Full Length Article

Open Access

Implementation of ICT in Secondary Education: A Case Study of District Ghotki, Sindh

Pervaiz Memon¹, Asif A Shah², Sobia Shafaq³, Akber Ali⁴

¹Research Scholar, Mehran University Institute of Science, Technology & Development (MUISTD), Jamshoro.

²Assistant Professor, Mehran University Institute of Science, Technology & Development (MUISTD), Jamshoro.

³Assistant Professor, Institute of Business Administration, University of Sindh, Jamshoro

⁴Dean, Management Information System, NUST Karachi Campus

ABSTRACT

This research aims to investigate the initiatives of Federal and Provincial Governments concerning the implementation of Information and Communication technology (ICT) projects in Secondary Education. The main objective of this study is to investigate the actual implementation of ICT projects at secondary school level in Sindh province by selecting district Ghotki as a case study. While conducting research, it was observed that out of forty secondary schools in district Ghotki, only thirteen schools were selected for introduction of ICT by the Education Department. Initially, this research focused on identification of the current status of resources allocation pertinent to ICTs at each secondary school, later on, an attempt was made to identify the parameters responsible for successful and unsuccessful implementation of ICT projects in district Ghotki. The research findings determine that although, students enthusiasm and basic infrastructure are present, however, unavailability of electricity and absence of maintenance expenditure for ICT laboratories, appeared as key factors concerning the unsuccessful implementation of ICT projects in a secondary school of distinct Ghotki. This suggests that these two barriers have a strong impact on lowering students' interests in opting for computer science as a major subject for class IX and onwards. Finally, this study concludes with some recommendations to overcome these problems for successful implantation of ICT at secondary school system of Sindh province.

Keywords: ICT, Secondary Schools, Implementation, Students, Success.

1. INTRODUCTION

Information and communication technology (ICT) forms an integral part of everyday living. There is a general agreement among policy makers and researchers that ICT is necessary to support various commercial, developmental and government activities

Address of Correspondence

Asif Ali Shah
Asifali.Shah@faculty.muuet.edu.pk

Article info

Received Oct 13, 2016
Accepted Dec 19, 2016
Published Dec 26, 2016

(Dutta, 2011). It is believed that children's' ICT awareness needs to be nurtured in early phases of their life to achieve their personal development and career progression in future endeavors. Primarily, young children have an innate curiosity for ICT, which suggests that within the school environment, ICT can easily be integrated with other subjects to develop thematic and interdisciplinary curriculum. Many governments since the late 1990s have developed plans to intensify their investments concerning ICT in the education sector. Furthermore, the quick upsurge of the internet and the worldwide web has led to the adoption of the key objective to equip all schools with access to these facilities in a relatively short period of time.

Notably, ICT literacy is a requisite ability necessary for children living in this modern society (Hiramatsu, 2010). Now in this era, when a bulk of information is available, kids need to know how to access and extract required information to suit their specific needs. Since the investment in ICT could improve literacy, thus, the expansion of ICT infrastructure in schools is expected to promote learning (Hsu, 2011). ICT can also help remote communities to achieve development through improving their connectivity. The integration of ICT has now turned distance communities more accessible (Jafri et al, 2011), therefore, the adoption of ICT can be conceptualized as a tool for globalization (Nair and Hindle, 2013). This refers that schools should act as operating base for the ICT learning activities that systematically involve students and other stakeholders in the creation and refinement of ICT-enabled educational programs and infrastructures. Investment in ICT has been viewed as a source of future economic and social benefits (Crede et al., 1998).

Pelgrum (2001) suggested that forces at all levels of education system i.e schools or classrooms can bring changes, which are not even under the direct control of main bodies of education. Hence, this research investigates the actual implementation of ICT in a secondary education system that could help in improving future technology-based decisions involving large financial investments derived from public resources. In this regard, Rhee and Riggins (2007) pointed out that in order to make modern information society, ICT literate human resource capacity is must for developing infrastructure and e-

development. This capacity building can be achieved through various means such as foreign direct investment, promoting e-development through e-government, e-democracy, and e-medicine (Rhee and Riggins, 2007).

No doubt, if society fails or shows an unwillingness to respond to change through the acquisition of knowledge, ultimately that society will disintegrate (Hassan, 2007). In Pakistan, particularly Sindh province has no effective monitoring system in place to check the status of ICT projects implemented in the past. This research endeavor is first of its kind, which focuses on identification of effectiveness of ICT project implementation in secondary education. As an initial research effort, this study has adopted case study approach through focusing on District Ghotki, Sindh.

ICT-BASED INITIATIVES IN PAKISTAN:

Pakistan is a developing country and adoption of ICT can provide leapfrogging in achieving various economic and academic goals. The Pakistani Government widely recognizes the role of ICTs and trying to adopt multiple policies to draw maximum benefits from it. Mainly, ICTs are being used for human development with their penetration in education, health, and employment. Although, the Government of Pakistan is trying to enhance ICT coverage by offering maximum possible opportunities in almost all major sectors of the economy, however, a matter of concern is that ICTs require prudent policies and careful project design. Even, if ICT infrastructure reaches the poor, there is no assurance that they are going to access or benefit from ICT. In this regard, keeping in view the necessity of time, the Ministry of Education, the Government of Pakistan in 2004 initiated to explore mainstreaming ICT in education, which resulted in the formation of National Information and Communication Technology (NICT) Strategy (GOP, 2005).

NICT STRATEGY FOR EDUCATION IN PAKISTAN

The National Information and Communications Technology (NICT) Strategy mainly supports the targets of National Education Policy (NEP, 1998–2010), National Plan of Action (NPA) i-e: the Education for All (EAF, 2001–15) and the Education Sector Reforms (ESR, 2002–06). The current National Education Policy (NEP, 2009)

also stresses that the use of Information and Communication Technologies (ICTs) in education shall be promoted in line with the Ministry of Education's "National Information and Communication Technology (NICT) Strategy for Education in Pakistan launched in 2004. This shows that NICT is the main policy formulating body for the promotion of ICT in education. Notably, quality/improved secondary education is considered as fundamental to the creation of effective human capital in any country (Evoh, 2007). Therefore, one of the major focus areas of NICT (2004) strategy were the installation of over 1,400 computer laboratories in secondary schools, through Ministry of IT.

ICT-BASED INITIATIVES AT SECONDARY EDUCATION IN SINDH:

The government of Sindh has also taken initiatives in adopting/ implementing ICT throughout all levels of Education. A course of computer science is also being introduced at a Class 9th level as an optional subject. To promote widespread use of ICTs at secondary school level as highlighted by NICT, a joint project was launched by the Education and Literacy Department (E&LD), Government of Sindh (responsible for Operation and Maintenance) and Pakistan Computer Bureau (PCB) Islamabad. The aim of this project is to promote the NICT strategy for the installation of computer laboratories in secondary schools of Sindh. The PC-1 of the project was approved by ECNEC in its meeting held on 07.01.2004 with matching funding by federal and provincial governments at 50% - 50% ratio to meet the above goals. Although, as per PC-I of the project the completion date was fixed for December 2007 extendable up to June 2009, however, the project implementation was delayed considerably.

The project aimed to recruit 206 ICT/ Computer Science Teachers, 206 Laboratory In-charges to equip 206 Computer Laboratories at secondary schools in Sindh to raise the teaching standards of Computer Science in Governments' Higher Secondary Schools / Colleges. In each district of Sindh 13 secondary schools were selected except Badin (12 schools), Mirpurkhas (11 schools i-e: Mirpurkhas 08, Umerkot 03) and Karachi (14 Schools). The details of each item allocated for each computer laboratory are shown in Table 1.

DESCRIPTION	QUANTITY
IT/ Computer Science Teacher	01
Lab In-charge	01
Computer P-IV	15
Server P-IV	01
Printer	01
Computer Tables and Computer Chairs	17/31
Air- Conditioner (2- Ton)	01

Table 1. Information and Communication Technology (ICT) Laboratory Resources

Pertinent to achieve stated objectives, Eickelmann (2011) stresses that it is necessary to make an evaluation of ICT projects to identify their effective implementation. Firstly, this research aims at measuring the degree of successfulness of ICT projects and then lays a ground for future impact assessment of the project as a whole.

2. RESEARCH METHODOLOGY

In this study, both qualitative and quantitative research methods have been applied. Analyses of individuals, events, decisions, time periods, projects, policies, institutions or other systems that are studied holistically by one or more methods is called case study method (Thomas, 2011). Basically, a case study provides a systematic way of looking at events, collecting and analyzing information and reporting results. As a result, the researcher gains a sharpened understanding of why the events happened, and what might become important to look at more extensively in future research. Case studies lend themselves to both generating and testing hypotheses. In the context of this research, in a form of secondary data, various reports regarding the ICT and its implementation were studied in the literature review process, which forms the foundation of this research.

Initially, a pilot field study was conducted and reliability of the questionnaire was calculated. The reliability of the questionnaire comes out to be 0.82 (Cronbach alpha). The data collected was then analyzed by using different tests through SPSS (Statistical

Package for Social Sciences). The sample size for quantitative research conducted through questionnaire distribution is shown in Table 2. The study questionnaire consists of three sections. The first section is based upon the details of project resources allocated to each school, the second section asks the stakeholders i.e. all existing EDOs, headmasters, and computer teachers of district Ghotki to pinpoint the reasons for successful and unsuccessful implementation of ICT projects, whereas, 15 students from each school were also randomly selected for the survey. The third section concerns with the number of students enrolled in computer sciences in class IX, which indicates the success rate of the said project in terms of students' motivation to undertake computer science as a major subject. Finally, a hypothesis is tested to investigate the impact of implementation of ICT projects on students in secondary schools to know whether they are showing greater interest in the subject of computer science or not.

Table-2 Sample Size

Stakeholders	Number
EDO (Education)	01
Head Masters	13
Computer Teachers	10
Students	195 (15x13)
Total:	219

The conceptual framework of this research is depicted in Figure 1.

The objectives of this research are:

1. To identify the status of resources allocation for ICTs in secondary education of District Ghotki
2. To investigate the factors of successful and unsuccessful implementation of ICT projects
3. To identify the impact of ICT projects on a number of students being enrolled in class 9th in a secondary school of district Ghotki.

3. RESULTS AND DISCUSSION

In order to achieve the first objective, the data collected through the first section of a questionnaire concerning the availability of allocated resources for ICT in all schools were summarized. The overall status of ICT resources availability in secondary schools' laboratories are represented in Table 3.

Table 3. Status of ICT Resources in Secondary Schools

Name of School	Area	Computers			Server			Air conditions		
		Available	Total Number	Working condition	Available	Total Number	Working condition	Available	Total Number	Working condition
Govt. (N) DAV High School Ghotki	Urban	Available	15	12	Available	1	Working	Available	1	Working
Govt. (P) High School Ghotki	Urban	Available	15	10	Available	1	Working	Available	1	Working
Govt. (B) High School Mathelo	Rural	Available	15	12	Available	1	Working	Available	1	Working
Govt. (G) Higher Sec. School Ghotki	Urban	Available	15	9	Available	1	Not Working	Available	1	Not Working
Govt. (B) High School Umer Daho	Rural	Available	15	11	Available	1	Working	Available	1	Working
Govt. (B) High School Mirpur Mathelo	Rural	Available	15	10	Available	1	Not Working	Available	1	Working
Govt. (B) High School Hayat Pitafi	Rural	Available	15	12	Available	1	Not Working	Available	1	Not Working
Govt. (B) Higher Sec. School Khanpur Mahar	Rural	Available	15	13	Available	1	Working	Available	1	Working
Govt. (SS) High School Daharki	Rural	Available	15	14	Available	1	Working	Available	1	Working
Govt. (G) High School Daharki	Rural	Available	15	8	Available	1	Not Working	Available	1	Not Working
Govt. (B) High School khambra	Rural	Available	15	7	Available	1	Not Working	Available	1	Not Working
Govt. (G) High School Ubauro	Rural	Available	15	9	Available	1	Not Working	Available	1	Not Working
Govt. (G) Degree College Daharki	Rural	Available	15	14	Available	1	Working	Available	1	Working

Data collected through the first section of the questionnaire also identified that out of 15 computers provided to each school, not a single school has 100% availability of a computer in a working condition. This finding highlights the issue of maintenance problems for computers. Out of thirteen schools, six schools have 80% functional computers, one school has 70% functional computers, four schools have 60% computers functional, one school has 50% computers in working condition and one school even has 50% computers functional. Whereas almost 50% of the computer servers provided in all schools are not in working condition, hence, the majority of the students are unable to

benefit from the internet or Local Area Networks.

Local Area Network setup at the computer laboratories are not being utilized for any purpose and no Internet facility was available in any computer laboratory visited. 40% air conditioners were out of order in 13 schools of District Ghotki, where ICT laboratories were established. In thirteen secondary schools of District Ghotki, as per project requirement 13 ICT teachers and 13 laboratory In-charge, one in each school are required to be posted/ employed. As per data collected (as reported in Table 4), 76% ICT teachers and 92% laboratory In-charge are available as per allocation.

Table 4. Current Status of Human Resources

Name of School	Area	Other Subjects Teachers	ICT Teachers	Lab Incharge
Govt. (N) DAV High School Ghotki	Urban	47	1	1
Govt. (P) High School Ghotki	Urban	43	1	1
Govt. (B) High School Mathelo	Rural	24	1	1
Govt. (G) Higher Sec. School Ghotki	Urban	39	1	1
Govt. (B) High School Umer Daho	Rural	37	1	1
Govt. (B) High School Mirpur Mathelo	Rural	69	1	1
Govt. (B) High School Hayat Pitafi	Rural	29	1	1
Govt. (B) Higher Sec. School Khanpur Mahar	Rural	30	1	1
Govt. (SS) High School Daharki	Rural	13	1	1
Govt. (G) High School Daharki	Rural	22	0	0
Govt. (B) High School khambra	Rural	22	0	1
Govt. (G) High School Ubauro	Rural	55	0	1
Govt. (G) Degree College Daharki	Rural	8	1	1

Once, the status of allocated resources concerning ICT was identified, the first objective of the research was achieved. Hence, the study findings pertinent to the second objective are discussed below:

Identification of successful and unsuccessful factors for implementation of ICT projects

Successful factors are those occurrences whose presence or absence determines the successful implementation of ICT based projects and unsuccessful factors are those occurrences that restrict proper implementation of ICT at secondary education (Gichoya, 2005). Apart from infrastructure and allocated resources, Georgios, (2015) also stressed that the role of school head is also dominant for successful implementation of ICT in schools. Hence, some of the factors identified for successful and unsuccessful implementation of ICT projects through literature are modified for this research as shown

in Table 5. The rationale of such modification is related to aligning the identified parameters w.r.t the parameters of the ICT project under study. However, awareness and students enrolment were studied through proper functioning of Computers and other ICT equipment in secondary schools, as very small numbers of government school are able to run these projects due to the dysfunctional status of computers and other ICT equipment. This situation resulted in less awareness and low enthusiasm towards computers as a subject; hence, few students are enrolling in computer science stream in higher levels.

Table 5. Factors identified for successful and unsuccessful implementation of ICT

Factors Identified through literature	Factors modified for this research in terms of local environment
Interest of students	Interest of students in Computer Science subject
Presence of ICT Teacher	Availability of Computer teachers and laboratory staff
Interest of Teachers	Commitment and Interest of Head Master/Mistress and Computer Teachers
Presence of Infrastructure in working condition	Availability of Computers Availability of Electricity or power Funding for maintenance of computers and ICT equipment
Awareness of ICT subject	Proper functioning of Computers and other ICT equipment
Enrolment of students in ICT subject	

The data collected through the second section of survey questionnaire were analyzed by SPSS to determine the overall level of agreement for above-identified factors among headmasters, teachers, and students (as reported in Table 6).

Table 6. Successful and Unsuccessful Factors concerning ICT Implementation Level of Agreement among Respondents for all Factors

Successful Factors	Mean of Head Masters (HMs)	Level of agreement (HMs)%	Mean of Teachers	Level of agreement of Teachers%	Mean of Students	Level of agreement of students %
Interest of Students in Computer subject	3	60	2.69	53.8	3.62	72.4
Availability of Computers, teachers and laboratory staff	3.54	70.8	3.54	70.8	3.54	70.8

Commitment, Interest of Head Master and Computer Teachers	3.15	63	3.15	63	2.69	53.8
Availability of Electricity or power	2.54	48.8	2.54	48.8	2.31	46.2
Funding for maintenance of computer and ICT equipment	1.31	26.2	1.69	33.8	2	40
Proper functioning of Computers and other ICT equipment	2.85	57	2.85	57	3.08	61.6

then the presence of all factors in the Schools is found equal or above 50% (i-e half of overall agreement) it is considered as successful implementation of ICT project, whereas, below 50% is categorized as unsuccessful implementation. Therefore, as per descriptive statistics, mainly two factors: unavailability of electricity and lack of funding for maintenance of computer and ICT equipment are identified as main obstacles responsible for unsuccessful implementation of ICT projects, whereas, all other factors appeared in a good position. This status is represented in Figure 2.

Figure 2. Successful and Unsuccessful Factors for ICT implementation

Level of Agreement among Respondents for all Factors

After identifying the factors responsible for successful and unsuccessful

implementation of ICT projects, the impact of these factors on students' enrolment in opting for computer subject at higher levels is tested through a hypothesis in next section to achieve the third objective.

Impact of ICT projects on choosing computer subject at higher levels

As computer subject at the secondary level in class-9 is an optional subject instead of Biology. Therefore, students have the choice to enroll either in Computer Science or Biology subject. According to Board of Intermediate and Secondary Education Sukkur (BISE), Computer subject is divided into two components, Theory and Practical. Although, both subjects carry total marks of 100 in the examination, however, marks assigned to theory and practical work are different in each subject. While theory component of Biology carries 85 marks, whereas, theory component of computer sciences carries 75 marks and practical component of each subject carry 15 and 25 marks respectively. With regard to ICT implementation at the secondary level, the following hypothesis was framed.

Hypothesis: The effective implementation of ICT projects in secondary schools does not influence students' enthusiasm towards the subject of computer science.

In order to test the above hypothesis, net enrolment of students in each school was traced i-e from class VI to Class X by especially segregating the class IX students being opted for Biology and Computer Science streams. The data collected are represented in Table 7.

Name of School	Area	Enrollment in class (VI-X)	Enrollment in class IXth	Enrollment in Computer
Govt. (N) DAV High School Ghotki	Urban	1731	180	50
Govt. (P) High School Ghotki	Urban	878	100	0
Govt. (B) High School Mathelo	Rural	892	90	23
Govt. (G) Higher Sec. School Ghotki	Urban	929	70	0
Govt. (B) High School Umer Daho	Rural	1865	130	32
Govt. (B) High School Mirpur Mathelo	Rural	1942	160	0
Govt. (B) High School Hayat Pitafi	Rural	591	60	0
Govt. (B) Higher Sec. School Khanpur Mahar	Rural	1162	111	23
Govt. (SS) High School Daharki	Rural	915	80	20
Govt. (G) High School Daharki	Rural	1288	105	0
Govt. (B) High School khambra	Rural	1071	88	0
Govt. (G) High School Ubauro	Rural	1091	72	0
Govt. (G) Degree College Daharki	Rural	450	250	65

Table 7. Biology V/S Computer Science Enrolment

From the above Table 7, it is evident that in 7 (53%) out of 13 schools, none of the

students have undertaken computer science as a major subject. This finding points towards the failure of this project as more than half of the schools appeared unable to induct students in computer science stream. This reflects that there is some correlation among unsuccessful factors identified in above section i-e unavailability of electricity and lack of funding to maintain the ICT laboratories in terms of students' interest in opting for computer science as a major subject. In this regard, the findings drawn from correlation test revealed that there is a negative relationship between students enrolled in Class IX of computer science stream and funding for maintenance of computer/ ICT equipment (-0.06). In addition, according to Mann-Whitney U statistics test (at the significant level of 0.005), it was found that the mean rank for students' interest in computer science and functionality of ICT laboratories at the secondary level significantly differs from each other, therefore, the above hypothesis is rejected. This suggests that the students will not opt for computer science in class IX until and unless the fully functional computer laboratories would not be available at the secondary level.

Findings and Recommendations

The key findings and corresponding recommendations for successful implementation of ICT at Secondary Education level of District Ghotki are offered below:

- This study found that out of total 40 secondary schools, 13 secondary schools have ICT labs. Among these 13 schools, 07 schools have no student enrollment in the ICT subject. In 3 schools no ICT teacher is available. This shows that although the project itself is a positive step to enhance the ICT skills of low strata of society, however, the scope of the project needs to be broadened to incorporate all government schools in the district Ghotki.
- In some cases like Govt. (G) College Daharki, a number of ICT teachers are very less as compared to the total students' enrollment in school. This suggests that ICT teachers should be hired in each school as per students' enrollment size and vacant posts of ICT instructors and lab in-charge needs to be filled on a priority basis.
- It was noted that majority of the students perceive that computer books for Urdu and Sindhi speaking students are not up to the mark and do not adequately help them in learning computers. There are no screenshots in books to help students in

understanding the function of a computer program. Thus, the same may be incorporated in revised version of books.

- There was no educational software available to students in any ICT labs visited. This reflects that educational software should be provided to ICT labs, which will increase the students' understanding of ICT utilization.
- Computer orientation to grade 6, 7, and 8 class students is not being provided in government schools of District Ghotki. This highlights the need for the arrangement of computer classes for 6th, 7th, and 8th class grades for the introduction of computer subject. The same practice is being adopted in secondary schools of Punjab
- The setup of Local Area Network (LAN) established at the computer labs were not being utilized for any purpose due to the unavailability of Internet facility in any computer lab visited. This necessitates that internet service should be given in all ICT Labs.
- From concerned authorities, there is no mechanism was established to monitor and supervise the project implementation. This suggests that there should be an ICT skilled Executive or Focal person in all the districts of Sindh who can monitor the ICT implementation in a future project of the education sector.
- It was noted that electricity power was not present in Schools. This requires uninterruptible Power System (UPS) with stabilizers or solar panels should be provided for the proper functioning of Computers and Internet services.
- Funds for daily operating expenditures were not available (such as papers, racks). This requires an allocation of separate or joint budget for ICT equipment and its up-gradation.
- Moreover, ICT group needs to be introduced by Education & Literacy Department in class IX and onwards. This can help students in pursuing computer studies at graduate and post graduate level.

4. CONCLUSION

This study concludes that although the government has taken initiatives to introduce ICT in educational sector at secondary school level, however, due to lack of proper supervision and monitoring, desired goals have not be achieved yet. Lack of funding,

improper maintenance, inadequate staff and a shortage of electricity appeared those obstacles which have severely hampered the effective implementation of ICT projects at secondary school level. Notably, a strong awareness campaign needs to be initiated to familiarize students with significance and utility of ICTs in educational settings and for their future skill development.

REFERENCES

- Crede, A., & Mansell, R. (1998). Knowledge societies... in a nutshell: Information technologies for sustainable development. Ottaa, Canada: IDRC.
- Dutta, S. & Doss. (2011). ICT and Rural Infrastructure: Cases from Indian Rural Sector, the IUPJournal of Infrastructure, 9(4), 37-46.
- EAF (2001-15). Education for all. Pakistan: Government of Pakistan.
- Eickelmann, B. (2011). Supportive and hindering factors to a sustainable implementation of ICT in schools, Journal for Educational Research Online, 3(1), 75-103.
- ESR (2002-06). Education Sector Reforms. Pakistan: Government of Pakistan.
- Evoch, C.J. (2007). Policy networks and the transformation of secondary education through ICTs in Africa: The prospects and challenges of the NEPAD e-schools initiative, International Journal of Education and Development using ICT, 3(1), 44-49.
- Georgios, H. (2015). The contribution of the school head in the introduction and implementation of ICT (information and communications technology) as innovation in an elementary school: a case study, International.
- Gichoya, D. (2005). Factors Affecting the Successful Implementation of ICT Projects in Government. The Electronic Journal of e-Government, 3(4), 175-184.
- Hasan, J. A. (2007). Instruction in Pakistan, A White Paper; Document to Debate and Finalize "The National Education Policy". Pakistan: Government of Pakistan.
- Hiramatsu, Y. (2010). A study of ICT literacy education by mobile phone for children of the elementary school. IADIS International Conference e-Learning: Part of the IADIS Multi Conference on Computer Science and Information Systems. MCCSIS.
- (Hsu, 2011). Who assigns the most ICT activities? Examining the relationship between teacher and student usage, Computers and Education, 56(3), 847-855.
- Hussain, I.J, Soomro, S. & Khan, R.A. (2011). ICT in distance education: improving literacy in the province of Sindh Pakistan, Sindh University Journal of Education, 40, 37-48.
- Nair, G., Hindle, R. (2013). Use of ICT in Education, International Journal of Information Communication Technologies and Human Development, 5(4), 10-19.
- NEP (2009). National Education Policy. Pakistan: Government of Pakistan.
- NEP (1998-2010). National Education Policy. Pakistan: Government of Pakistan.
- NICT (2004). National Information and Communication Technology Strategy. Ministry of Education: Government of Pakistan.
- Pelgrum (2001). Obstacles to the integration of ICT in education: results from a worldwide educational assessment, Computers & Education, 37, 163-178
- Pelgrum, W. J. (2001). Obstructions to the incorporation of ICT in instruction: Results from an overall training appraisal, PCs & Education, 37, 163-17
- Rhee, H. & Riggins, F.J. (2007). Development of a Multi-Factor Set of Country-Level ICT Human Resource Capacity Indicators, UN: The United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (UN-APCICT).