conferencing, allow for standardization of quality of instruction, and enable each student to learn. The use of ICT allows schools to expand their markets, respond to the business and environmental requirements, support cross cultural and cross functional teams of trainees to engage and work together, and allows faster and more practical cooperation between instructors from various nations while maintaining the targeted level of quality delivery of knowledge and education.[2] So Egypt's government ensures to increase the IT teachers to facilitate the education process (see figures 5 and 6).
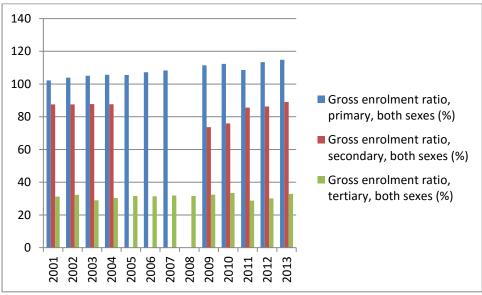
Figure 5
Gross enrolment ratio, primary, secondary and tertiary %

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[1] Kozma, R.(2005)**. Op.cit.** p.125.

[2] Dahawy, Khaled, Eskandar Tooma, Sherif Kamel (2005)**.** The Use of IT in Teaching Accounting in Egypt: the Case of Becker Conviser, *Communications of the IIMA*, *Volume 5 Issue 3*. P. 19.

Source: By author using data of the World Bank database

Figure 6
Proportion of IT teachers %

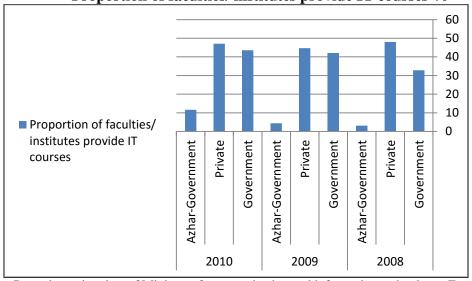By author using data of Ministry of communication and information technology- Egypt

The World Bank is pushing for reform efforts in Egypt that are directed at improving the quality of higher education. The World Bank considers Egyptian higher education to be 'severely compromised' because of centralized governance and excessive state control, instead of expansion to meet rising enrolment demands. Egypt has established private and foreign universities, and this help in coping with the
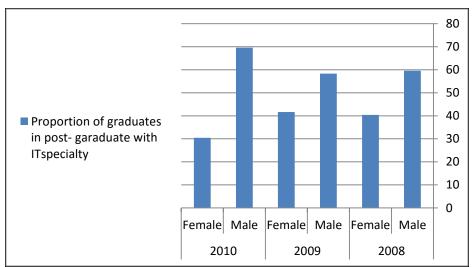
expansion in enrolment at higher education level (see figures 7 & 8). E-learning centers funded under the HEEP are expected not only to generate products (fully developed courses), but also to establish procedures for creating and supporting courses, training and supporting faculty members, and assuring online course quality.[1]

Figure 7
Proportion of faculties/ institutes provide IT courses %

By author using data of Ministry of communication and information technology- Egypt

Figure 8
Proportion of graduates in post- graduates with IT specialty %

By author Using data of Ministry of communication and information technology- Egypt

The Ministry of Education in Egypt is taking a leap in ICT to move to the 21st century. However it is faced by many challenges, there are some constraining features in the education system as follows:-

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[1] OBHE (Observatory on Borderless Higher Education) *Quality versus quantity? World Bank urges Egypt to cap enrolments, as government turns to private and foreign provision.* [Online]. http://www.obhe.ac.uk/news/sample398.html [2007, February 13]

- Although there are many initiatives and programmes, the current technological infrastructure is still insufficient. Egypt has addressed the issues of infrastructure and universal service to reach out across the unconnected parts of the country to allow development in ICT. Curriculum Education could contribute to the development of Egypt's information society by improving the quality of its human capital. A reform effort has been initiated and technology has been identified as an important component of this effort. ICT is a subject in the school curriculum, but the material is not periodically improved. There are major barriers to change within the education system itself. Most significantly, the country's curriculum and assessment systems emphasize the memorization of facts, which works against innovative thinking and knowledge creation in both schools and universities.

- Fewer numbers of schools and even fewer universities and higher institutions are available in rural communities. There is a lack of infrastructure and facilities in rural areas. There is also a serious problem with the number of school dropouts especially in rural areas.

- In general the level of illiteracy is higher among females, which reflects access to ICT training and skills. There are many more female school dropouts than males due to cultural and economic issues especially in rural areas where females receive education to a certain age then drop out of school.

- The larger population of teachers lacks proper ICT training; a large number of projects and programmes are concerned with capacity-building and human resource development as a basic need for achieving educational development.[1]

Part Five: The Methodology

The paper uses the econometric tools to analyze the impact of ICT on education in Egypt using a vector auto regression VAR methodology through three variables the Gross Domestic Product (GDP), the Investment in telecoms with private participation (IT) and the number of Enrolment in primary and secondary education (ENP), according to the study of Pegkas (2014).

The data of Gross Domestic Product in Egypt (GDP) measured at 2005 constant prices US$, Investment in telecoms with private participation in Egypt (IT) measured at 2005 constant prices and the number of Enrolment in primary and secondary education for both sexes in Egypt (ENP). The data are annual for the period (2000 – 2014) and are taken from the World Bank database.

At first the Augmented Dickey Fuller test is checked to assure if the series are stationary or not.

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[1] UNESCO (2013)**:** *ICT in Education in Five Arab States, A comparative analysis of ICT integration and e-readiness in schools in Egypt, Jordan, Oman, Palestine and Qatar,* Information Paper, April. pp.40-43.

1- The Unit Root test

The results in Tables 1, 2 and 3 show that the Gross Domestic Product GDP, ICT investment IT and educational level ENP are not stationary in their level, but tables 4, 5 and 6 show that the series became stationary after taking the first differences.

Table 1
Augmented Dickey-Fuller Test for GDP

ADF Test Statistic	-0.975173	1% Critical Value	-4.0681
		5% Critical Value	-3.1222
		10% Critical Value	-2.7042

Source: By author using the results of the model on Eview.

Table 2
Augmented Dickey-Fuller Test for IT

ADF Test Statistic	-2.170012	1% Critical Value	-4.1366
		5% Critical Value	-3.1483
		10% Critical Value	-2.7180

Source: By author using the results of the model on Eview.

Table 3
Augmented Dickey-Fuller Test for ENP

ADF Test Statistic	-0.705101	1% Critical Value	-4.1366
		5% Critical Value	-3.1483
		10% Critical Value	-2.7180

Source: By author using the results of the model on Eview.

Table 4
Augmented Dickey-Fuller Test for D(GDP)

ADF Test Statistic	-3.445353	-4.1366	1% Critical Value*
		-3.1483	5% Critical Value
		-2.7180	10% Critical Value

Source: By author using the results of the model on Eview.

Table 5
Augmented Dickey-Fuller Test for D(IT)

ADF Test Statistic	-3.155370	-4.2207	1% Critical Value*
		-3.1801	5% Critical Value
		-2.7349	10% Critical Value

Source: By author using the results of the model on Eview.

Table 6
Augmented Dickey-Fuller Test for D(ENP)

ADF Test Statistic	-3.157909	-4.3260	1% Critical Value*
		-3.2195	5% Critical Value
		-2.7557	10% Critical Value

Source: By author using the results of the model on Eview.

2- *Test for Co-integration*

In the second step of estimation, using the Johansen co-integration test for a long-run relationship between GDP, IT and ENP, the results concludes that GDP, IT and ENP are cointegrated and there is a long-run relationship between them.

Table 7
Contegration test for GDP, IT, and ENP

Hypothesized No. of CE(s)	Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value
None	0.798102	27.45519	29.68	```
At most 1	0.407939	8.255255	15.41	20.04
At most 2	0.151081	1.965499	3.76	6.65

Source: By author using the results of the model on Eview.

3- The Vector Auto Regression Model

Thirdly the paper runs the vector auto regression model and the result of estimation is viewed at table 8.

The VAR Model – After estimation:

GDP = 1.171388087*GDP(-1) - 0.2499884282*GDP(-2) + 0.2881362553*IT(-1) + 0.7781663052*IT(-2) + 1957.956271*ENP(-1) - 1297.945005*ENP(-2) + 3170355748

IT = 0.2776782804*GDP(-1) - 0.2143539174*GDP(-2) + 0.415413722*IT(-1) + 0.02543105369*IT(-2) + 841.8071049*ENP(-1) - 2059.742839*ENP(-2) + 4459185114

ENP = 0.0001867489426*GDP(-1) - 7.988129954e-05*GDP(-2) + 0.0002908589943*IT(-1) + 0.0002101551684*IT(-2) + 0.08933686408*ENP(-1) - 1.112463183*ENP(-2) + 7310512.157

Table 8
The Results of VAR Model

	GDP	IT	ENP
GDP(-1)	1.171388	0.277678	0.000187
	(0.50787)	(0.25906)	(0.00020)
	(2.30648)	(1.07186)	(0.95044)
GDP(-2)	-0.249988	-0.214354	-7.99E-05
	(0.40319)	(0.20567)	(0.00016)
	(-0.62003)	(-1.04225)	(-0.51210)
IT(-1)	0.288136	0.415414	0.000291
	(1.05851)	(0.53995)	(0.00041)
	(0.27221)	(0.76936)	(0.71024)
IT(-2)	0.778166	0.025431	0.000210
	(0.93718)	(0.47806)	(0.00036)
	(0.83032)	(0.05320)	(0.57961)
ENP(-1)	1957.956	841.8071	0.089337
	(2058.18)	(1049.87)	(0.79628)
	(0.95130)	(0.80182)	(0.11219)
ENP(-2)	-1297.945	-2059.743	-1.112463
	(2598.45)	(1325.46)	(1.00530)

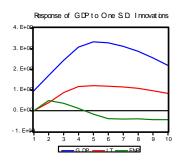|	(-0.49951)	(-1.55398)	(-1.10660)
C	3.17E+09	4.46E+09	7310512.
	(1.4E+10)	(7.3E+09)	(5558860)
	(0.22065)	(0.60841)	(1.31511)
R-squared	0.996812	0.746458	0.887573
Adj. R-squared	0.992987	0.442208	0.752660
Sum sq. resids	1.13E+19	2.93E+18	1.69E+12
S.E. equation	1.50E+09	7.66E+08	580999.3
F-statistic	260.5933	2.453433	6.578879
Log likelihood	-265.3331	-257.2552	-171.0445
Akaike AIC	45.38885	44.04254	29.67408
Schwarz SC	45.67171	44.32540	29.95695

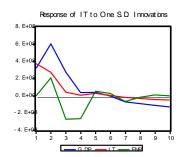Source: By author using the results of the model on Eview.

According to the results, it is shown that for the GDP equation IT is positively affect GDP for IT(-1) and IT (-2), and ENP is positively affect GDP for ENP(-1) but negative for ENP(-2). And for IT equation GDP(-1) has positive impact on IT, but GDP(-2) has negative impact and the same for ENP that ENP(-1) is positively affect IT and ENP(-2) is negatively affect IT . Finally for ENP equation GDP(-1) has positive impact on ENP and GDP(-2) has negative impact. But IT is positively affect ENP for the both IT(-1) and IT(-2). The R-squared reaches to 99.7% and the adjusted R-squared is 99.3%.
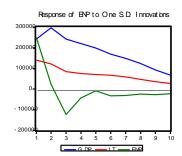
4- The Impulse Response Functions

For studying the dynamic properties of the VAR models, the paper uses impulse response functions analysis over ten years by using the Cholesky decomposition. The impulse response function derived from the unrestricted VARs, which are presented in figure 10. From the figures, it is shown that one standard deviation shock of primary and secondary education has a positive impact on economic growth over four years then become negative; also a one standard deviation shock of ICT investments has a positive impact on economic growth over ten years. And the response of ICT investment is positively for one standard deviation shock of GDP over six years then become negative, and also there are positive response for ENP one standard deviation shock over two years. Finally the response of ENP for one standard deviation shock of GDP is positive response over ten years, and also the one standard deviation shock of ICT investment has a positive impact on the primary and secondary education over the ten years.
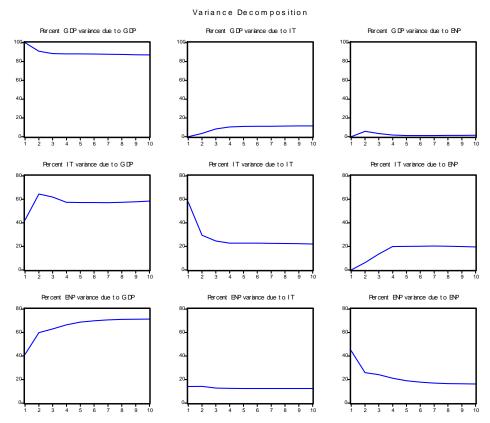
Figure 10
Impulse Response of the Variables

Source: By author using the results of the model on Eview.

5- Variance Decomposition Analysis

The variance decomposition (VDC thereafter) is estimated for each variable in the VAR models for a period of ten years. The results of VDC estimation are presented in figure 11. As it shown GDP affects more variation of primary & secondary education and ICT investment. And primary & secondary education affects less variation of GDP but more variation of IT. Also, as the years pass the ICT investments affect the variation of GDP and primary & secondary education in all figures.

Figure 11
Variance Decomposition

Source: By author using the results of the model on Eview.

The overall results from the variance decomposition and the impulse response functions show the importance of GDP and ICT investment to explain variation in primary & secondary education.

Part Six: Conclusion

The improved access to ICT in education can help individuals to compete in a global economy by creating a skilled work force and facilitating social mobility. The ICT in education has a multiplier effect throughout the education system, by enhancing learning and providing students with new sets of skills; by reaching

students with poor or no access; by facilitating and improving the training of teachers; and by minimizing costs associated with the delivery of instruction.

However, these advantages are hindered by the presence of several challenges that arise from the use of various information and communication technologies, including the need for expensive infrastructure and large startup costs, finding qualified instructors, and the lack of face to face instruction, which may diminish the trainees interpersonal, social, and communication skills. Therefore, it is crucial to find ways to speed up the educational process of its citizens and one of the venues could be distance learning and computer based technologies, which could lead to a cheaper process and yet as effective and as efficient.

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