Dareecha ICT Training Program for Public Schools in Rural Punjab

Sarmad Hussain
Sana Shams
Huda Sarfraz

Center for Language Engineering
Al-Khawarizmi Institute of Computer Science
University of Engineering and Technology, Lahore, Pakistan

www.kics.edu.pk

www.idrc.ca

Published by

Center for Language Engineering
Al-Khawarizmi Institute of Computer Sciences
University of Engineering and Technology Lahore, Pakistan
www.cle.org.pk

ISBN: 978-969-9690-01-5

This work has been published through a PAN Localization Project grant from the International Development Research Centre (IDRC), Ottawa, Canada, currently administered through the Center for Language Engineering (CLE) at Al-Khawarizmi Institute of Computer Sciences, University of Engineering and Technology, Lahore, Pakistan. The project was carried out by the National University of Computer and Emerging Sciences, (NUCES), Lahore, Pakistan.

Dedicated to

Arfa Karim Randhawa

who was the youngest Microsoft Certified Professional in the world

and who wanted IT to be accessible for the rural children of Pakistan

Preface

Dareecha Project has been a challenging but a rewarding experience. At the start of the project the team had a lot of apprehensions about a variety of aspects, including the logistics in rural schools, the support of the school management, the response of the teachers and the interest of the students. Logistics turned out to be as challenging as anticipated, and in most cases the team ended up staying in a nearby city and commuting daily to the participating rural schools, as there were no local options for stay. This made the training process very hectic. However, the support provided by the management, the oversight by the teachers and the enthusiasm and ability shown by the students encouraged everybody along.

The team appreciates the efforts of all those who have supported this project. This includes Sheharyar Sultan, the District Coordination Officer (DCO) of Sargodha, who took personal interest in the project. Ataullah Shah, Executive District Officer (EDO) – Education, and District Education Officer (DEO) of Sargodha also provided untiring support in the process, under the directions of the DCO. We are also grateful to the DCOs of Attock and Chakwal, who granted permissions to work in the schools of these districts. The school management and teachers also require special thanks, especially the teachers who contributed their personal time to make this project successful.

We would also like to thank the management of National University of Computer and Emerging Sciences, which provided the platform to conduct the project, Al-Khawarizmi Institute of Computer Sciences at University of Engineering and Technology, which provided a platform to analyze and publish the results of the project, and the International Development Research Center of Canada, that has provided financial support for this program through the PAN Localization Project.

The Dareecha Project Team
(Lahore, Pakistan)

Dareecha Project Team

(in alphabetical order)

Mahwish Bano

Riffat Bokhari

Nadir Khan Durrani

Sarmad Hussain

Iqra Javed

Kamran Azam Khan

Atif Mirza

Ahmed Muaz

Asad Mustafa

Mudasir Mustafa

Raheela Parveen

Sophia Pervez

Saba Nauman

Huda Sarfraz

Samreen Saleem

Sana Shams

PAN Localization Project

PAN Localization Project (www.PANL10n.net) is a regional initiative to develop local language computing capacity in Asia. It is a collaboration between Pan Asia Networking (PAN) program of IDRC, Canada (www.IDRC.ca) and Center for Language Engineering (www.CLE.org.pk) at Al-Khawarizmi Institute of Computer Science (www.KICS.edu.pk), University of Engineering and Technology, Lahore, Pakistan (www.UET.edu.pk) to generate technology, build human resource capacity, and advance policy for local language content creation, access and use across Asia.

This project has been divided into two phases. Phase-I (2003-2007) focused on developing local language standards and technology across the partner Asian countries including Afghanistan (Pashto), Bangladesh (Bangla), Bhutan (Dzongkha), Cambodia (Khmer), Laos (Lao), Nepal (Nepali) and Sri Lanka (Sinhala, Tamil). Some major milestones achieved in Phase I include development of Linux distributions for Dzongkha and Nepali, working OCR systems for Sinhala, Bangla and Lao, Lexicon and spell checking utility for Bangla, Dzongkha, Khmer, Lao and Nepali, Text To Speech System for Sinhala and standards for local keyboards, collation sequences and fonts for a number of these languages. Phase II (2007-2012) aims to advance this work, with the following objectives:

1. Examine effective means to develop digital literacy through the use of local language computing and content.
2. Explore development of sustainable human resource capacity for R&D in local language computing as a means to raise current levels of technological support for Asian languages.
3. Advance policy for development and use of local language computing and content.
4. Study and develop coherent instruments to gauge the effectiveness of multi-disciplinary research concerning the adoption of local language technology by rural communities.

Phase II of the project has been extended geographically and linguistically to include Afghanistan (Pashto), Bangladesh (Bangla), Bhutan (Dzongkha), Cambodia (Khmer), China (Tibetan), Indonesia (Bahasa), Laos (Lao), Mongolia (Mongolian), Nepal (Nepali), Pakistan (Urdu, Torwali and other languages spoken in Pakistan) and Sri Lanka (Sinhala and Tamil). The teams have not only been working to enhance the technology already developed in the first phase, but are actively collaborating to deploy this technology to different end-user groups, to evaluate local language computing adoption models across these countries.

Table of Contents

1. Introduction

Information and Communication Technologies (ICTs) have potential for a significant impact on education. Selinger (2008) notes that ICTs are "a powerful tool that when implemented appropriately can catalyze and accelerate education reform and development." Aiming to achieve this impact, nations across the globe have been devising strategies and undertaking efforts to integrate ICTs into education, e.g. the School Net projects, which have been going on for two decades globally. The Ministry of Education in Pakistan, also realizing the importance of integrating ICTs in school education, has stipulated this need in the recent National Education Policy (NEP) in 2009. There have been additional efforts across Pakistan to take concrete steps in integrating ICT in schools. For example, Government of Punjab rolled out a large scale IT Labs Project, in which computer labs with Internet connectivity have been established in more than 4,000 public schools across Punjab. While policy makers are starting to provide the requisite ICT infrastructure and training for education in Pakistan, there is need to undertake quantitative and qualitative studies to further inform the policy and implementation on the challenges presented by the local cultural context and solutions to facilitate the process.

Dareecha Project was planned to investigate aspects related to ICT literacy in rural schools, and focusing on the cultural constraints due to language and gender. The current report describes the project undertaken, summarizes the results, and puts forward relevant recommendations based on the analysis of this study. Chapter 2 lists the objectives of the project, summarizing some of the related published literature. Chapter 3 presents the methodology of the project. Chapter 4 presents the findings of the project for ICT capacity building in rural schools. Chapter 5 discusses the data on preference for and impact of language for learning the use of ICTs by the school children. Chapter 6 discusses the role of gender in ICT adoption. Chapter 7 sums up the experiences of the Dareecha ICT training program and presents recommendations based on the lessons learnt for further implementation, in the context of NEP.

Findings in the report are equally applicable to other developing countries striving to promote and integrate ICT education in schools and with similar linguistic and cultural context.

2. Scope and Context

A new society requires new skills
- Hepp et al. (2004)

The Ministry of Education (MoE) in Pakistan, cognizant of the need to integrate ICTs in the educational system, stipulates the use of ICTs "creatively to assist teachers and students with a wide range of abilities and from varied socio-economic backgrounds" and "to strengthen the quality of teaching and educational management" in the recent National Education Policy (NEP) of Pakistan (MoE, 2009). The MoE further states that the "[u]se of Information Communication Technologies (ICTs) in Education shall be promoted in line with the Ministry of Education's National Information and Communication Technology Strategy for Education in Pakistan" (NICTSEP).

NICTSEP (MoE, 2007), adopted by the NEP, recommends the following key areas of focus in education: (i) use ICT to extend the reach of educational opportunity, (ii) apply ICT to strengthen the quality of teaching and education management, (iii) employ ICT to enhance student learning, (iv) develop complementary approaches to using ICT in education, (v) build on the current experiences of existing and successful ICT programs, and (vi) develop capacity at the federal and provincial department of education levels. A comprehensive program is needed in order to achieve these goals to integrate ICT in education in the public schools of Pakistan. The eventual aim is to integrate ICTs in all aspects of education, including teaching (e.g. Kent, 2004, Balanskat et al., 2006, Stevens, 2008) and learning (e.g. Wagner et al., 2005, Cabero, 2006, Balanskat et al., 2006), addressing associated challenges (e.g. Chinien, 2003, Vrasidas, 2010). However, for achieving these goals where students and teachers are integrating this technology in their daily routine effectively, basic ICT literacy for students and teachers is a necessary pre-requisite (Unwin, 2005).

2.1 Objectives

Dareecha Project has been a pilot effort planned to explore challenges and solutions for providing ICT literacy training to secondary school children in rural Punjab. The project has been specifically designed to explore the following three aspects:

1. *An effective model for general ICT literacy training for rural area school children*
2. *The preference for and impact of language on learning the use of ICTs*
3. *Differences in ICT adoption across gender for rural area school children*

2.2 ICT Literacy Training in Rural Areas

Any ICT program must have a significant focus on rural areas, as they have 68% of total population of Pakistan (PAP 2010) and need special consideration (Hepp et al. 2004). This has also been emphasized by the Pakistan IT Policy (MoIT 2000), which explicitly recommends to "make

participation by rural and poor segments of society in IT education a strategic priority for social and economic development." This focus is urgent because Pakistan is currently ranked 127 on the ICT Development Index (IDI), a composite index measuring ICT impact based on three factors: infrastructure, use, and skills within a country (ITU, 2009). As pointed out by the ITU (2009, pg. 28), "Pakistan has made less progress on the skills sub-index, which scores relatively low" (ranked 144) even though it has done better in the areas of infrastructure (ranked 118) and its use[1] (ranked 98).

"Rural schools pose different and more complex challenges than urban schools, but they also offer unique opportunities for fostering better learning by using ICT. Therefore, rural schools require and deserve special considerations and distinct strategies. Rural schools can also become a critical agent for the diffusion of ICT in their surrounding communities" (Hepp et al., 2004). These challenges posed by rural settings include geographical remoteness, limited availability of infrastructure and services, smaller schools and number of students, and different cultural dynamics including linguistic and gender challenges. Attaining ICT literacy itself has many challenges, including: access to hardware and software as well as funding; time for planning, personal exploration, online access, and skill development; technical and administrative support and resources; training and expertise; resistance, passivity, school cultures, and traditions of teaching; vision and leadership; support for integration of technologies into instruction and the curriculum. These can be categorized into extrinsic factors (access, time, support, resources, and training) and intrinsic factors (attitudes, beliefs, practices, and resistance), the latter being necessary but much harder to address (Earle, 2002; Ertmer, 1999).

Both students and teachers need to be trained to use ICTs for effective adoption of this technology in education. Though training students is a more obvious goal, "capacity building - in the form of increasing the proportion of well-trained ICT literacy teachers and/or full-time ICT instructors - is at the heart of the renewal of effective and high quality work in ICT and education" (Unwin, 2005). Thus any program which focuses on ICT skill development in schools must focus on both students and teachers. In addition, management of the schools also needs to get involved in the process through a well designed and executed monitoring and evaluation system, a key ingredient for the overall success (Wagner et al. 2005).

2.3 Language and ICT Literacy

ICT education and adoption is in turn based on many factors, including language and community (Ashraf et al. 2009). NICTSEP also highlights language barrier in ICT literacy program, especially in the context of Pakistan's rural areas. The policy asks the stakeholders that "You must also address the issue of language. In what language(s) will you develop these ICT interventions?" However, NICTSEP stops short of recommending a solution. Answering this question is fundamental for effectively addressing ICT literacy in rural areas of Pakistan; notwithstanding the volatile language

[1] Though even use is low as only 1.16 per hundred Pakistanis use the internet (Pernia, 2008).

policies in Pakistan (e.g. Rahman, 2002a, 2002b, Khalique, 1999). Research clearly indicates that children who study in their mother tongue usually learn better and more quickly than children studying in a second language (Cueto et al., 2009; UNESCO, 2008; Woldemikael, 2003), and that teaching in a language which is not the mother tongue "create[s] cycles of disadvantage in education" (UNESCO, 2010, pg. 134)[2]. "[E]ducation in mother tongues … can also motivate learners to gain literacy skills and, by making literacy more relevant, support the creation of a literacy-conducive environment" (UNESCO 2006, pg. 3).

UNESCO (2008, pg. 2) points out three common myths around language and learning, which include: "the best way to learn a second language is to use it as a medium of instruction …to learn a second language you must start as early as possible…the home language gets in the way of learning a second language" which are all false but frequently mislead policy makers to promote dominating official languages. There is a continued national debate in Pakistan on use of English (which is the official language) vs. local languages for education and other sectors. Benson (2008) asserts that "multilingual countries … have focused their attention on the political aspects of mother tongue-based education … at the expense of pedagogical discussions." This debate in Pakistan is colored with political issues as well (see Rahman (2002a; also see Khalique (2007) for social implications). Therefore, though NICTSEP raises the issue of language, it does not conclude it.

The IEA SITES study (Law et al., 2008), which surveys 22 participating educational systems world-wide, reports that "language [is] an obstacle for schools in ICT-implementation in teaching and learning" where English is not the primary language spoken at home. Though ICTs are normally deployed in English, literacy in English is very low in rural areas of Pakistan as well. Thus, a core evaluation issue for the Dareecha Project was to determine the impact of language on ICT literacy for rural area school children. The project aimed to collect quantitative and qualitative evidence to further inform the policy makers on this debate, specifically investigating various aspects of learning the use of ICTs in Urdu versus English language.

For the target communities, it would have been best to offer ICTs and the literacy program in Punjabi, their first language (L1). However, there has been very limited work in Punjabi terminology, making it difficult for preparing the materials. In such cases "where use of the home language is logistically difficult … it may be useful to adopt a local lingua franca…This works best where children have some exposure to the lingua franca outside school, or where the lingua franca is from the same language family as the L1" (UNESCO, 2008). Because Urdu is either first or second language of most Pakistanis (Lewis, 2009) and is the lingua franca and national language of Pakistan, the project team chose to develop the relevant materials and conduct the training in Urdu. There are also additional reasons for preferring Urdu. First, the Urdu terminology for ICTs is already developed (e.g. see NLA, 2005); second, it is already used as a medium of instruction in public

[2] Still 221 million school age children around the world speak a language in school which is different from the language they speak at home (Dutcher, 2004).

schools in Punjab; third, the students are exposed to Urdu through media on daily basis; and finally, Urdu is linguistically closely related to the Punjabi language.

2.4 Gender and ICT Literacy

"The digital divide includes a gender divide, especially for rural and marginalized women, and the newer ICTs have the capacity to allow us to benefit from the full contribution of women," (Green, 2003, pg. 29). Addressing gender is essential for achieving the larger Education for All goals (EFA; UNESCO, 2000). United Nations Millennium Development Goals (MDGs) for 2015 (UN, 2000) prescribe "[e]liminating gender disparities in primary and secondary education by 2005, and achieving gender equality in education by 2015, with a focus on ensuring girls' full and equal access to and achievement in basic education of good quality." This is also an important dimension to address for Pakistan, where education poverty[3] for females (42.5%) is much greater than males (25.9%) (UNESCO, 2010, Table 3.3).

This gap is even more pronounced in rural areas as shown by the Gender Parity Index of 0.76 (Lynd, 2007) and the gender based difference in the District Education Index being 15.25 in rural areas vs. 5.21 in urban areas (Jamal and Khan, 2007). This difference is largely attributable to poverty, cultural constraints, and an inadequate number of government schools (Lloyd, 2007). Thus, addressing any gender differences in education through ICTs has been subscribed by NEP. Specifically for ICTs, though empirical evidence reported by Lau (2010) affirms that male and female students with same prior academic skill levels do not have significant performance differences in computer programming disciplines, Anderson (2009) reports that female students have negative attitudes towards ICTs in the United States, Australasia, Europe, Israel and some Asian countries, because ICTs are perceived as technical, difficult and boring. In addition to intrinsic preferences, in the developing countries girls also face external resistance from their parents and guardians, where the elders prefer that these girls spend more time in learning and performing household tasks instead of learning and using computers (Ashraf et al., 2009). If such attitudes are also prevalent in the social context in Pakistan, ICT literacy effort for school girls may require different strategies, a question which must be explored in detail as well.

A gender study in 2001 for the World Links project (www.world-links.org) in Africa showed that ICTs are more productively used towards learning by girls compared with boys and also helps in raising their self esteem. However, the impact can only be realized through mainstreaming[4] gender, achieved through gender-sensitive program design including, but not limited to the following: providing women and girls access to equipment, providing gender-sensitive training, keeping ICTs relevant (to the interests of) and educating women and girls on the benefits of ICTs (Green 2003). The Dareecha Project has aimed to address these areas for the girl students, by providing a conducive environment and appropriate materials for their participation. Realizing that "gender,

[3] Percentage of population with less than four years of schooling (UNESCO, 2010, Table 3.3).
[4] See DFID (2009) for a detailed discussion on gender mainstreaming.

poverty, language and culture often combine to produce an extremely heightened risk of being left far behind" (UNESCO 2010), all are relevant factors for girl students in rural Pakistan, and exacerbated by the possibility of pre-conceived intrinsic bias against ICT education for women as discussed, the project specially addresses the differences in ICT adoption across gender for school children in rural areas in Pakistan.

The project has been conducted in three phases, within a period of three years, each phase lasting for about a year. In the first phase, the ICT literacy training program was designed and all relevant tools and materials were prepared, closely considering the needs of rural area public school children, both boys and girls. In the second phase the training sessions were conducted for participating teachers and students across the participating schools. Detailed project planning was also done in the first phase and careful project monitoring was performed in parallel to the training during the second phase. This planning and data collection was done using the Outcome Mapping framework (Earl et al., 2001) explicitly extended for gender considerations (Shams et al., 2010). In the third phase, the project data analysis and evaluation has been conducted and the results are being synthesized for dissemination to the stakeholders.

3. Methodology

The use of ICT … does offer opportunities to reduce the social divide for individual beings or communities
- Pimienta (2007)

This chapter presents the technical, procedural and logistical details of the Dareecha ICT literacy training project. Some details of the planning, material development, training and evaluation aspects are presented in this chapter.

3.1 Curriculum Design

ICT literacy could mean different sets of skills for different end users. ETS (2002) defines ICT literacy as the use of "digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society." Pernia (2008) adds that the ICT literacy has three dimensions: knowledge, skills and attitude, all of which are important and should be highlighted in any related program, and further divides these dimensions into concrete competencies, e.g. skills to search on the internet, email, creating presentations, distinguishing credibility of online data, etc. ECDEC (2004, pg. 14) defines "digital learning" as the capability "to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in networks via the Internet."

At the outset, the scope of ICTs and literacy also had to be defined for the Dareecha Project. In the context of the project, use of ICTs has been limited to computers and the objectives have been to teach the participating students skills for basic usage of computers for accessing information and communicating and to generate their own relevant online content. The first task undertaken was to specify these desired skills in more detail. To better plan the program, the scope was divided into the following four high level *functional areas*:

1. *General Computer usage*
2. *Information Access*
3. *Communication*
4. *Content Generation*

These functional areas were sub-categorized into seven *learning areas* for ICT literacy for eighth grade rural public school children. Granular and incremental *competency levels* were then derived for each learning area. Finally, these competency levels were used to formulate training, practice and assessment materials for the students. The functional and learning areas are given below. The curriculum design and development process is illustrated in Figure 3.1.

1. **General Computer Usage:** This functional area includes basic skills required by students exposed to computers for the first time. This includes a single learning area: basic computing skills.
    a. **Basic Computing Skills:** This learning area focuses on the ability to operate and use a computer, including identifying and using basic hardware components, understanding the graphical user interface and event based navigation using the operating system, and the simple functions of common desktop applications.
2. **Information Access:** This covers modes of information access available through desktop computers and suitable in a rural school environment for students, and includes a single learning area: web browsing.
    a. **Web Browsing:** The learning area of web browsing covers the rudimentary skills a secondary school student will need to search for, access and retrieve required information from the Internet using a web browser. The student should be able to exploit all modes of information, including textual, audio or video data.
3. **Communication:** This functional area covers synchronous and asynchronous modes of communication available through computers and useful in a secondary school environment, sub-categorized into two learning areas: emailing and instant messaging.
    a. **Emailing:** This learning area covers the ability to use an email client to exchange emails. This means understanding concepts related to asynchronous communication, data modalities and attachments, privacy, computer security, etc.
    b. **Instant Messaging:** This learning area covers the ability to use a simple instant messaging application for communication, appreciating synchronous communication, learning privacy issues and ethics of communication.
4. **Content Generation:** This functional area contains a variety of learning areas. Though the other functional areas introduce many of these concepts, Content Generation integrates and expands these aspects more methodologically. It includes development of textual and graphical content, and formatting it for online publishing. It includes the following three learning areas.
    a. **Word Processing:** This covers the ability to type text in Urdu and English, create English and Urdu documents, and do reasonable level of formatting to organize the presentation.
    b. **Graphics Editing:** This learning area focuses on skills to produce simple drawings, e.g. diagrams, pictures, and modifying existing material, for school assignments, greeting cards, etc.
    c. **Webpage Development:** Students who reach this point have a reasonable capability of communicating, accessing and generating content. In this learning area, they go through the final step of making the content available for others on the Internet. It is equally important to learn about the relevant privacy and security issues to prevent abuse.

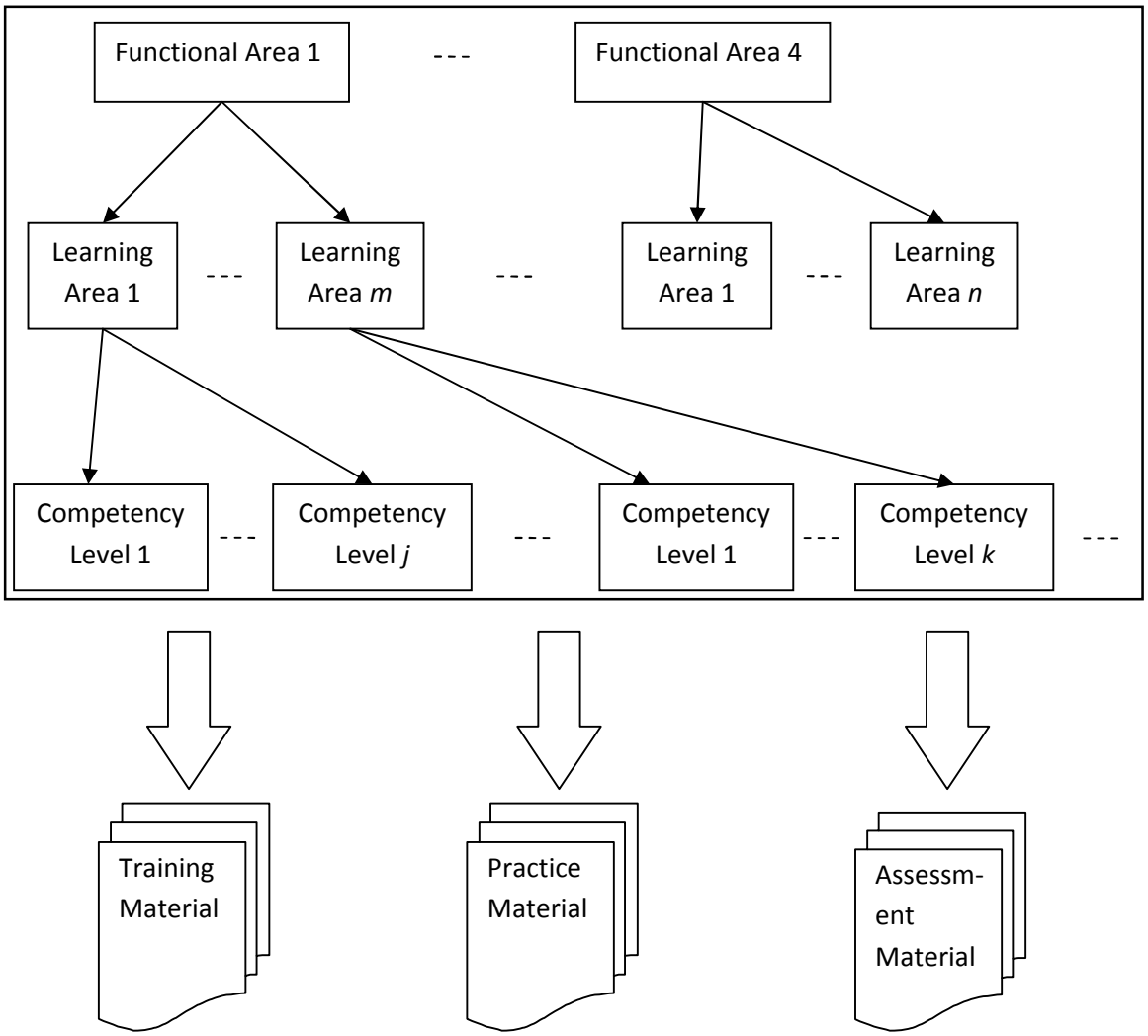

Figure 3.1: Training Development Model for the Dareecha Project

These high-level functional and learning areas are translated into finer sequences of competencies, starting with simple skills and building up to more complex functions. The purpose of these competency levels has been to provide a guideline for the development of training, practice and assessment materials for each of the specific learning areas. Entry criteria, which should be met before users can proceed, and exit criteria, which are to be fulfilled at the end, are also defined for each learning area. Set within the entry and exit criteria are a graduated set of competencies to be acquired corresponding to the learning area. As an example, for the learning area of web browsing, the skill set has been sub-categorized into eight steps. This number varies across the learning areas, because some require competence in a wider array of skills. For example, there are twelve competency levels in the area of graphics editing.

All competency levels are designed such that they correspond to the desired skills and are not tied to a specific software application. For example, competency levels for web browsing are equally applicable for any web browser (Mozilla Firefox, Internet Explorer etc.). However, these are later used to develop training and assessment materials for a specific browser (Urdu version of SeaMonkey Navigator), and can be similarly used to develop training materials for other browsers.

The competency levels are further detailed and specified into sub-skills, which map abstract concepts onto actual actions and knowledge to be learnt and acquired. They provide a stepwise guide for trainers to teach the needed skills and to prepare the training materials.

Appendix A gives complete details for Functional *Areas, Learning Areas, Competency Levels* and *Level 2 Competencies* developed in the Dareecha Project.

3.2 Software Selection and Localization

Before the training was conducted, software had to be localized. After defining the requirements through the functional and learning areas, the next step was the identification of software applications through which the school students would be trained. The main criteria for software selection were ease of use of the software and its internationalization support as needed to localize the software into Urdu. All the software applications were open source and were localized into Urdu through the project, because it is an integral part of the process to enable effective use of ICTs (Pimienta, 2007). Table 3.1 shows the software applications selected for each of the learning areas identified for the Dareecha Project.

Table 3.1: Software Applications Localized in the Dareecha Project

Functional Area	Learning Area	Software
General ICT usage	Basic computing	Operating System
Information access	Web browsing	Urdu SeaMonkey Navigator[5]
Communication	Emailing	Urdu SeaMonkey Mail & Newsgroups[5]
	Instant messaging	Urdu Psi[6]
Content development	Word processing	Urdu OpenOffice.org Writer[7]
	Graphics editing	Urdu OpenOffice.org Draw[7]
	Webpage development	Urdu SeaMonkey Composer[5]

In addition to the software listed for the training program, the computers also had additional general use software installed including anti-virus software etc.

[5] www.seamonkey-project.org
[6] www.psi-im.org
[7] www.openoffice.org

Using open source software allowed flexibility for the project team to take over the localization as Urdu versions were not available. This was done by a team composed of researchers with Urdu language and computer science backgrounds. These collective language and technology skills greatly assisted the localization process. SeaMonkey Internet suite, OpenOffice.org office suite and Psi were localized through this process and used for the Dareecha training program. Figure 3.2 shows the localized version of OpenOffice.org Writer. All menus and dialogue boxes are in Urdu. The software localized for the project is available through the Dareecha website at www.panl10n.net/dareecha/ or through the PAN Localization Project website (www.PANL10n.net). See Appendix F for further details regarding the localization related challenges in the project.

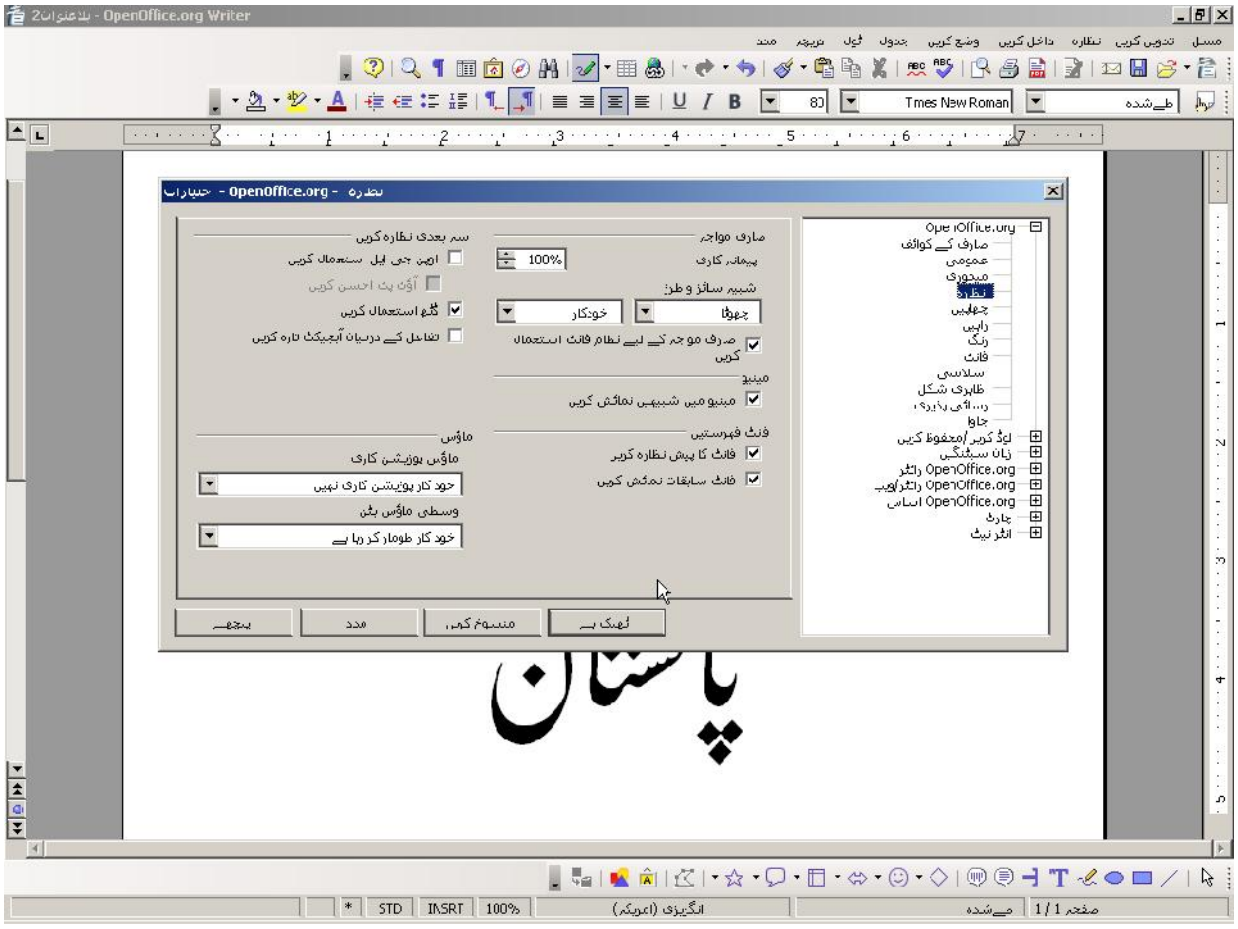

Figure 3.2: OpenOffice.org Writer Localized in Urdu

3.3 Training and Assessment Material Development

To effectively conduct the localized ICT training for rural school students, the training materials were also developed in Urdu and customized for students of both genders. The materials include books, slide shows, practice exercises and assessment tests. All this material has been derived from the competency levels developed for each learning area, as described earlier.

These materials were developed through the collaborative efforts of the linguists and technical personnel of the project team. The entire team was involved in the planning phase for each item, to ensure a balanced perspective from both the technical and non-technical perspectives. An initial outline and table of contents was authored by the linguists to ensure that it was not developed from a technical perspective, and finalized after reviews by technical personnel. Once the materials had been planned, its writing and production was done by linguists in the team, who are fluent in Urdu, to ensure that the content produced was easy to understand for new users and not overly technical. The drafts underwent several reviews by researchers from both technical and linguistic backgrounds to ensure correctness and completeness. This review process ensured that the material produced was technically sound and easily understandable.

Seven training books (one for each learning area) were published by the Dareecha team[8], to be used for the training of both students (girls and boys) and teachers (men and women). As students were the primary focus of the training program and the teachers were being asked to facilitate, the books were designed around the needs and context of the students. Copies of the training books were freely distributed to all participating children and teachers through the schools. Though the initial plan was to hand the books over to the students, after discussing with the schools, the books were given to the school library and then checked out to the students for their use. This enabled the schools to get the books back and use them for training subsequent batches of students.

Figure 3.3: Dareecha Training Books

These books, shown in Figure 3.3, are available for free download under the Creative Commons License at www.panl10n.net/dareecha/.

[8] Designed based on learning areas and arranged in the colors of the rainbow.

Lecture presentations and slides were also prepared along with the books, for use during the training sessions. Examples and practice exercises used during and after the training sessions were customized for boys and girls. For example, in training sessions conducted at girls' schools, topics that were found more relevant for school girls were used. These topics were determined through training activities and informal discussions held with participants during a pilot training session during the planning and development phase. All presentations developed for the training program are available at www.panl10n.net/dareecha/ under the Creative Commons License.

Tests were also developed for the practice and assessment of the students, and were identical for male and female students. At least one exercise question was developed corresponding to each competency level. This resulted in development of practical as well as theoretical exercises that were used throughout the training program to keep the students involved. Assessment materials were developed in the form of ICT literacy tests, which also served as a quantitative evaluation tool to determine the technical competency of the training participants. Three types of tests were designed and developed for each learning area as described below:

1. **Pre-training test:** to be taken by students before commencement of the training for a particular learning area. The result of this test was taken as a baseline for the initial competency.
2. **Post-training test (short term):** to be taken by students immediately after the end of training on a particular learning area (possibly on the same day). The results from this test were used to measure the extent to which the learning area was mastered by the participants.
3. **Post-training test (long term):** to be taken at the beginning of the next training (approximately two months later). The results from this test measured the long term retention of the concepts taught during the training sessions and the effectiveness of the practice sessions coordinated through the teachers at each school during the two months since the training.

The practical aspects of the progress of students were also gauged through exercises conducted during the training, and qualitatively assessed. More details of both qualitative and quantitative assessments are discussed in the next sections.

3.4 Training Team Composition

Training teams for both boys and girls were composed of two trainers each, one specializing in the Urdu language and one in technical matters. As described earlier, these Urdu language experts were the primary authors of the training materials, and the technical personnel participated in the design and review. This composition ensured that the training sessions would also be conducted primarily in Urdu[9] (avoiding unnecessary technical terminology in English) and would not be overly technical in nature and thus easier for the students to follow. As the language experts had been part of the software localization, the training material development process and the subsequent reviews, they

[9] These trainers were encouraged to communicate in Punjabi if needed.

were quite well versed in the necessary technical aspects of the training. Also, they were able to coordinate well with the technical staff as they had been working together through the program.

As these schools are not co-educational, to address gender relevant concerns it was ensured that the training team going to the girls' school was comprised of female trainers and the training team going to the boys' schools was comprised of male trainers. The training teams for girls' schools and boys' schools worked in parallel, as these schools were located near each other in each of the five locations selected.

A project evaluator regularly accompanied both teams, devoting time to each location to gather qualitative and quantitative data for monitoring and evaluation. The evaluation staff was also a female, to ensure access to both boys' and girls' schools (as the boys' school would allow female staff but girls' schools would not allow for male staff, to visit and interact with the students. In addition, these teams were also sometimes accompanied by management staff, for discussions with school and district administration and for monitoring purposes.

3.5 School and Participant Selection

As public schools were involved, the school headmasters and headmistresses needed the permission of the Department of Education of Punjab. To seek this permission, initially the provincial headquarter was contacted. However, this process was found bureaucratic and time consuming. As an alternative, the district authorities were directly contacted, and they were found forthcoming for this collaboration. This resulted in an initial contractual agreement with the district of Sargodha in Punjab, whereby eight schools (a girls' school and a boys' school each, at four locations) were nominated to participate in the training program. These schools were located in the Tehsils of Sarhodha (L1), Bhalwal (L2), Sahiwal (L3), and Silanwali (L4). In addition, contracts were signed with the districts of Chakwal and Attock (L5) to add additional geographic diversity; these districts nominated a boys' and a girls' school respectively, each located near the other. Thus, ten schools participated in the Dareecha training program at five locations, with a boys' and a girls' school at each location. All of these schools were in very rural settings, indicated in part by the fact that a major national courier services does not deliver at any of these locations[10]. A complete list of schools is given in Appendix B.

[10] This was discovered when project material had to be shipped to these locations. Eventually, the project staff carried the material when they traveled to these locations for training the students.

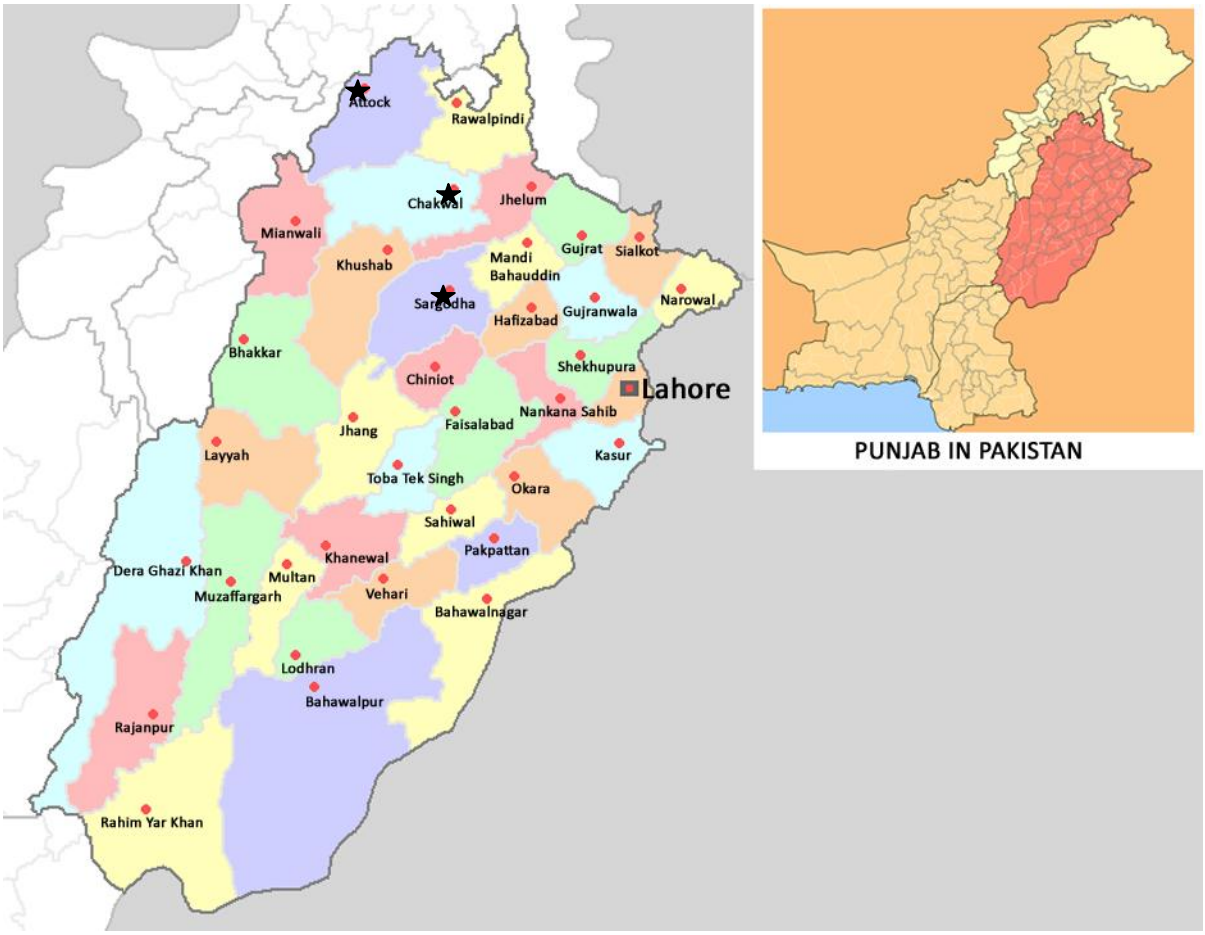

Figure 3.4: [11] **Locations of Districts of Sargodha, Chakwal and Attock, and Project Secretariat at Lahore, in Punjab, Pakistan**

There were three main motivations behind selecting a pair of boys' and a girls' school in the same locations. First, and foremost, it would not have been feasible to have the women trainers travel alone to these locations, even though they were traveling to conduct training in girls' schools, due to cultural constraints. Having girls and boys schools within easy access of each other allowed female trainers to travel with their male colleagues to these rural locations from the project secretariat in Lahore, and to stay at the same locations. The female trainers conducted the training in the girls' schools and the male trainers conducted the training in the boys' schools, in parallel. Second, this also ensured that the girls and boys participating in the training had the same or similar social and cultural contexts, making the comparison of data across gender less biased on such factors. Finally, this also enabled the secretariat to reduce the costs of lab setup, training and evaluation as physical locations were reduced from ten to five communities.

[11] http://en.wikipedia.org/wiki/Punjab,_Pakistan

As this was a pilot project to research into literacy, language and gender factors, the first step was to choose the level of students for the target group. The aim of the program has been to investigate challenges for developing ICT literacy skills to a level where the participating students can develop their own online content. As sixth and seventh grade students are young, they were not considered as suitable as older students to develop meaningful online content. Among the rest, eighth grade children were selected, because of multiple factors. First, eighth grade students have more time to spare for extra training, versus students in ninth and tenth grades, because the latter students are generally more focused on the Matriculation examination, and find it harder to spare the time. Second, eighth grade students are in the school for three years before they join a higher secondary school, and thus the project can follow-up to review the longer term impact with these students. Finally, if they develop an interest in this area, based on their exposure to ICTs during the program, these students have the opportunity to opt for IT as a subject in the following year in the ninth grade, adding to the sustainability of the intervention.

Though the limit was 14 students (two students per computer in the lab), in most cases all students enrolled in the eighth grade at these schools were accommodated. In one of the schools, where the number of students was almost double, the training sessions were repeated twice daily to accommodate all the students.

To support the program during its implementation and to keep it sustainable beyond the funding duration, school teachers were also trained. Totter et al. (2006) identify openness to change, willingness to collaborate and constructivist teaching style as three positive characteristics to consider for teachers in such contexts. Headmasters and headmistresses were asked to consider such criteria. It has been observed that the school-heads preferred nominating teachers associated with science subjects, e.g. Mathematics, Physics, Biology, etc., even though there was no such stipulation by the project. Most of the teachers available had none or minimal prior experience in using computers. These teachers were given a small stipend to acknowledge their extra effort and contribution. It has been easy to attract both institutional support and teacher interest in setting up the labs and conducting the training as ICTs are increasingly considered important for further success, and thus have a high degree of appreciation in Pakistan, as also observed by Pernia, (2008).

3.6 Lab Setup and Maintenance

None of the participating schools had a computer lab. Therefore computer labs have been setup through the Dareecha training program. The Lab setup at each of the ten schools included a network of eight refurbished computers (with one setup as a server), a printer, a scanner, a pair of speakers and head phones. Special keyboards with Urdu characters printed along the English alphabet were acquired separately and also distributed with the computers; an absence of Urdu letters may have had adverse effects on literacy (as also pointed out by Hall et al. (2009)). Internet connectivity was provided through PTCL local loop service. External antennas were installed as these were remote locations and required the signal to be amplified to enable proper

communication. The set up also included furniture for the equipment and to seat twenty people. To contain the cost, refurbished computers were acquired, which had sufficient processing power to perform the tasks undertaken through the program[12]. Details of lab equipment deployed are given in Appendix C.

Figure 3.5: Computer Lab Setup at the Govt. Girls High School Bhalwal by the Dareecha Project

The project encouraged the schools to make these labs available for general use for all students, to encourage experimentation and ICT literacy beyond the students participating directly in the program. Developing the labs also addressed the sustainability of this training program.

Lab setup for each school was carried out shortly before the training sessions started, by one of the technical team members. Nominated teachers were requested to work with the team member during the process so that they could learn some of the skills they would need to maintain the lab. The first training phase for teachers also included a specific session on hardware and lab maintenance, during which all teachers were also provided with handouts with a step-by-step guide for them to diagnose and fix common problems. The project team also devised a plan to provide support over the telephone or through email.

However, as mentioned earlier, the teachers available at the schools had little or no exposure to computers. Therefore, a lot of the times, especially during the start of the project, the only solution was for a project team member to physically visit the school to diagnose and fix any software or hardware related issues. It was noted that due to inexperience, teachers found it difficult to diagnose problems even when support was provided over the telephone. An illustrative example is of a teacher reporting over a telephonic conversation that "the server is crashing continuously", but the problem turned out to be a loose power cable, and was fixed simply by plugging it in tightly.

[12] The cost of setting up each lab, including equipment, furniture and networking, was about PKR 100,000 (USD 1600 approx.).

Another interesting example is a teacher calling in a member of the support team and reporting that she was unable to connect to the Internet. After multiple detailed walkthroughs, which kept resulting in failure, the team member discovered that the caller was using the same telephone line for calling that was providing the dial-up Internet connection to the lab. The problem was solved when the teacher was instructed to end the telephone-call and repeat the same procedure.

These problems were alleviated after a few schools took the initiative and identified experienced people from within their community who were able to provide limited support. The same types of problems, as described above, were solved more easily with such onsite support. These volunteers were sometimes able to provide a solution on their own and at other times after consultation with a project team member over the telephone.

Through this process, the teachers gradually gained experience and the project team incrementally improved the technical support documents provided to the teachers at the start of the program. So, by the end of the training program, teachers are now much better equipped to manage and maintain the school labs as compared to their capabilities at the start of the training program.

Schools were provided with replacements if there were any equipment problems during the course of the training program. The item most replaced was the power cable, perhaps due to the nation-wide electricity supply problems (power cuts, fluctuations in voltage etc.) at the time of the training program. More robust power cables, custom-made for local context, could have provided a better alternative. The computers provided were refurbished, but there was no failures reported, except one monitor and one motherboard out of the 80 computers deployed, from the initiation to the end of the training program.

3.7 Training Plan

The training sessions commenced after the lab setup in each school, and spanned the period of a year starting from September 2008. The training program was organized and executed in three phases. Each phase was focused on 2-3 learning areas, as listed below. As Callister (1992) points out "if the teacher does not know what to make of the tool, or fears it, or misconstrues its uses, it will be used badly or not at all." Thus, each phase started with a teacher training session for all the nominated teachers from the participating schools at a single location at Chak 88 Boys' School in Sargodha. A single training event was organized for three full-days for each phase. This teacher training was a cornerstone of the Dareecha effort because this prepared the teachers to act as facilitators during the subsequent student training sessions at their respective schools and for the interim two months between the three training phases. The teacher training sessions included training on functional areas that the students would be learning, and some additional areas, for example, lab maintenance.

Training was then repeated for students at each of the participating schools by the Dareecha Project team. As the students had to attend the training along with their regular course work, each session was arranged for three hours each day, spread over five days.

1. **Training phase 1**
    a. Basic computing
    b. Web browsing
2. **Training phase 2**
    a. Email
    b. Instant messaging
3. **Training phase 3**
    a. Word processing
    b. Graphics editing
    c. Webpage development

The training was planned within the premises of each participating school to ensure participation of the students, especially the girls. The complete training schedule is given in Appendix D. Detailed training plans for all sessions are available at www.panl10n.net/dareecha/.

Figure 3.6: Govt. Boys Higher Secondary School, Chak 88, Sargodha

The training sessions were designed to be interactive and to enable participants to get the maximum possible hands-on time for practical exercises on the computers under the supervision of the trainers. Student assessment was carried out throughout the training sessions using the ICT literacy tests designed for the program. The sessions were also interspersed with frequent, simple competitions designed to keep the training sessions exciting and the participants motivated. For example, during the web browsing training session for teachers, after a brief introduction to the concept, teachers were asked to search online for the cost of an Internet connection provided by a

local ISP, and the teachers who found the information first were declared the winners. Simple prizes (books, stationary items etc.) were also distributed during such competitions.

Figure 3.7: Students at Govt. Girls High School Bhalwal Practicing during Training

3.8 Evaluation

The Dareecha Project was evaluated primarily to research the following three issues:

1. Effectiveness of the project in raising the digital literacy of the participants
2. Impact of the language in which ICT training is provided
3. Gender differences in adoption and use of ICTs by rural school students

The project evaluation team followed a comprehensive evaluation methodology to seek answers to these questions. The core approach was based on Gendered Outcome Mapping (Shams et al., 2010), complemented by other methods. Specific indicators for each evaluation question were identified and monitored for quantitative analysis and semi-structured individual and group interviews were conducted to gather qualitative data, to form the final results. Specific research techniques and tools employed for each evaluation question are detailed in the next sections. A longitudinal study was conducted, spanning over the period of a year, starting from the time when the participating schools were selected, and ending after the website development competition, from Sept. 2008 – Aug. 2009. Though more students participated, 14 students and two teachers from each of the ten schools (five boys' and five girls' schools) were selected for evaluation purposes. The data presented in the following chapters is from these 140 students and 20 teachers, unless otherwise specified.

Figure 3.8: Govt. Boys High School Chak 152 NB, Sillanwali, Sargodha Team (Joint Winners of the Community Website Category) Receiving a Trophy

4. ICT Literacy

The need [is] to focus on the teacher and the learner and not the technology
- Earle (2002)

The fundamental challenge of the Dareecha Project has been to develop the ICT literacy of the students and teachers enrolled in this program. Thus, for the purpose of evaluation, the project team measured the capability of the participants in the four functional areas of general computer usage, information access, communication and content development.

The planning started with a Gendered Outcome Mapping (OM^g) (Shams et al., 2010) analysis of the project. OM^g framework, developed by the PAN Localization Project, is an analytical tool extended from Outcome Mapping (Earl et al., 2001), to effectively plan, monitor, and evaluate development projects, with a focus on gender. The uniqueness of the framework is in its strength to demonstrate how the project has contributed to changes in the capacity and behavior of the project *Boundary Partners*[13], allowing explicitly to plan and monitor from a gender perspective. The planning included defining the *Vision* and *Mission* of the project for the project stakeholders, called *Boundary Partners* which the project wants to influence. The desired change in behavior is captured through *Outcome Challenges*. For monitoring and evaluation purposes, this overall change in behavior is sub-divided into graded steps, called *Progress Markers* which are defined for each *Boundary Partner* in three categories: Expect-to-See, Like-to-See and Love-to-See. The overall plan also includes *Strategy Maps* for the project, to specify how to achieve the desired outcomes of the project. These aspects are further elaborated in Appendix E. For further details of these steps see Earl et al. (2001) and Gul et al. (2010). Based on OM^g framework, the following section elaborates the data collection methodology using different tools and also illustrates the process of rating the Progress Markers using the Outcome Journals (Earl et al., 2001).

4.1 Expect-to-See Progress

During the five day training sessions held at each school, attendance during the training was recorded to gauge the regularity and willingness of participants to acquire ICT skills. This data was used to rate the expect-to-see Progress Markers of the program. Table 4.1 presents this attendance data for the students combined for 70 male and 69 female students (14 male and 14 female students at each of the boys' and girls' school; one boys' school and one girls' school at each of the five locations).

[13] Those individuals, groups or organizations with whom the program interacts directly and with whom the program can anticipate some opportunities for influence (Earl et al., 2001).

Table 4.1: Attendance Summary of Students at the Five Participating Locations for the Three Training Phases

	L1	L2	L3	L4	L5
Phase 1	100%	100%	100%	96%	99%
Phase 2	93%	82%	96%	93%	97%
Phase 3	93%	93%	93%	96%	100%

As evident from the results above, students regularly attended all the training sessions held at each of the five locations. On average, the attendance remained above 90% at each location during the three training phases. Thus, a high rating was given against these Progress Markers.

A detailed daily observation form was used to record the evaluator's observations regarding the performance of the trainees during the training sessions. This form was used to record observations such as the number of drop-outs from the training program and reasons for dropping out, interactivity of the training sessions, i.e. if the students or the teachers were asking or answering questions during the training, any technical difficulties in understanding the training lectures etc. The project evaluator would also seek input from the project trainers while filling in these observation forms. These observations were used to monitor and improve the training, and to rate progress along the Progress Markers, e.g., for the last two expect-to-see markers for the female students given in Table E.1 of Appendix E.

4.2 Like-to-See Progress

As discussed, ICT literacy tests were designed and conducted by the project team to gauge progress against various competencies for each learning area. The test scores were used to ascertain the progress, e.g. for Progress Markers 4-10 in Table E.1 of Appendix E. Results of the pre-, post- (short term) and post- (long term) test scores were used to quantitatively analyze the performance in each of the four functional areas: computer usage (using results from the basic computer usage learning area), content access (using results from the Webpage browser learning area), communication (using results from the Emailing and Instant messaging learning areas) and content generation (using results from the Word processing, Graphic editing and Webpage development learning areas). Figure 4.1 presents the average score achieved by 139 eighth grade students (70 male and 69 female) in these functional areas.

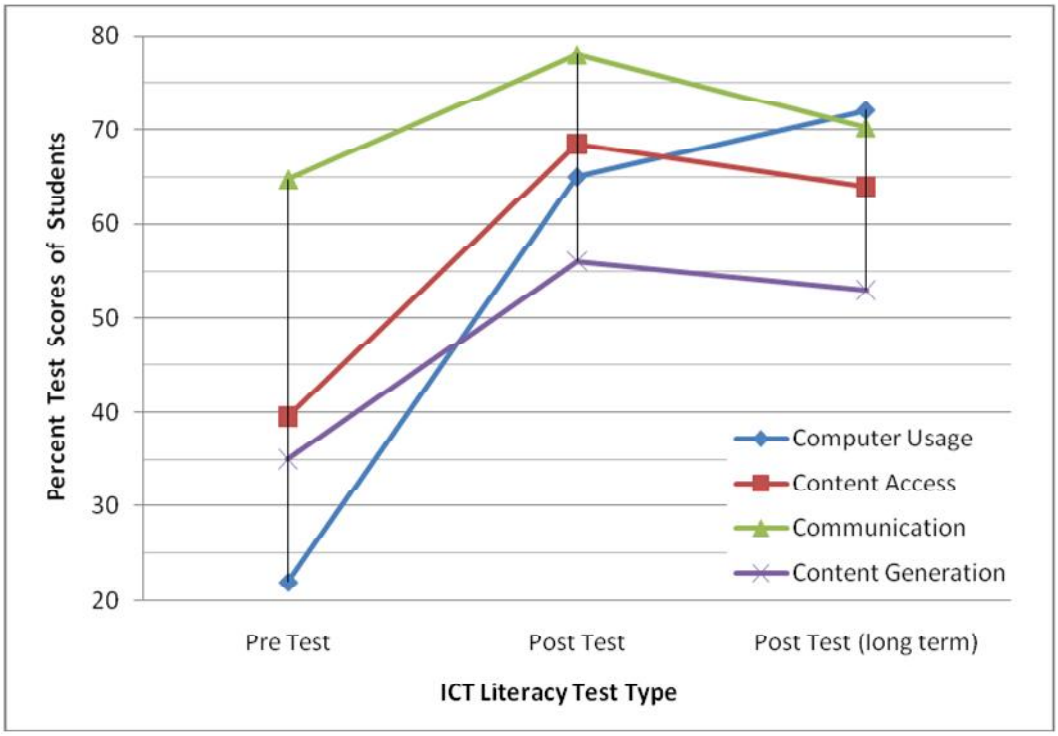

Figure 4.1: Development of ICT Literacy of Students in the Four Functional Areas

The figure shows that the ICT literacy training helped raise the capacity of the school students in each of the four learning areas. Generally it was observed that the scores achieved by students during the training sessions were very high compared with the pre-test results. This was because the students were not aware of ICT tools beforehand and the training provided them with the new technical knowledge. The most significant increase is observed in computer usage where the results show an improvement from 22% to 72%. Another significant increase is observed in Content Access.

There are relatively high scores in pre-training test results for Communication. The key reason is that the preceding training on Content Access had already familiarized the students with using web applications, which were also being used for the Communication functional area, e.g. web-based email and chatting tools, thus raising the baseline.

The results depict a slight drop from the acquired capacity in the post-training (long term) test results which were conducted after a gap of two months. This was anticipated because, even though the students were using the lab facilities, they could not use them as regularly and with as much supervision as during the training program. Therefore, they tended to lose some of the breadth of theoretical and practical knowledge acquired, and only remembered what they had been practicing. Shortage of electricity supply in schools also presented a challenge not just for the training but to

keep students involved over time, as frequent electricity failures in rural areas kept them from using the labs in the little free time they had while in school.

Figure 4.2: Teachers using the Trainer's Laptop for Practicing during Electricity Breakdown

The project built in extra activities to keep the students engaged during this time between training sessions, by handing out practice materials and holding online competitions via email and chat sessions. This contributed to their retaining skills over time. During the evaluation their participation was also used to monitor remaining like-to-see Progress Markers. A competition record was maintained to document the actual number of students who were participating in the competition after the training had ended. The following graph presents a comparative picture of the participation of both girl and boy students at each of the five locations.

In addition to helping the students remain involved in the training, these competitions also served as an effective tool for offsite monitoring of these school students. For example, as indicated in the graph above, when there was no participation indicated in Competition 1 at location L3, the respective girls' and boys' schools were approached by the project team, to investigate the reason. Upon enquiry, it was found that one of the school teachers trained at the girls' school had been transferred to another school, while the other had left on medical leave. Therefore, the students did not have a resident local trainer in their school and the computer lab was closed. As a response, the Dareecha team approached the school administration and requested them to nominate two new teachers for the program so that the lab facility could remain open for the school students, ensuring their participation in future competitions and other project activities. On following up with the boys' school at L3, no concrete reasons were found except just general reluctance to open and utilize the

lab. Thus, these interventions allowed effective monitoring and ensured that the team could proactively intervene, mitigate and resolve any issues when needed.

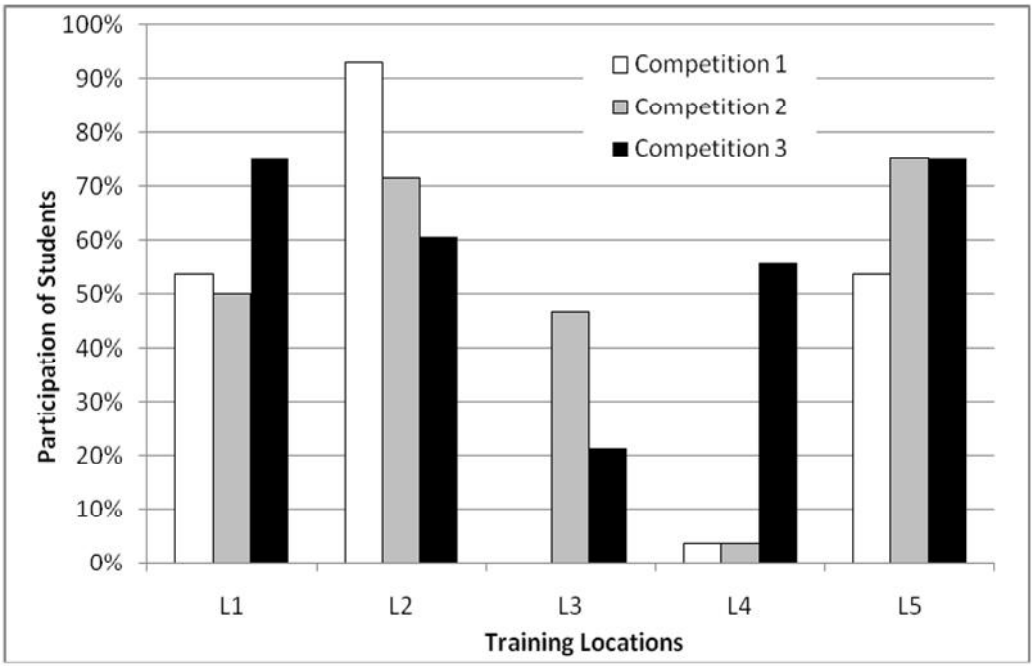

Figure 4.3: Participation of Students in Online Competitions between the Training Sessions

4.3 Love-to-See Progress

Love-to-See Progress Markers focus on larger and longer term impact, e.g. on sustainability, institutional and environmental influence. Qualitative data from end-users was gathered during the training sessions through face-to-face interactions between the project evaluator and the trainees to gauge this change. The interviews were used to gather feedback on the training program including the program design, level of comfort in using the software, etc. Such onsite interviews were also conducted with other stakeholders and used to rate love-to-see Progress Markers. The overall results showed an enthusiastic response from participants, demonstrating their eagerness to share their knowledge with others, building on what they had learned for school work, and also voicing requests for continued training.

Propagation of the ICT training and knowledge formally or informally beyond the people trained directly through the program was one of the aspects which was investigated. There were some very encouraging instances. Some students in the Chak 88 Boys' School started teaching the same course to other senior and junior students in school for a small fee during the three month summer vacation. Several students also mentioned teaching siblings at home informally. Some cases were noted in schools where students would bring siblings along with them to attend the training sessions. In addition, knowledge from the training sessions also trickled outwards towards the communities, with the Maluwala Girls' School setting up an identical training program for

community women, where participants were tested after training and formal certificates were issued by the project on their request, with the training program logistics and training being wholly organized by the school.

It has also been noted that many students and teachers have started using the lab for their routine work. For example, some Chak 88 Boys' School students had searched the web to find information for an essay on Muslim scientists for their regular studies and had found online information about Eucalyptus trees for a competition on the environment organized by the district. Chak 88 Girls' School teachers shared that they had started using the computers for developing the school budget. Staff in several other participating schools started using the lab facilities to develop and print out notices, applications and other official documents. For example, the teachers at the Girls School in Attock have been regularly printing and distributing the board results to students and other schools in the region, as these results become available online before they are published in the gazette.

Interestingly, many male students showed commitment by acquiring computers of their own. The project trainers received queries from up to 20 students regarding suggestions on the type of computers they should buy. Several requests for software were also received for installation on home computers. In addition to the request for software and advice on hardware, the project also received additional training requests, e.g., on spreadsheet software. A female student even expressed interest for further training explaining that she would like to develop a business venture around this area of work.

A large majority of the participants took part in the content development competitions and provided very competitive websites with significant original content. Much of this content is related to their local communities and is not available online. This was definitely not an anticipated outcome of the program, and certainly not to the extent of the quality and quantity of content which has been developed, and suggests very promising possibilities for the future. This is supported by independent reviews from the distinguished panel of judges, one of whom summed up the effort as "Excellent! Excellent! Excellent!"[14] These examples show that given the opportunity, students and teachers had the motivation and capacity to learn new technologies, and pro-actively take the learning forward.

4.4 Overall Outcome

Nine instances of Outcome Journals were recorded separately for female and male student Boundary Partners and seven instances of OJs were recorded for female and male teachers, using the evaluation tools mentioned above, and as discussed in Appendix E. The quantitative data was collected for the 140 students and 20 teachers who participated in the program. The same participants were sampled for gathering the qualitative data. Each journal was then quantified as per the process defined by Outcome Mapping framework. Comparing these values for the OJs would

[14] Comment by Mr. Ahmad Nawaz, General Manager, Punjab IT Board, Govt. of Punjab, Pakistan.

represent changes in capacity of each Boundary Partner over time. The optimum value for an OJ is 100. However it must be noted that this value is intended as a relative measure of change, and must be interpreted in context of its preceding or following OJ values for the same Boundary Partner[15] , and is only an indicative measure of change in behavior. The results indicating ICT capacity development for each Boundary Partner, as synthesized through OJs, are given in Figure 4.4.

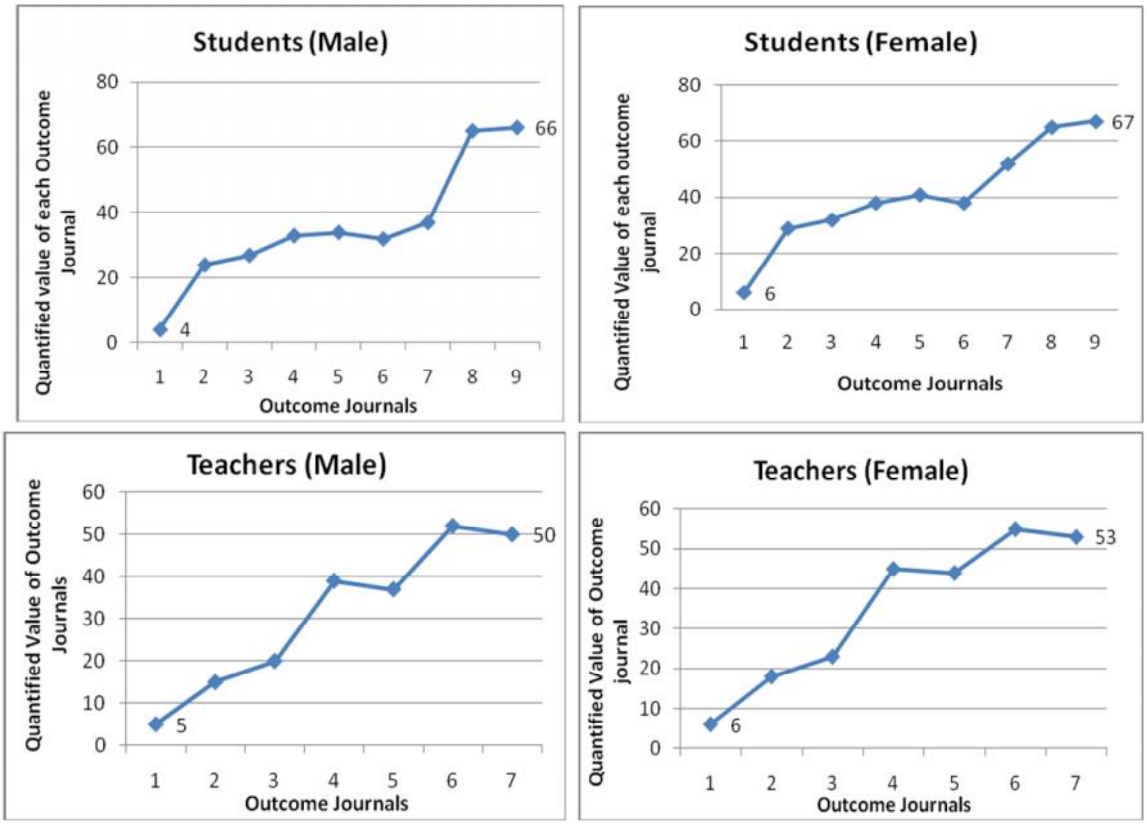

Figure 4.4: Trendlines Depicting Change in the Behaviour and Capacity of the Boundary Partners during the Dareecha Project

The graphs show significant positive change in each of the four Boundary Partners. Female students steadily progressed from an aggregate value of 6 to 67, and a similar trend noted for male students who progressed from 4 to 66. Female school teachers started at 6 and graduated to 53, while scores for male teachers went from 5 up to 50.

These results are based on the Progress Markers, similar to the set for female students given in Table E.1 in Appendix E, and show that the training was able to significantly change the behavior of the students, but to a lesser degree for the teachers. This is also confirmed through interactions during

[15] See Earl et al. (2001) for details about how monitoring progress against the Progress Markers may be translated into quantitative OJ data and how it may be interpreted.

the training, where it was evident that the students were more active and receptive and were quicker learners compared with their teachers in ICTs.

Anecdotal evidence also substantiates this capacity improvement. Rural school students, who were trained to use the Internet to search for required content, were researching supplement materials to prepare their school assignments. Some students had mastered the document processing tools to an extent that they were preparing curriculum vitae for themselves and their peers, using Open Office tools. Similarly, some school students were connecting to their relatives living abroad through emails and instant messengers.

As well, the rural school teachers were utilizing the acquired ICT skills in performing their administrative tasks. Upon their own initiative, teachers prepared their annual school budget, daily time table, and student results, using these tools. In addition, the official documents such as letters, memos, applications, notices, etc. were also being prepared using the ICT tools learnt through the program. A few teachers were even found complaining that the newly acquired skills have increased their work load because now they are being asked by school principals to type official letters for communication with the education department.

The Dareecha Project was thus effective in meeting its prime objective of improving the ICT literacy skills of the students and teachers enrolled in the program. As evident from the segregated and cumulative qualitative and quantitative data presented, the project was successful in building the capacity of the project trainees in computer usage, content access, online communication and web-content creation.

5. Language and ICT Learning

[U]sing the learner's language goes a long way toward resolving many of the access and quality issues [in education]
-UNESCO (2008)

Different activities were planned and executed to gauge the influence of language on the four learning areas, including basic computer skills, accessing information, communicating and generating online content. As competence in language of instruction is a pre-requisite to learning, activities were also conducted to gauge the general competence of the participants in English and Urdu languages for reading, writing, understanding and retaining academic or extra-curricular information.

5.1 Language Preference for Software and Training Material

Both software and training materials are generally available in English. The current project also made both available in Urdu. An opinion survey was conducted twice during the Dareecha program to document the preference of the participants for English or Urdu versions, once at the start of the project and once at its end. The survey asked for student and teachers to choose among the following options:

1. Both the training materials and software are in English
2. Both the training materials and software are in Urdu.
3. Software is in English and the training materials are in Urdu

The fourth choice was not presented, because if the software is in Urdu, training materials in English were not considered viable. There were 139 respondents before the training and 136 respondents after the training. The results of the survey from male and female students across the ten schools are given in Table 5.1 below and depicted in Figure 5.1 (as percentage of respondents on the vertical scale).

Table 5.1: Preference of Language for Software and Training Materials for Students

	Software		Training Material	
	# Students Before Training	# Students After Training	# Students Before Training	# Students After Training
Preference for Urdu	90	106	128	129
Preference for English	49	30	11	7

When surveyed at the beginning of the project, an overwhelming 92% of students opted to receive training materials in Urdu language. However, a much fewer 65% preferred to have the computer software in the Urdu language. It is interesting to note that, when the same group was surveyed again at the end of the project, though about the same number of students (94%) wanted to receive the training materials in the Urdu language, a much larger number, 78.5% wanted software in Urdu.

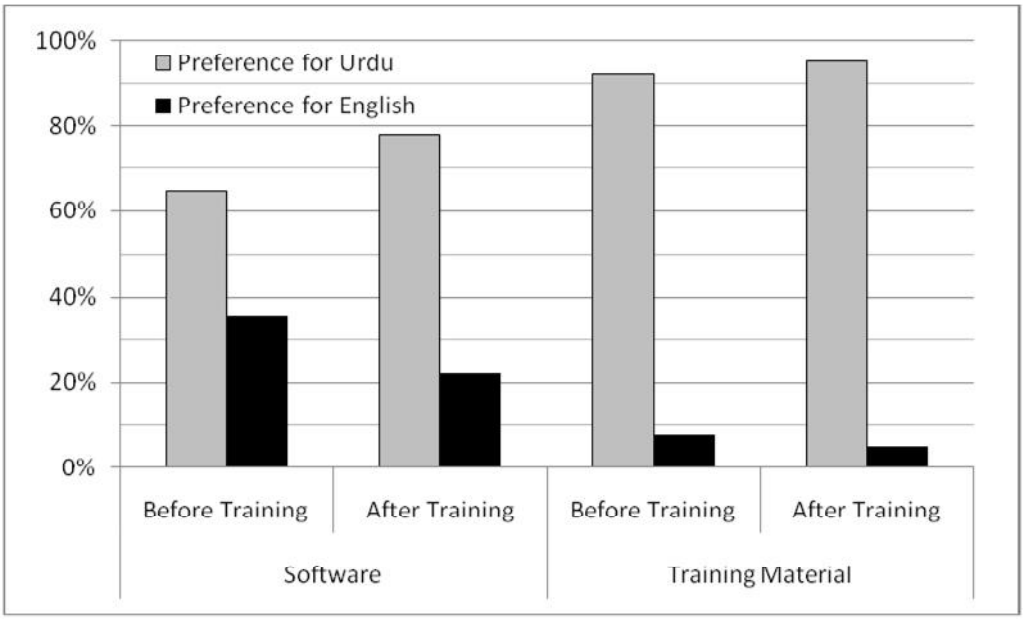

Figure 5.1: Preference of Language for Software and Training Materials by Students (based on Table 5.1)

When asked during the training sessions, students affirmed that, "Because Urdu is our national language, and we use it more often at home, therefore it is easier for us to understand written material in Urdu language as compared to English." In another instance, the students revealed that, "We may be able to understand text in both English as well as Urdu language; however, it takes more time to understand and retain the same in English than in Urdu."

More students opted for having computer software in Urdu after the project training, because they had earlier thought that computers could never be available in Urdu, therefore they had indicated an English language preference. However through the training, when students saw a computer interface available in Urdu language, and its ease of use, they changed their opinion.

The teachers were also asked what language they preferred for interface and training materials. Based on responses from 18 teachers before and 17 teachers after the training, Figure 5.2 shows that rural teachers, like the students, consistently opted to have the training materials in Urdu. Moreover, though initially a higher percentage (67%) opted for software in English, as with the students many

of the teachers (14%) switched their preference to an Urdu interface after the training, with at the end 47% of teachers wanting the software to be in Urdu as well.

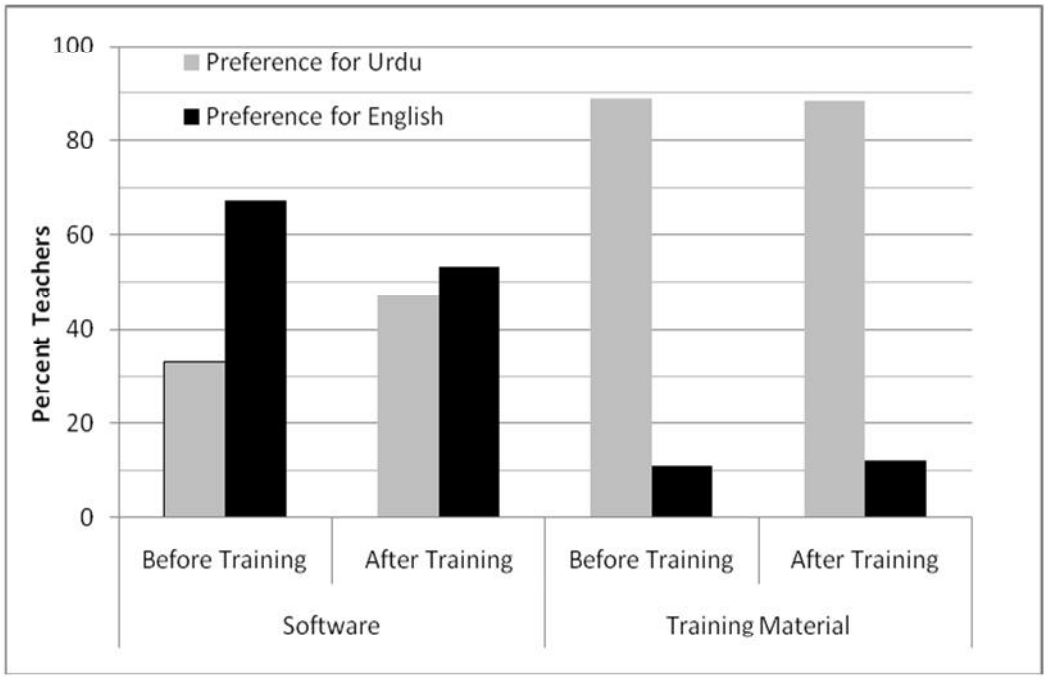

Figure 5.2: Preference of Language for Software and Training Material by Teachers

When asked about the reason for their selection, one of the rural school teachers mentioned that, "English is an international language and computers are used for worldwide communication, therefore computer programs must be in English language." However, when the same was asked from teachers who had chosen an Urdu language interface for computer programs, they stated that, "We cannot understand a foreign language and comparatively, Urdu is easier."

During interviews with the Dareecha team, the school teachers further shared, that as the market demand is for people able to operate computer applications in English, the training should also be in English. However, they added that having learnt the applications in Urdu, it was now easier for them to graduate to similar software with an English language interface. Thus, these surveys substantiated a need for providing localized software and training materials.

5.2 Reading and Writing Skills in Urdu and English

Preference to use a particular language is dependent on competency in that language. Though it was evident during the team visits that the competence of the students and the teachers in Urdu significantly surpassed their competence in English, short exercises were still conducted to get some quantitative measure of this difference. To compare the reading skills of students in English and Urdu, a few students were randomly selected from participating schools and were individually

shown multiple error messages in either Urdu or English. They were asked to read through the error page and describe its meaning. This activity was informally done by a few students. Three of the four students were unable to understand the English message displayed on the computer. When asked why they could not understand the message displayed, students responded that they were unable to understand the words written in the error page, thus could not make out the meaning. Specifically they could not understand "operation timed out," "connection request," etc.

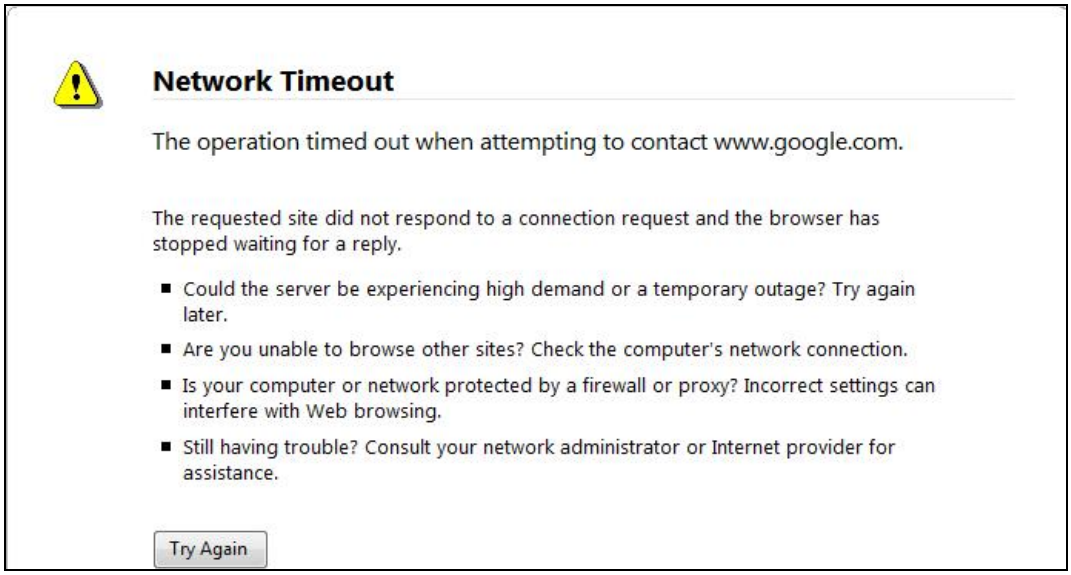

Figure 5.3: Sample Error Messages in English and Urdu

However, when the same screen was shown in the localized software, all students could understand what was written and were able to describe the page in their own words, e.g., saying, "I think the

Internet connection is disabled that is why this page is being displayed," which was a correct reason. One set of English and Urdu error messages used is shown in Figure 5.3. This reading activity is indicative of the fact that the students have better reading and comprehension capacity in Urdu compared with English; however it should be remembered that the sample size is quite small.

Comparative analysis of English and Urdu writing skills was also done by requesting students to compose a simple essay on "Me and My School" in both languages. The total number of mistakes including spelling errors and grammatical mistakes made by students in English and Urdu essays were recorded. Analysis of the essays reveals that though the number of spelling errors in English was only slightly higher, the grammatical errors in English are significantly greater in number compared to Urdu. Also, on average the students wrote 200 words in Urdu compared to 65 in English on the same topic during the same amount of time given for the exercise, indicating more difficulty in composition using English. These results are presented in detail in Table 5.2.

Table 5.2: Analysis of Essays Written in English and Urdu by Students

Gender	Number of Respondents (Students)	Total Words in Essay	Errors			
			Grammar	Grammar Normalized over Total Words (%)	Spelling	Spelling Normalized over Total Words (%)
English						
Female	65	4495	3016	67%	368	8%
Male	65	4012	1841	46%	532	13%
Urdu						
Female	65	14587	2046	14%	913	6%
Male	65	11373	1067	9%	990	9%

Average Urdu and English scores in Sargodha board Matriculation (10th grade) exams of the students[16] from four of these ten schools were calculated for the year 2009. The average Urdu score for 418 students was 54 out of 150, and average English score for these students was 40 out of 150. The scores, not surprisingly, further indicate that these students are much weaker in English than in Urdu.

5.3 Preference of Language for Technical Terminology

An experiment was conducted to determine preference of language for technical terminology used in the computer interface. During the training sessions, trainers introduced certain computer

[16] These students are one year senior than those who participated in the Dareecha program.

terminology in both English and Urdu. Later, the students were provided with questionnaires including pictures of different computer icons and asked to choose from one of the following four options: (i) Icon's name in English; (ii) Icon's name in Urdu; (iii) Icon's name transliterated from English into Urdu; and (iv) "Do not know". The sequence of choices was randomized to remove any bias based on their order. A short time was given to the students for response, to prompt for the option which they would prefer intuitively. This exercise was conducted three times during the project, once after every training session. Data was collected from 110 students. A total of 2099 instances of response were elicited from the students, of which 1347 were in Urdu, 330 in English, 333 in Urdu transliteration of English terms and 89 were left unanswered. Detailed data, segregated by gender, is given in Table 5.3 below.

There are two important deductions which can be drawn from these results. First, it is clear that students prefer using terminology in Urdu. Second, as there are almost equal number answers for English and English transliterated into Urdu, it indicates that the core issue is lexical vocabulary and not the script (English/Latin for former and Urdu/Arabic for latter) for recognition. The total, as percentages, is given in Figure 5.4.

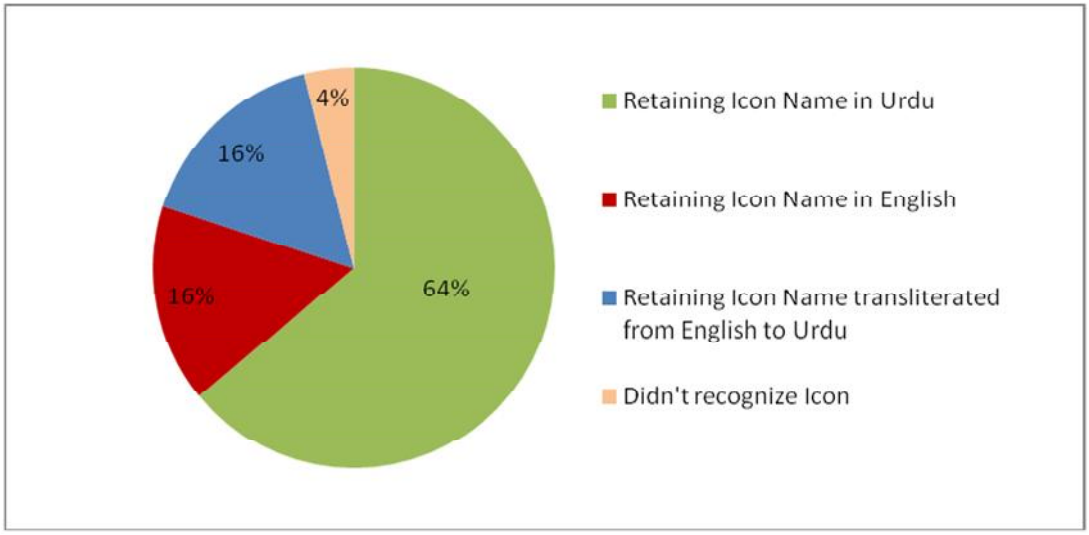

Figure 5.4: Student Preference for English and Urdu Terminology for Computer Interface

Table 5.3: Language Based Data on Identification of Computer Interface Icons by Students

Icons	Icon Identification by Students								
	Urdu		English		English Transliterated into Urdu		Didn't Recognize		Sub-Total
	F	M	F	M	F	M	F	M	
Icon 1	34	46	5	1	9	6	4	1	106
Icon 2	49	39	0	6	3	9	0	0	106
Icon 3	45	48	3	3	1	2	3	1	106
Icon 4	45	41	2	6	3	4	2	3	106
Icon 5	50	41	5	16	4	4	6	6	132
Icon 6	29	23	4	15	29	28	3	1	132
Icon 7	17	11	33	39	13	17	2	0	132
Icon 8	42	30	10	18	11	15	2	4	132
Icon 9	26	28	16	20	17	11	6	8	132
Icon 10	59	57	1	3	2	5	2	2	131
Icon 11	38	44	16	12	6	9	5	2	132
Icon 12	42	40	2	6	1	2	0	1	94
Icon 13	37	33	2	6	3	8	3	2	94
Icon 14	40	35	3	5	2	8	0	1	94
Icon 15	31	29	0	6	13	12	1	2	94
Icon 16	24	30	12	12	8	7	1	0	94
Icon 17	23	26	1	7	15	14	6	2	94
Icon 18	25	25	16	12	1	8	3	4	94
Icon 19	35	30	1	5	9	14	0	0	94
Sub-Total	691	656	132	198	150	183	49	40	2099
Total	1347		330		333		89		2099

5.4 Learning ICTs through Experimentation

A lot of learning in ICT is done through experimentation. Based on the Hole in the Wall project, Mitra et al. (2005) report that "groups of children can learn to use computers and the Internet on their own, irrespective of who or where they are." An activity was designed to investigate if the language of the computer interface contributed to the process of exploring and extrapolating for learning newer concepts. Fourteen students at each of the ten selected schools were divided into two groups (seated separately). Both groups were asked to draw a 3*3 table using Open Office

Writer after some initial training but before the students had been taught to perform this particular task. The first group was given an English interface of the software, while the second group used the localized Urdu version of the same software. In addition each group was given instructions with hints on terminology in English (for the group using English Interface) and Urdu (for the group using Urdu Interface). The task required students to explore the menus and complete the table development task in fifteen minutes.

The results demonstrated that when the students were provided an English interface for the software, 52% were able to complete the task either partially or completely, compared with 87% of the group using the Urdu interface. Another significant factor noted in the experiment was that it took less time to complete the task using Urdu software (on average 7 minutes) than using the English software (on average 11 minutes). It must be noted here that, even though both groups were unfamiliar with the task to be performed, there was a bias in this experiment in that the students were more familiar with the Urdu interface in general, having gone through training with that interface for the first three functional areas. This bias could not be controlled for. However, as the terminology to be used for the tasks had not been taught to either groups and there were hints to it in the instructions, the ease of use in local language is still a significant factor in the difference in performance across the languages.

5.5 Language Preference for Accessing Online Content

In addition to interviews and language competency tests to gauge the interest and preference for interface and training material in English and Urdu, experiments were also conducted to collect data on choice of language for content access, communication and content generation. Two different experiments are reported here, which were specifically designed during the training sessions to gauge the preference of language for accessing online content.

5.6 Searching for Information on the Web

This activity was conducted during the second phase of the Dareecha training. Students had already been trained to browse the web in the first phase of the training. In the experiment, they were instructed to search for the deadline for the submission of application forms for a local university. These instructions were given in writing, displayed on a screen using a multimedia projector, and typed in English as well as in Urdu. Prior to the activity, the team had made sure that the requested information was available online in both languages. While the students searched for the information on the internet, the evaluator recorded the number of students searching in English and in Urdu. The exercise was repeated at each of the ten participating schools. The results are given in Table 5.4 below.

Table 5.4: Language Preference for Searching on the Internet

Students	Language Used		Total
	Urdu	English	
Female	44	2	46
Male	45	2	47
Total	89	4	93

The results show that an over-whelming 96% of the students chose to search for the information in Urdu. When asked about the reason for searching in Urdu, the students responded that, "We preferred to search the answer of the query in Urdu language because it is difficult for us to read and understand English language. When we try to search content in English language, we usually do spelling errors." This response identifies two distinct problems with using English: first, the ease of comprehension of Urdu, and second, the difficulty in the query formation process in English.

5.7 Setting the Homepage

In a second experiment, the students and teachers were first taught the concept of, and method for, setting the homepage. During the training, the homepage was defined as the most frequently accessed and favorite website. Then they were introduced to two popular local news websites, one in English and the other in Urdu, and asked to set one of the two as their homepage. At the end of this activity the evaluator recorded the number of students and teachers setting the homepage for the Urdu news website and for the English news website. Among the 138 students and 18 teachers who participated in this activity, all of the students selected the Urdu news website as their homepage. A majority of the teachers, 13 out of 18, chose the Urdu website as their homepage as shown in Table 5.5.

Table 5.5: Preferred Language for Setting a Homepage

Participant	English	Urdu
Students	0	138
Teachers	5	13
Total	5	151

This data further establishes the preference of accessing information in Urdu for students and teachers alike. The preference is clearly much stronger for students.

5.8 Language Preference for Online Communication

Language preferred for online communication was also investigated by the Dareecha team. The team logged all written communication by the project participating students and teachers with the project staff and noted the language in which the communication was done. These communication

logs included academic, logistical and any other formal or informal queries and responses received by the team from the participants. Formal and informal instant messages received from the trainees were also included in these communication logs. The Figure 5.5 presents data from 1467 emails and 363 chats logged by Dareecha team from Nov. 2008 till Dec. 2009.

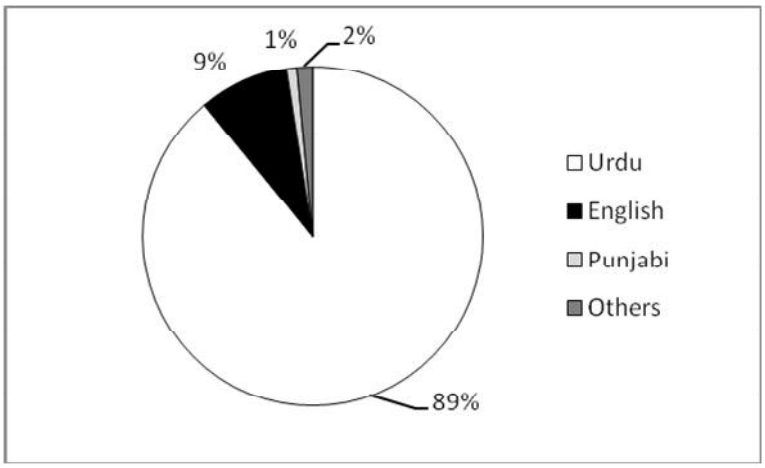

Figure 5.5: Online Communication in Different Languages by Students and Teachers

Data presented in the graph shows that 89% of the total online communication was in Urdu, 9% in English and 3% in other local languages, clearly showing the preference of Urdu for communication purposes. It was seen that even with limited support for formatting Urdu text in the localized text editors, the training participants enjoyed sending emails to Dareecha teams, and frequently wrote popular Urdu quotations, poetry and prose in their emails. Another important point to note is that when the communication was done in English, it was less expressive with grammatical and spelling mistakes, and often was following Urdu grammatical structure.

5.9 Language Preference for Developing Online Content

The Dareecha Project organized a fairly extensive website development competition at the end of the training, during the three month summer vacations in the schools. There were three categories of the competition, and winners were to be rewarded with handsome cash prizes, to ensure that the activity was taken with seriousness and dedication. Teachers trained in the program were asked to develop a website for their respective schools. Five top performing students in each school were grouped in a team to develop a website for their school. Other students not selected had the option to work on individual websites (based on local themes) on an individual basis. Students and teachers in each school were given explicit instructions that they could create websites in any language, and that the winners would be determined from the originality, quantity and quality of the content. The competition details and prize money was advertised before the competition started. A flyer developed for this purpose is given in Figure 5.6 below.

Figure 5.6: Flyer for Website Competition for the Dareecha Project

The websites were collected by the team and made available online and a panel of distinguished national senior ICT practitioners, academics and policy makers was put together to carry out the evaluation. The panel was impressed by the dedication and hard work put in by the teams of students and teachers. The websites and the details of this evaluation are available at www.PANL10n.net/english (see Output section for Pakistan). A sample webpage of the website developed by the student team of the girls school at 10 ML in Bhalwal is given in Figure 5.7.

Figure 5.7: Website by the Student Team of Girls School at 10 ML Village, Bhalwal

Although the motivation for organizing the website competition was primarily to encourage online local content creation, from the evaluation perspective the competition provided an important tool to analyze the language of choice for generating such online content. The data based on the entries received for the website competition is given in Table 5.6.

Table 5.6: Preferred Language for Setting a Homepage

Website Competition Category	Language of Website		
	Urdu	English	Total
School Website (by 10 School Teacher Teams)	9	1	10
Local Village Website (by 10 School Student Teams)	8	0	8[17]
Open Category (Individual Students)	38	0	38
Total	55	1	56

A total of 56 websites were received, of which one website was developed in English and 55 websites were developed in Urdu. This clearly showed that participants preferred that any serious online content generation exercise be done in Urdu. When asked for the reasons of developing websites in Urdu, most of the students remarked, "It is convenient for us to produce content in Urdu language because we easily understand it and do fewer mistakes as compared to English language." A

[17] One school did not participate, and one school website was disqualified as the team took significant external assistance.

6. Gender and ICT Adoption

[W]omen and girls must not be left behind in the digital revolution
- Green (2003)

Initial assessments conducted through the program on the usage of computers had given mixed feedback, where parents generally want their children, both boys and girls, to learn to use computers, deeming it a necessary technology of the modern age. However, in practice, the opportunity at home seems to be biased in favor of the boys and men in the family whereas the access to the technology is limited for girls and women. The Dareecha Project aimed to provide equal participation opportunities for both male and female students and teachers. This meant addressing social limitations faced by girls and women participating in the program through specific strategies. The project also aimed to investigate the effectiveness of such strategies for acquiring ICT literacy skills, to identify any gender specific differences.

Participation, technical competence and enthusiasm to learn and adopt ICTs were assessed. For assessing the participation and enthusiasm, indicators included the number of students and teachers attending the training sessions, the number of students interacting with the project team through emails and instant messenger, and the number students and teachers participating in the website development competition. For comparing the technical competence of the trainees the indicators included the results of ICT literacy tests and website development competition. Results based on the data collected and synthesized are explained in this section.

6.1 Participation in the Program

Gender-segregated data regarding the total number of students and teachers associated with the program were collected based on their attendance during the training sessions to determine their involvement and participation. Attendance was recorded on daily basis during the training sessions held in the rural schools for every student and teacher enrolled in the program. The data, based on 10 female and 10 male teachers for nine days of training, and 69 girls and 70 boys for 15 days of training, is presented in Figure 6.1 below.

The results show high participation for both male and female students. Participation of male teachers also remained high, but female teachers showed lower participation in the training program. Female students showed high attendance because the student training was held within school premises. The relatively lower participation for female staff was because the teacher training was held at a central location near Sargodha city and it was more difficult for women to attend due to social issues (i.e. women could not travel alone, and were dependent on men in their family to accompany them) and other demands on their time (i.e. women had to be home in the evening

before dark for safety reasons and to attend to family responsibilities at home). Thus, women who were attending were putting in extra effort compared to the men to attend the training. The project assisted where possible. For example, though the women from Sargodha district could travel and return home to their villages (or the home of their relatives in Sargodha) the same day, the teachers from Attock and Chakwal districts had to stay in a hotel for the three days of each training session. Though this was acceptable for the men, it is not culturally acceptable for women. Thus, through the project accommodation was arranged for the father of the female teacher attending the training from Attock, who had accompanied her.

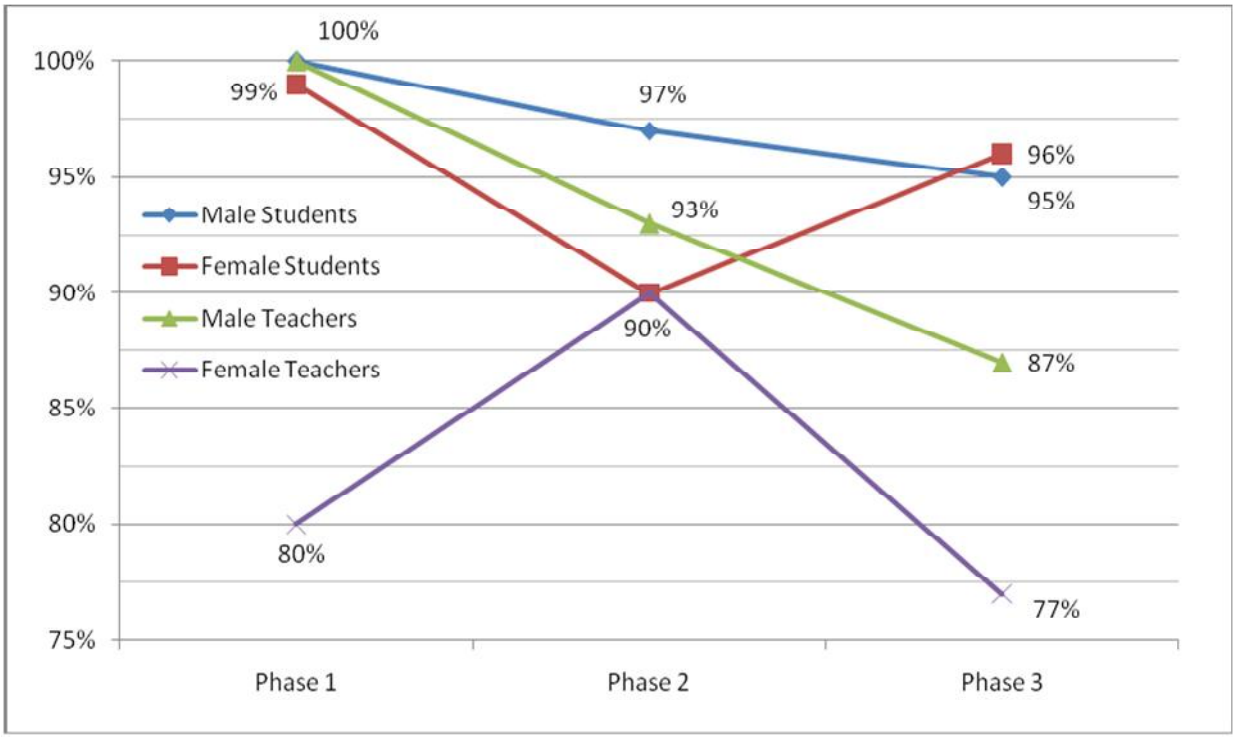

Figure 6.1: Participation of Male and Female Teachers and Students in the Training

It was encouraging to note that very few students or teachers dropped out of the training program. The primary reason for discontinuation was that some boys and girls had failed in the annual exams and could not be promoted to the next class. Therefore, they did not continue the ICT training with their peers.

The primary reasons for the success of the program in retaining the participants, especially female students, have been the explicit measures taken in anticipation of the gender issues. First, a very positive and constructive image of ICTs, which already existed, was reinforced within the schools and for the students to whom the training was being given. To capture the interest of the students, training sessions were kept interesting, interactive and friendly so that students and teachers did not hesitate in asking questions. Provision of female staff for conducting training and evaluation in girls'

school was a significant factor that enabled the female participation in the program[18]. The girls' school teachers and headmistresses also played a critically important role in the process by maintaining a positive image of ICTs, directly interacting with the parents and addressing any reservations, assigning time for training and practice during school days, and by making sure that labs were kept open with requisite support staff for the girls to practice and learn.

6.2 Participation in Online Communication

Though participation in training was anticipated for girls and boys, the project staff had concerns specifically regarding girls being able to participate in activities related to online communication, based on the prevailing social and cultural norms. Anticipating these potential reservations, the project had adopted strict measures for online presence of the students, and especially to safeguard the girls against any abuse. All students were given special lectures and training material on online safety and instructions on not to disclose personal and private information on the internet while using instant messengers and when receiving emails from any unknown sources. Further, to respond to queries of the Dareecha team, and to post general questions on the web, separate web-boards and email groups were formed for girls and boys, in line with the segregation practiced in the public schools in Pakistan. These measures proved successful in keeping girls engaged online and addressed any reservations of the administration and parents in this context. Both male and female students remained equal in their online presence through the periods after Training Phases 2 and 3. The results tabulated from the email and chat logs segregated by gender are given in Figure 6.2.

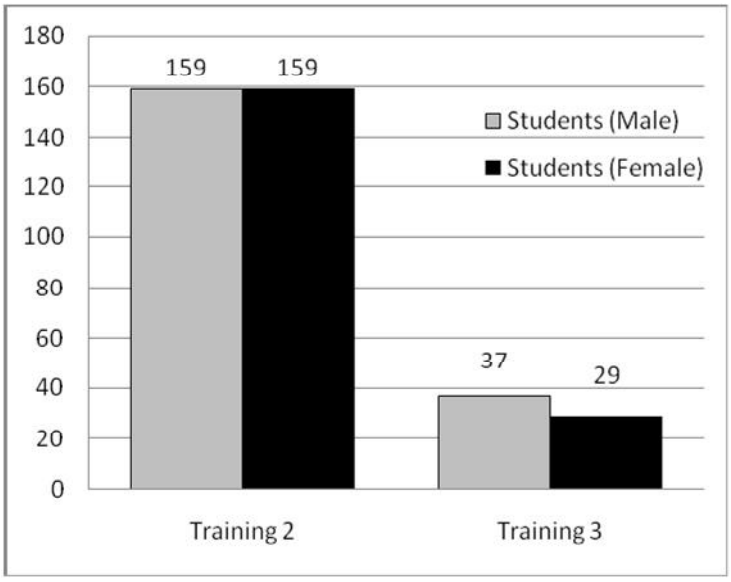

Figure 6.2: Post-Training Comparative Online Communication by Students

[18] Interestingly, while the labs were being set up, a male staff member had worked at each school for only a day, and the girls' schools had showed their reservation even on this interaction.

Most of the communication was required after Training Phases 2, as it focused on learning how to email and chat. The drop in communication after Training Phase 3 in Figure 6.2 is because the students were not required to communicate after this third phase, as they had gone home for summer vacation and were working on the website development competition.

6.3 Gender Based Comparison on ICT Literacy

Extra measures were undertaken to enable the girls to acquire the skills being taught through the ICT literacy program. These measures focused on both extrinsic and intrinsic issues. Learning environment is one of the most important factors for sustained interest. This was made congenial for girls by setting the computer labs within their school premises. In addition, their own teachers were trained to support them through the program. The training was provided by female research staff of the project, and evaluation was done by female staff. The project management continuously interacted with school headmistresses to ensure that the labs remained open for the girls for practice and the teachers were devoting their time for supervision and support. The project also provided books and supplemental materials to study at home, which is congenial for girls. Finally the slides presented during the training sessions were specialized with relevant content and examples for girls and boys. Figure 6.3 presents gender-segregated ICT literacy test results in each of the four functional areas.

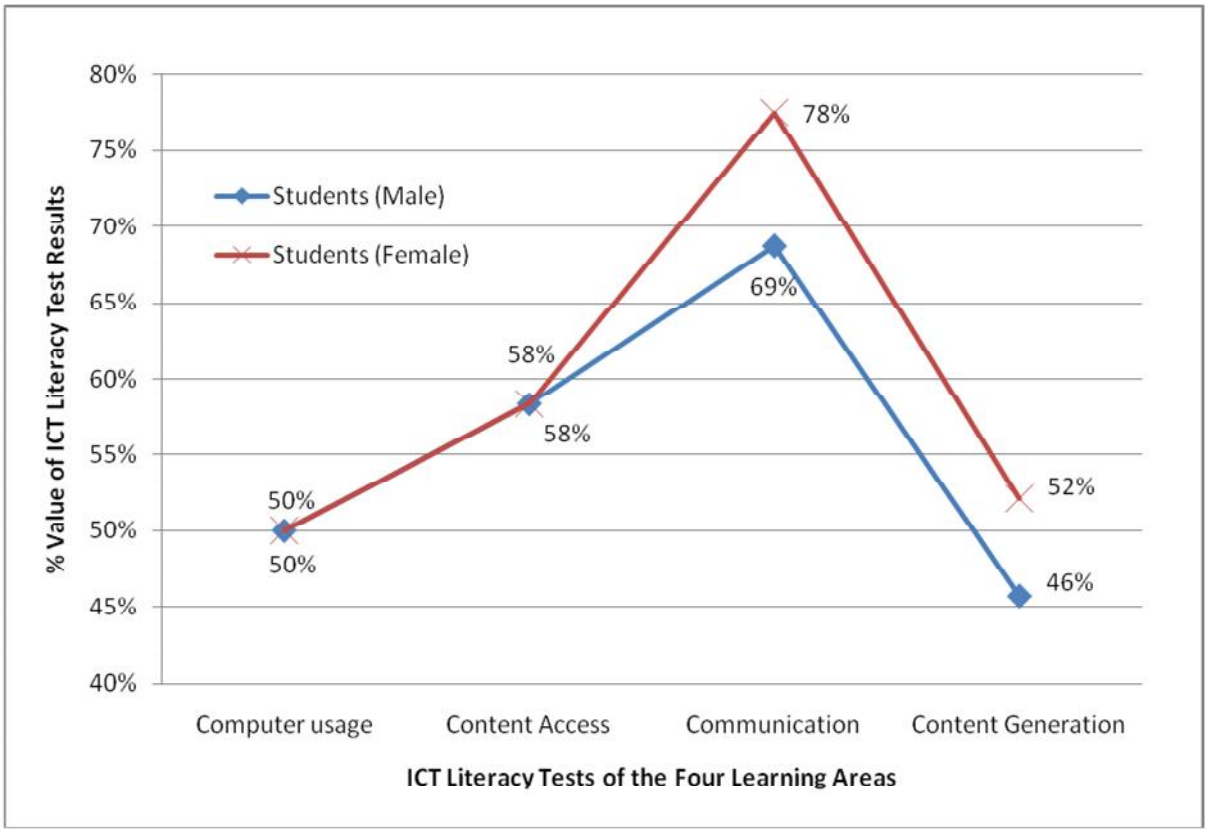

Figure 6.3: Results of Students in ICT Literacy Tests

Based on studies conducted, Green (2003, pg. 31) reports that the "female teachers were less positive regarding interest in and personal importance attached to computers, they were less secure about their computer skills, and they knew less about computers. They also viewed computing as an abstract science. The male teachers, in contrast, were more interested in computing, had higher self-confidence in their ability to use computers, and viewed the computer as a masculine technology." This is also echoed in a different context by Halai (2010), who reports that students of female teachers performed significantly more poorly than students of male teachers in analytical subjects, especially mathematics. However, in contrast, the results in this project show much more effectiveness among the girls and thus for the female teachers. The comparative ICT literacy test results show that the performance of school students (both boys and girls) remained comparable for Computer Usage and Content Access. Girls performed better in the areas of Communications and Content Generation. Overall adoption and change in behavior of girls and female teachers was also comparable to boys and male teachers respectively, as determined through the Outcome Mapping analysis, based on the Outcome Journals (see Figure 4.4). These results show that if adequate measures are taken to address differences (e.g. see Ashraf et al. (2009)) and biases (e.g. see Anderson (2009)), which are more pronounced in the rural communities, girls and female teachers can compete well with boys in ICTs (also see Lau (2010)).

6.4 Gender Based Comparison on Developing Online Content

As discussed, a website development competition was held at the end of project. This competition concluded the ICT literacy training, and provided solid and practical evidence of how well the program had trained the participants and had been able to keep the participants involved. Overall 103 students and teachers participated in this activity, which had both team and individual competitions. As already discussed, a total of 56 websites were submitted. Table 6.1 gives gender segregated data for this competition.

Table 6.1: Participants in the Website Development Competition

Category	Female Participants	Male Participants
Teachers	10	10
Students	56	27

The website development competitions designed for students required gathering data from the community and then organizing and publishing it online. The data shows that the number of girls participating in the website development competition was more than double the number of boys, dispelling any notions of their inability to undertake use of ICTs due to social norms. The numbers indicate that their participation in this competition was much better than for the boys despite the

fact that their access to labs and travel to schools was more restrictive than boys during the summer holidays during which time the websites were developed.

In addition to higher participation, girls and women won more prizes in the competition. In the first category of the school website development competition among teachers, the first and third prizes were won by female teachers, while the second prize was won by teachers from a boys' school. In the second category of community website development competition among school student groups, the first prize was shared between two teams, one each from a boys' and a girls' school. The second prize was not awarded, and the third prize in this category was won by a girls' team. In the third category of individual websites, among 11 prizes nine were won by girls, including the first prize.

The website development competition results highlight the achievement of girls in the practical aspects of the use of the technology, in addition to its theoretical aspects. The degree and quality of participation shows that given the opportunity, girls can be first among equals, and out-perform boys.

6.5 Gender and Language in Learning ICTs

Benson (2008, pg. 183) writes that "Researchers like myself (Benson 2002, 2005a, 2005b) and Hovens (2002) have found convincing evidence that language minority girls' school participation is significantly enhanced, even more than that of language minority boys, through use of the mother tongue. Evidence to date includes higher passing and retention rates, higher teacher estimations of performance, and more active involvement in classroom activities." This is corroborated by the short language-based tests conducted through the project. As given in Table 5.2 earlier, girls make more grammatical errors than boys in an essay writing exercise. Though the difference is smaller for Urdu essays, the English grammar skills of girls seem far poorer than boys (67% errors for girls vs. 46% for boys, when errors are normalized over number of words written) [19]. Poorer English skills imply that using Urdu will help girls more than it will help boys in learning ICTs. The data in Table 5.3, illustrated in Figure 6.4 below, shows that though both boys and girls prefer Urdu names for icons on computer interface, the numbers are slightly higher for girls for Urdu and accordingly slightly lower for English or English transliterated into Urdu.

[19] However, Matriculation exam results for 418 one year senior students from two participating boys' and two participating girls' schools indicate equally poor performance in English vs. Urdu across gender.

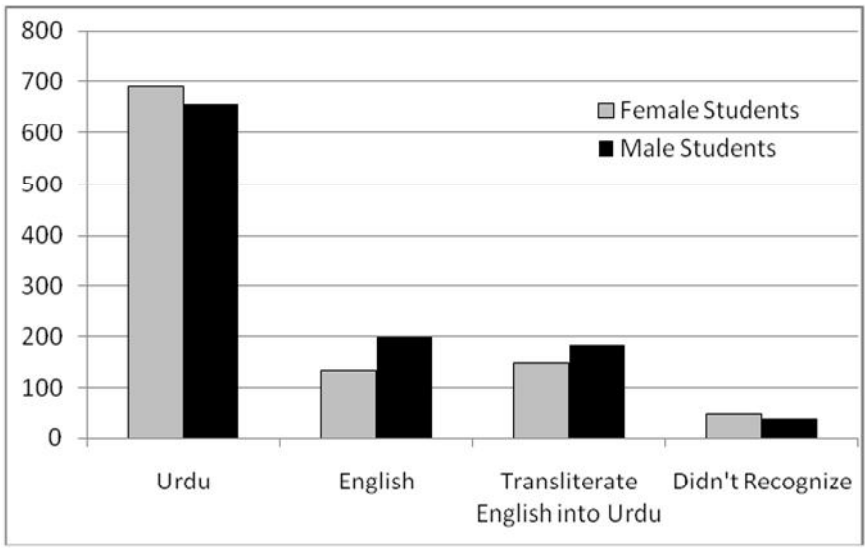

Figure 6.4: Computer Interface Terminology Identified by Girls and Boys (from Table 4.3.)

For content access and generation using ICTs, both boys and girls seem to be so heavily biased towards Urdu that there is little difference between them. However, in these cases, the point to note is that girls are still overwhelmingly, if not unanimously, dependent on the local language for learning and participation with ICTs. For example, all the websites developed in the website competition held by the project were in Urdu. This is also corroborated by their preference for software and training materials in Urdu, as shown in Table 5.1 and corresponding Figure 5.1. And thus, local language becomes an important factor in ICT learning for girls.

7. Conclusions and Recommendations

The Dareecha Project has been conducted to research an *effective model for ICT literacy training for rural area school children, preference for and impact of language on learning the use of ICTs* and *differences in ICT adoption across gender for rural area school children.* The project has fundamentally focused to inform relevant researchers and policy makers for deriving appropriate pedagogical practices, in light of the National Education Policy of Pakistan (NEP, 2009) and the National ICT Strategy for Education in Pakistan (NICTSEP, 2007). However, the analysis could also be helpful in deriving useful insights on issues in learning ICTs for other relevant programs in similar conditions globally.

7.1 Model for ICT Literacy in Rural Area Schools

After defining the scope of ICT training, identifying the four functional areas and sub-dividing them into seven learning areas, the program developed detailed competency levels for learning ICTs, as given in Appendix A. These competencies provided a very useful framework to develop training, practice and assessment materials for the program (see Figure 3.1). Breaking the program into such granular modules allowed the program team to develop both the breadth and depth of the work which was undertaken, proving very useful for formulating the training. The model was also very effective because it minimized the contact between the technology staff and the children, as such communication could inadvertently become overly technical and difficult to understand. Asking non-technical staff to learn the technology, develop the training material and then conduct the training, assisted by the technical staff, was an innovation in the program which was very effective in achieving its goals. However, technical staff was still crucially needed to ensure that materials and lectures developed and delivered were accurate and complete. *Careful and detailed planning of scope and design of material to ensure it is not overly technical and is in easy to use language* is needed to ensure success.

Ownership by school headmasters/headmistresses was a significant factor in the success of the program. Interestingly, the children showed more consistent participation in the schools where the headmaster or headmistress nominated themselves as one of the teachers being trained by the program. Equally significant was the interest of the volunteer teachers. Schools where teachers were motivated showed better student performance, most likely because in such cases students were provided with more opportunity to practice, better guidance and more opportunity to experiment and learn. Thus, *ownership and motivation of school management and teachers is a critical factor for success of such programs.*

When the project team had gone to partner schools, the latter had agreed to participate because of the recommendation of the district management. However, the school management and teachers were apprehensive of the outsiders-the Dareecha Project team-as they were not sure about the team's intentions and commitments. Multiple interactions with the schools, spread over a year, were finally able to build trust and confidence between the project staff, school management and the

participating students. This trust was also important to eventually nurture the commitment to the goals of the program on behalf of the teachers and the students. Short-term training would not have been able to achieve this. Thus, *repeated interactions over the long-term have been necessary to evoke the internal commitment of the participants,* necessary for the success of the program.

The training sessions were very useful in building initial capacity of the participants. However, the training sessions would not have been sufficient as students would have forgotten what they had learnt. Another factor which contributed to the students being able to retain what was learnt was the interweaving of the practice periods between the three training sessions. The students were given a face to face training session for five days and kept engaged through competitions during the intervening two months between each training session. This was repeated three times over a year, gradually developing the competency of the participants. This gave them time to practice at their own pace and opportunity for peer interactions. An effective monitoring mechanism was also in place to ensure that extra help and support could be extended to partnering schools when needed. An example of the peer based learning that evolved through the program was that in one school a student had offered an ICT training course during summer for other students not included in the Dareecha Project (and had charged a nominal fee for this training, with the consent of the school management). *The program would not have worked as effectively if the training was not interspersed with monitored practice periods providing a self-paced and peer-based learning opportunity and with motivating competitions.*

In the closing ceremony, all participants were given certificates identifying participation, successful completion or excellence. In addition, headmasters, schools, teachers and students were given certificates, trophies and cash awards based on performance. Numerous competitions were also conducted and cash awards were given to endorse the hard work put in by all the participants who were declared winners. *These awards brought a sense of achievement and pride to all those who have participated and would be crucial in sustaining the training* and in motivating them to participate in any future programs.

In addition, *there are significant issues related to language and gender, which must be addressed for effective learning, and which are specifically important for rural areas*. These are discussed in detail in the next two sections.

Though the program has been successful in demonstrating that ICT learning by rural area students and teachers to a level where they are comfortable to communicate online, access and generate content, this is only the first step in a larger goal. This goal is to integrate these skills into their learning in all subjects, where ICTs are tools and not an end in themselves. Next questions include: how to motivate teachers and students to sustainably create relevant content for learning in school? How to integrate this and other available content in daily learning? And, how to integrate ICTs into school management and administration, beyond pedagogical needs? Many of these questions are already raised by NICTSEP, but remain unaddressed.

7.2 Impact of Language on Learning ICTs in Rural Schools

The project has experienced interplay of three languages. English is the conventional language of ICTs in Pakistan. Urdu is the medium of instruction in the schools and is the language of the text books used by these students and teachers, and the language of the media (newspaper and television). Punjabi is the mother tongue and normally used to communicate among friends and at home. Punjabi is not taught or read as a subject in school. Urdu and Punjabi are closely related languages. Student perceptions and assessments show that they are more competent in Urdu and prefer using it instead of English. *Competency and preference of Urdu is so marked over English that its use causes a positive attitude and confidence towards learning in school, including ICTs.*

Specific experiments on learning the use of various aspects of ICTs quantitatively support these qualitative perceptions. Students convincingly prefer using Urdu terminology for operating the computers, choose to access online content in Urdu instead of English and opt to communicate in Urdu using email and chatting (even over Punjabi) and generate their own online content in Urdu. They show better retention, improved experimentation of concepts, and enhanced quality of work in Urdu in the context of learning ICTs. Thus, *the use of Urdu rather than English gives them significant advantages in learning and extrapolating the use of ICTs.*

The experiments have been possible through the use of open source software localized into Urdu and training materials developed and published in Urdu. Neither was available before the training and had to be developed. This was found to be a time consuming task, as it took at least a third of the time of the whole project. These materials were specialized for use by these students, containing relevant examples and references. The intervention has shown that *such investment of time and effort to produce the materials in a local language is worth the advantage these materials provide in learning the use of ICTs in rural areas.*

However, even with the strong preference for Urdu for learning, there has been some indication that an English-based computer application interface (and terminology) is still useful. Though Urdu is useful as a stepping stone, eventually these students will have to learn the English interface as they have to use computers in English in the larger social context and in the future as they proceed to college and university. Though these concerns were voiced by only a few (mostly teachers), they present a practical issue which has to be addressed. It cannot be assumed that the computing environment can be changed completely to Urdu in Pakistan in the short or medium term. Therefore, a more realistic solution might be to use Urdu terminology with the original English terminology in parenthesis, e.g. مسلیں اور پوشے (files and folders), so that a student can comprehend and use Urdu but at the same time start becoming familiar with the English version. This would address both better learning in Urdu at this time and enable an easier switch to English in other contexts or in the future. Keeping this in mind, the books and material published through the

project have already been converted in this form. One could also experiment using a similar mechanism for localization of software in the future.

7.3 Differences in ICT Adoption across Gender for Rural Children

Aiming to be inclusive, the project anticipated and explicitly addressed gender related concerns. Training staff, materials, training location, logistic support and all other necessary measures were tailored to accommodate female students and teachers in the program. These measures delivered results, showing comparable outcomes for ICT literacy across gender. In specific areas, quantitative and practical results show better performance by girls and female teachers compared with boys and male teachers respectively. The functional area of communication was thought likely to be the most challenging for females in the beginning, owing to the cultural restrictions. However, segregating online groups and taking other measures allowed the female students to participate without hesitation and even led them to perform better at the end. This shows that *gender related differences may be surmounted in the adoption of ICTs when the socially and culturally motivated gender constrains in rural areas are appropriately addressed.*

ICT training has had two aspects, theoretical and practical. The overall results show that girls have performed better than boys in both aspects. The quantitative results of the theoretical exams indicate that girls have a better understanding of the concepts. In addition, equal participation in communication exercises and significantly better performance in website development competition shows suggest that they also have a better practical output. *This goes some way to dispel the notion that girls in this type of rural environment have a negative attitude towards ICTs* as they seem eager to adopt ICTs and more adept at utilizing them.

However, the girls do seem to be at a disadvantage compared with boys in using the English language. Thus, using ICTs in English would place girls in a more disadvantaged situation. However, in the case of the current program, which has undertaken training in Urdu, this bias due to a foreign language has been minimized, making ICTs as accessible to girls as they are to boys. Indeed, as also discussed by other researchers, *using the local language reduces one of the disadvantages for girls in learning and adopting ICTs,* though the results have shown that it is equally necessary for the boys.

The most significant constraint in learning ICTs faced by the project was the limited physical mobility of the female teachers brought about by cultural constraints, which could adversely affect their learning and in turn the learning of the girls they teach. Thus any teacher training programs must address this concern by providing training locally, so that the women can return home after daily training. Administrative instructions cannot force them to override these cultural constraints, and must be addressed explicitly. Another challenge for teaching ICTs to girl students is finding appropriate time slots for them to learn during the school day. It was found to be much harder for

the girls to stay at school after school hours are over, while the boys could normally stay back and practice in the labs established in the school premises. This requires more effort on the part of management for the girls' schools and also on part of the girls, who have to put in more dedicated time in learning during normal school hours.

References

Anderson, N. (2009). *Equity and Information Communication Technology (ICT) in Education*. Peter Lang Publishing Inc., New York, USA.

Ashraf, M. , Hanisch, J. and Swatman, P. (2009). "ICT intervention in the 'Chandanbari' Village of Bangladesh: Results from a field study," in *Information Systems Frontiers 11:155–166*

Benson, C. (2002) "Bilingual Education in Africa: An exploration of encouraging connections between language and girls' schooling," in *Education—A Way out of Poverty?* Melin, M. (ed.), New Education Division Documents No. 12. SIDA, Stockholm, Sweden.

Benson, C. (2005a) *Mother Tongue-based Teaching and Education for Girls*. UNESCO Bangkok. Available from unesdoc.unesco.org/images/0014/001420/142079e.pdf.

Benson, C. (2005b) *Girls, Educational Equity and Mother Tongue-based Teaching.* UNESCO Bangkok.

Benson, C (2008). "Questions, Answers and Remaining Issues," in *Improving the Quality of Mother Tongue-based Literacy and Learning: Case Studies from Asia, Africa and South America*, UNESCO, Bangkok, Thailand, pp. 182-183.

Balanskat, A., Blamire, R., Kefala, S. (2006). *The ICT Impact Report: A Review of Studies of ICT Impact on schools in Europe,* European Communities.

Cabero, J. (2006). "Pedagogical basis of e-learning," in *Journal of University and Knowledge Society, 3 - 1.*

Callister, T.A. (1992). "The computer as doorstep: Technology as disempowerment," *Phi Delta Kappan, 74(4).*

Chinien, C. (2003). *The Use of ICTs in Technical and Vocational Education and Training.* UNESCO Institute for Information Technologies in Education, Moscow, Russian Federation.

Cueto, S., Guerrero, G., León, J., Seguin, E. and Muñoz, I. (2009). "Explaining and overcoming marginalization in education: a focus on ethnic/language minorities in Peru," background paper for EFA Global Monitoring Report 2010.

DFID (2009). *Guidance Note on Gender Mainstreaming and Social Exclusion in Research,* Department for International Development, London, UK.

Dutcher, N. (2004). *Expanding Educational Opportunity in Linguistically Diverse Societies,* Center for Applied Linguistics, Washington, DC, USA.

ECDEC (2004). *Implementation of 'Education and Training 2010' Work Programme: Key Competencies for Lifelong Learning, A European Reference Framework*, European Commission, Directorate for Education and Culture. Accessed from http://ec.europa.eu/education/policies/2010/doc/basicframe.pdf on 6th Nov. 2010.

Earl, S., Carden, F. and Smutylo, T. (2001). *Outcome Mapping: Building Learning and Reflection into Development Programs,* International Development Research Center, Ottawa, Canada. Available from http://www.idrc.ca/en/ev-9330-201-1-DO_TOPIC.html.

Earle, R.S., (2002). "The Integration of Instructional Technology into Public Education: Promises and Challenges," in *Educational Technology Vol. 42, No. 1.*

Ertmer, P. (1999). "Addressing first- and second-order barriers to change: Strategies for technology implementation," in *Educational Technology Research and Development, 47(4).*

ETS (2002). *Digital Transformation A Framework for ICT Literacy,* Educational Testing Service: New Jersey, USA.

Green, L. (2003). "Gender-based Issues and Trends in ICT Applications in Education in Asia and the Pacific," in *Meta-Survey on Use of Technologies in Education in Asia and the Pacific 2003-2004,* Farrell, G. and Wachholz, C. (eds.) , UNESCO Asia and Pacific Bureau for Education, Bangkok, Thailand.

Halai, A. (2010). "Gender and Mathematics Education in Pakistan: A Situation Analysis," in *The Montana Mathematics Enthusiast, ISSN 1551-3440, Vol. 7, no.1,* pp.47- 62, Montana Council of Teachers of Mathematics & Information Age Publishing, USA.

Hall, P., Ghimire, G. and Newton, M. (2009). "Why don't people use Nepali language software?" in *Information Technology and International Development, Volume 5 (1).*

Hepp, K. P., Hinostroza S. E., Laval M. E., & Rehbein, F. L. (2004). *Technology in Schools: Education, ICT and the Knowledge Society,* World Bank Pub. Online Resource, URL: http://siteresources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099079947580/ICT_report_oct04a.pdf.

Hovens, M. (2002). "Bilingual Education in West Africa: Does it work?" in *International Journal of Bilingual Education and Bilingualism 5 (5),* pp. 249-266.

ITU (2009). *Measuring the Information Society: The ICT development Index*. International Telecommunication Union, Switzerland.

Jamal, H. and Khan, A. (2007). *Education Status of Districts: An Exploration of Inter-Temporal Changes,* Research Report No. 71, Social Policy and Development Center (SPDC), Pakistan.

Kent, P. (2004). "E-Teaching – The Elusive Promise," in *The 15th International Conference of the Society for Information Technology and Teacher Education (SITE 2004).*

Khalique, H. (2007). "The Urdu-English relationship and its impact on Pakistan's social development," in *The Annual of Urdu Studies, Volume 22,* pp. 99-112.

Lau, W.F. and Yuen, H.K. (2010). "The impact of the medium of instruction: The case of teaching and learning of computer programming," in *Journal of Education and Information Technologies*. Springer. Accessed from http://www.springerlink.com/content/r551182572411510/fulltext.pdf on 6th Oct. 2010.

Law, N., Pelgrum, W.J., Plomp, T., (eds.) (2008). *Pedagogy and ICT Use in Schools Around the World: Findings from the IEA SITES 2006 Study.* Comparative Education Research Center, Faculty of Education, The University of Hong Kong (CERC)-Springer, Hong Kong, China.

Lewis, M.P. (ed.) (2009). *Ethnologue: Languages of the World*, 16th ed. SIL International, Dallas, TX, USA. Accessed from www.ethnologue.com on 29th Sept. 2010.

Lloyd C. (2004). "The Changing Transitions to Adulthood in a Comparative Perspective: the Case of Pakistan," in *The Pakistan Development Review 43 : 4 Part I.*

Lloyd, C., Mete, C., and Grant, M., (2007). "Rural girls in Pakistan: Constraints of policy and culture," in *Exclusion, Gender and Education: Case Studies from the Developing World*, Lewis, M. and Lockheed, M. (eds.), Center for Global Development, Washington DC, USA.

Lynd, D. (2007). *The Education System in Pakistan: Assessment of the National Education Census,* UNESCO Islamabad, Pakistan.

Mitra, S., Dangwal, R., Chatterjee, S., Jha, S., Bisht R. S. and Kapur P. (2005). "Acquisition of computing literacy on shared public computers: Children and the 'Hole in the Wall'," in *Australasian Journal of Educational Technology 21(3),* pp. 407-426.

MoE, 2007. *National Information and Communication Technology Strategy for Education in Pakistan*. Education Sector Reform Assistance (ESRA) Program, Ministry of Education, Government of Pakistan. Accessed from www.educationdev.net/educationdev/docs/p5.PDF on 29th Sept. 2010.

MoE (2009). *National Education Policy of Pakistan*. Ministry of Education, Government of Pakistan. Accessed from www.infopak.gov.pk/national_education_policy_2009.pdf on 29th Sept. 2010.

MoIT (2000). *Pakistan IT Policy*. Ministry of IT, Government. of Pakistan.

NLA (2005). *Electronic Dictionary of Localization of Computer Applications (English-Urdu)*, National Language Authority, Islamabad, Pakistan.

PAP (2010). "Population of Pakistan." Population Association of Pakistan. Accessed from http://www.pap.org.pk/statistics/population.htm on 15th Sept. 2010.

Pimienta, D. (2007). "Digital Divide, Social Divide, Paradigmatic Divide." Accessed from http://funredes.org/mistica/english/cyberlibrary/thematic/Paradigmatic_Divide.pdf on 6th Nov. 2010.

Pernia, E.E. (2008). *Strategy Framework for Promoting ICT Literacy in the Asia-Pacific Region,* UNESCO Bangkok, Thailand.

Rahman, T. (2002a). "Government Policies and the politics of teaching Urdu in Pakistan," in *The Annual of Urdu Studies, Volume 17,* pp. 95-124. Accessed from http://www.urdustudies.com/Issue17/index.html on September 30, 2010.

Rahman, T. (2002b). *Language ideology and power: Language-learning among the Muslims of Pakistan and North India.* Oxford University Press. Karachi.

Sarfraz, H., Bano, M., Mustafa, A., Parveen, R. and Hussain, S. (2010). "Urdu Localization of Open Source Software," in *The Proceeding of Fourth International Conference on Open Source Systems and Technologies (ICOSST)*, Lahore, Pakistan.

Selinger, M. (2008). "ICT in education: catalyst for development," in *ICT4D: Information and Communication Technology for Development,* Unwin T. (ed). Cambridge University Press, Cambridge, UK.

Shams, S., Hussain, S. and Mirza, A. (2010). "Gender and Outcome Mapping," in *Mapping, in Policy And Practice In Asian Distance Education* (Tian Belawati and Jon Baggaley, eds.), IDRC, Canada and Sage Publications Pvt. Ltd.

Stevens, K. (2008). "Collaborative Professional Education for e-Teaching in Networked Schools," in *International Journal of Human and Social Sciences 3:6*.

Totter, A., Stutz, D., Grote, G. (2006). "ICT and Schools: Identification of Factors Influencing the use of new Media in Vocational Training Schools," in *The Electronic Journal of E-Learning Vol. 4, No. 1*.

UN (2000). *Millennium Development Goals 2015*. United Nations. Accessed from www.un.org/millenniumgoals, on 29th Sept. 2010.

UNESCO (2000). *Education for All*. UNESCO. Accessed from www.unesco.org/en/efa, on 6th Oct. 2010.

UNESCO (2006). *Using ICT to Develop Literacy: ICT in Education Programme*, UNESCO Bangkok, Thailand.

UNESCO (2008). *Improving the Quality of Mother Tongue-based Literacy and Learning: Case Studies from Asia, Africa and South America*, UNESCO, Bangkok, Thailand.

UNESCO (2010). *Reaching the Marginalized*. UNESCO, Paris, France, and Oxford University Press, Oxford, UK.

Unwin, T. (2005). "Capacity Building and Management in ICT for Education," in *Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries*. InfoDev/World Bank, Washington DC, USA. Available at: http://www.infodev.org/en/Publication.9.html.

Vrasidas, C. (2010). "Why Don't Teachers Adopt Technology? A Survey of Teachers' Use of ICT in the Republic of Cyprus," in *ACM ELearn Magazine,* Apr. 2010.

Wagner, D., Day, B., James, T., Kozma, R., Miller, J., Unwin, T. (2005). *Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries*. InfoDev/World Bank, Washington DC, USA. Available at: http://www.infodev.org/en/Publication.9.html.

Woldemikael, T. M. (2003). "Language, Education, and Public Policy in Eritrea," in *African Studies Review, Vol. 46, No. 1,* pp. 117–36.

APPENDIX A: ICT Literacy Competencies

A.1. Competency levels for basic computing

Entry Criteria

1. The student is willing to go through the proposed ICT literacy training, and will be available for the duration of the training.
2. The student has access to a computer with relevant language support, and some basic software e.g., a rudimentary word processor, and a connection to the Internet.

Exit Criteria

1. The student is familiar with basic computer terminology.
2. The student knows how to use computer peripheral devices (mouse, keyboard etc.).
3. The student is familiar with general operating system use (filing systems etc.).

Competency Levels

Level 1: The student is aware of the concept of a computer and is familiar with it's components.

1. The student is aware of the concept of a computer.
2. The student is aware of the main benefits of using a computer.
3. The student is aware of the components and peripheral devices of a computer system.

Level 2: The student can turn the computer on and can use the four basic operations of a computer (input, processing, output and storage).

1. The student can:
    a. Turn the computer on.
    b. Log in with a user name and password.
    c. Lock the computer.
    d. Unlock the computer.
    e. Log off.
    f. Shut down the computer.
    g. Reboot the computer.
2. The student can use the four basic operations of a computer:
    a. Input: The student is able to use basic input devices like the mouse and keyboard.

b. Processing: The student is able to conduct simple processing operations (e.g., using a calculator).
c. Output: The student is able to use basic output devices like the monitor and printer.
d. Storage & retrieval: The student is able to perform simple storage and retrieval tasks (e.g., saving and then opening a simple document).

Level 3: The student is aware of the concepts of data and information and understands the four main functions performed by a computer.

1. The student is familiar with the concept of data and information, and knows the difference between the two.
2. The student understands the four functions performed by a computer:
    a. Input: The student knows that data can be input to a computer, and is aware of basic input devices like the mouse and keyboard. The student is also aware of other input devices like scanners, bar code readers etc.
    b. Processing: The student knows that the main function of a computer is to process data and also that input data can be changed through processing. The student knows that the processor is the basic computing device.
    c. Output: The student knows that one of the functions of a computer is to output data and that data can be output in many forms. The student knows of basic output devices like the monitor and printer, and also of other devices (speakers etc.).
    d. Storage & retrieval: The student knows that the fourth function of computers is storage and retrieval of data. The student knows of basic storage devices, like hard disks, CDs, DVDs, flash drives etc. that are currently in use.

Level 4: The student is aware of the basic architectural layers of a computer.

1. The student knows of the concepts of hardware and software. The student knows that hardware is the term used to refer to the physical components of a system and that software is the term used to refer to sets of instructions for the computer. The student is aware of the relation between hardware and software and the difference between them.
2. The student is familiar with the concept of an operating system.
3. The student knows that the operating system is a type of software that provides an interface between the computer and the user.
4. The student is aware of the filing system being used in the operating system (folders/directories, saving/opening files etc.)

Level 5: The student is aware of the wide range of usage of computers.

1. The student has a broad perspective regarding the use of computers and is aware that computers are being used in almost every field, and is aware of the different types of applications that are available (graphics, scientific, audio etc.).
2. The student has a general awareness of the development in computer technology from a historical perspective and is aware of the rate at which computer technology is developing.

Level 6: The student is aware of simple problems that may be encountered while using a computer and is equipped to conduct basic troubleshooting.

1. The student knows of:
    a. The operating system folder and knows that altering the contents of this folder may cause problems.
    b. The programs folder and knows that altering the contents of this folder may cause problems.
    c. The concept of a virus and the protection that is provided by an anti-virus program.
    d. Formatting and what it implies.
2. The student knows what to do if:
    a. The computer/application freezes.
    b. If the computer is not turning on as expected.

A.2 Competency levels for web browsing

Entry Criteria

1. The web browser is installed on the computer.
2. The computer is connected to the Internet.
3. The student is familiar with basic computer terminology.
4. The student has basic computing skills.
5. The student knows how to use computer peripheral devices.
6. The student is familiar with general operating system use.

Exit Criteria

1. The student can comfortably use the web browser, access URLs, navigate through websites, search for information, save and print information.
2. The student recognizes and can use the different types of information available on the Internet.
3. The student is aware of ethical and safety issues in the context of web browsing.

Competency Levels

Level 1: The student understands the concept of the Internet, browsers and URLs.

1. The student understands the concept of the Internet and its benefits.
2. The student understands that computers connect together to form a network and that the Internet is a global network of computers. The student understands that the Internet consists of hyper text documents linked together that can be accessed using a browser.
3. The student knows of the benefits available through use of the Internet, e.g.,
    a. Instant availability of information from all over the world.
    b. Information available from educational institutions from all over the world, including course materials.
    c. Access to other specialized websites for news, entertainment etc.
    d. Ability to share their own information over the Internet.
4. The student knows that a URL is entered in a browser to access a specific website.
5. The student knows that a URL is a unique identifier required to identify and access different websites. The is also familiar with the format of a URL
6. The student knows that the browser can be used to access and navigate through the web.
7. The student can start the browser through various methods available on the operating system (e.g., desktop icon, start menu, quick launch icon).

Level 2: The student can access a location on the Internet by typing in its URL and can navigate using the browser's basic functionality.

1. The student can type a given URL into the address bar to access a specific website.
2. The student can navigate the web using the browser toolbar buttons (Back, Forward, Reload/Refresh etc.).
3. The student understands the messages being conveyed by the status bar.
4. The student can open a new window or a new tab and enter another URL in it.
5. The student understands the concept of a homepage and can set and change it.

Level 3: The student is aware that data of different types is available on the Internet and should be able to identify and use the components of a web page.

1. The student should know about the following types of data available on the web:
    a. Text
    b. Image
    c. Video
    d. Sound
2. The student can scroll through a page and understand its components (note that all websites will not contain all the mentioned components and to see and use all of them components the student will have to browse through a variety of websites)
    a. Web menus
    b. Images
    c. Banners
    d. Links
    e. Pop ups
    f. Buttons
    g. Text boxes
    h. Drop down lists
    i. Combo boxes
    j. Video
    k. Audio
    l. Animation
3. The student is able to use all the items mentioned above.
    a. Hyperlinks: The student knows that hyperlinks point to a new URL, and clicking on them will take them to a new page. The student is also familiar with the two ways of opening new links (in the same window, in a new window or in a new tab). The student knows that some links can also point to files that may be downloaded.

b. Web Menus: The student can navigate through a website using its menu, understanding the concept of home for the website, using its internal links (e.g., Back, Forward, Back to Top), and also using the Back, Forward and Reload/Refresh buttons of the browser.
c. Images: The student knows of images as being part of a webpage, and is able to identify which images are actually links (and are therefore clickable, and will take them to a new page).
d. Banners: The student recognizes banners and knows that they are clickable.
e. Pop ups: The student recognizes pop ups, understands that some parts of the popup may be clickable, and can close them.
f. Buttons: The student can recognize and click buttons where required.
g. Textboxes: The student can recognize and enter text in text boxes.
h. Drop down lists: The student can select items from drop down lists.
i. Combo boxes: The student can select items from combo boxes.
j. Video: The student can play video content on the web.
k. Audio: The student can play audio content on the web.
l. Animation: The student knows of animation as being part of a webpage.

Level 4: The student knows of search engines and can use at least one effectively.

1. The student is aware of common search engine URLS, e.g., www.google.com, www.yahoo.com
2. The student can use appropriate keywords to obtain search results.
3. The student can navigate through results to access desired information.
4. The student can access any of the web pages included in the search results and navigate through it.
5. The student can use the advanced search feature available on search engines.
6. The student understands the benefit of advanced search (i.e., knows that the search can be narrowed down and targeted information can be obtained).

Level 5: The student is able to save, retrieve and manage information.

1. The student can save web pages.
2. The student can save images from web pages.
3. The student can save documents (e.g. PDF documents) from web pages.
4. The student can save audio files from web pages.
5. The student can save video files from web pages.
6. The student can print out web pages.

Level 6: The student can reasonably assess the reliability of different web sites.

1. The student can assess the quality of content and the reliability of the retrieved information.
2. The student is able to recognize personal web pages.
3. The student is able to recognize academic websites.
4. The student is able to identify well-known news and information websites.
5. The student is familiar with domain names to some extent.

Level 7: Student can manage the access of frequently visited websites using bookmarks/favorites, can adjust simple browser settings and is capable of rudimentary troubleshooting.

1. The student can bookmark pages and can categorize and manage bookmarked pages using the management facility available on the web browser (to add, remove, re-order etc.).
2. The student can locate and delete temporary files, cookies and history.
3. The student can diagnose and fix simple problems.
    a. The student can identify if the Internet connection is disrupted and re-connect.
    b. The student can identify if the typed URL is correct, and fix it if there is a common problem like a space in the URL.
    c. The student is aware if some content is being blocked through a pop-up blocker, and can activate or de-activate it as desired.

Level 8: The student is aware of the dangers of web browsing, and is aware of the concept of plagiarism and copyrights.

1. The student is aware of common safety procedures while browsing the web.
    a. The student is able to identify and avoid harmful websites.
    b. The student knows how to use a pop-up blocker.
    c. The student is careful when subscribing to websites and giving out email addresses and other personal information.
    d. The student knows that many downloads available through the Internet are illegal, may be virus-infected and should be avoided.
2. The student is aware of Internet ethics and etiquette.
    a. The student is aware of plagiarism and proper referencing procedures.
    b. The student is aware of copyrights and licensing of web content.

A.3 Competency levels for email

Entry Criteria

1. The email client is installed and an account has been created.
2. The computer is connected to the Internet.
3. The student is familiar with basic computer terminology.
4. The student has basic computer skills.
5. The student knows how to use computer peripheral devices.
6. The student is familiar with general operating system use.

Exit Criteria

1. The student knows how to send and receive emails.
2. The student knows how to send and receive email attachments.
3. The student can organize and manage emails.
4. The student can adjust simple settings and is capable of rudimentary minor troubleshooting.
5. The student can search through and print emails.
6. The student is aware of dangers, ethics and etiquette of email communication.

Competency Levels

Level 1: The student is aware of the concept and benefits of email, and can open an email client.

1. The student understands the concept of email.
    a. The student knows that email is a mode of instant communication available through the Internet.
    b. The student knows that email is a facility for the exchange of text messages and may include other media such as pictures, sound files etc.
    c. The student knows that an email account can be created for a unique email ID and understands the basic format of an email ID.
2. The student knows that email is an instant and cost-effective form of communication.
3. The student can open an email client in any of the ways available through the operating system (desktop icon, start menu, quick launch icon etc.).
4. The student can log into an email account using a user name and a password.

Level 2: The student can open an email.

1. The student can open an email and read its contents.

2. The student understands the concepts of different folders in the email client.
    a. Inbox: contains all the received emails for the user.
    b. Outbox: contains emails written by the user that have not yet been sent to the recipients.
    c. Deleted Items: contains emails that have been deleted by the user.
    d. Drafts: contains partially composed mails that are not ready to be sent yet.
    e. Sent Items: contains all the emails that the user has sent.
3. The student can identify read and unread emails.
4. The student can identify the date on which each email was received.
5. The student can identify the sender of each email.
6. The student can identify the subject of each mail.
7. The student can check the size of an email.
8. The student can tell if the email contains an attachment, can identify the type of attachment based on the file extension (image, document etc.), and can open and save it.
9. The student can recognize spam and harmful messages (e.g., message from an unknown person sending an exe file), and knows that it is best to not open them.
10. The student can print the contents of an email.
11. The student recognizes hyperlinks in an email and knows that clicking on a hyperlink will invoke a browser window in which the hyperlink will be opened.

Level 3: The student can write emails and use some higher level functions available on email clients.

1. The student can create and send a simple text email.
    a. The student can enter the email address for the recipient(s).
    b. The student can enter the subject of the email.
    c. The student can send the email.
2. The student can send an attachment in an email.
3. The student knows how to delete emails.
4. The student can sort and search for emails.
5. The student can forward a message.
6. The student can reply to a message.
7. The student can manage the address book.
    a. The student understands the concept of an address book.
    b. The student can add a contact.
    c. The student can remove a contact.

Level 4: The student can manage simple email settings and can organize emails.

1. The student can manage simple settings for the email client.
    a. The student can create a signature and send it with emails.

   b. The student can set email client views (preview pane etc.) as desired.
   c. The student can change settings for sending and receiving emails.
2. The student can organize emails.
   a. The student is able to label emails as desired.
   b. The student is able to create new folders as desired.

Level 5: The student is aware of email etiquette and safety precautions and is capable of rudimentary level troubleshooting.

1. The student is aware of email etiquette.
2. The student is aware of safety precautions in the context of email.
   a. The student knows that an email ID should be kept as private as possible.
   b. The student can identify suspicious emails and knows that it is best to not open them.
3. The student is capable of rudimentary level troubleshooting.
   a. The student is able to detect if the Internet is not connected and can reconnect.
   b. The student recognizes the correct format for an email address and can identify if a mistake has been made.
   c. The student can recognize when an email bounces.

A.4 Competency levels for instant messaging

Entry Criteria

1. The student is familiar with basic computer terminology.
2. The student has basic computer skills.
3. The student knows how to use computer peripheral devices.
4. The student if familiar with general operating system use.
5. The instant messaging client is installed and configured.
6. The user account is set up.
7. The computer is connected to the Internet.
8. The student is familiar with the concept of the Internet.

Exit Criteria

1. The student is able to communicate using the instant messenger.
2. The student is able to exchange files using the instant messenger.
3. The student is able to manage the user account.

Competency Levels

Level 1: The student is familiar with the concept of instant messaging.

1. The student is familiar with the concept of instant messaging.
2. The student is aware of the benefits of instant messaging.

Level 2: The student knows how to log in and out of the instant messaging client.

1. The student can run the instant messaging client.
2. The student is able to log in to a pre-configured account using a user name and password.
3. The student is able to log off.
4. The student is able to exit the instant messaging client.

Level 3: The student can manage and communicate with contacts.

1. The student can add contacts to the account.
2. The student can send and receive messages through the instant messenger.
3. The student can manage contacts (create groups, remove contacts etc.)
4. The student is able to authorize or reject an add request.

Level 4: The student understands and can use status icons.

1. The student understands the status icons that appear with contacts (away, offline, online, busy etc.).
2. The student is able to change his or her own status as desired.

Level 5: The student is able to use higher level features of the instant messenger.

1. The student can send and receive files using the instant messenger.
2. The student can log conversations and access them later.
3. The student can adjust simple settings such as sounds, appearances, etc.

Level 6: The student is capable of rudimentary level troubleshooting.

1. The student can check if the computer is connected to the Internet.
2. If unable to log in, the student can check if the user name and password is being entered correctly (e.g., caps lock may be on).

Level 7: The student is aware of the safety precautions that are needed while using instant messaging.

1. The student uses caution when authorizing contacts.
2. The student uses caution when accepting file transfers.
3. The student is cautious about clicking on hyperlinks in messages.

Level 8: The student is aware of instant messaging etiquette.

1. The student knows to check status icons before messaging a contact.
2. The student sets his or her own status according to the situation.

A.5 Competency levels for word processing

Entry Criteria

1. The student has basic computing skills (typing in particular).
2. The student is familiar with basic computer terminology.
3. The student knows how to use computer peripheral devices.
4. The student is familiar with the operating system.
5. A word processor is installed and includes appropriate language support.

Exit Criteria

1. The student can use the word processor to produce a simple document.
2. The student is capable of rudimentary level troubleshooting.

Competency Levels

Level 1: The student knows the concept of a word processor.

1. The student understands what a word processor is used for.
2. The student understands the benefits of using a word processor.

Level 2: The student can create and save a document with simple text in it.

1. The student can start the word processor.
2. The student can create a new document.
3. The student can type in text.
4. The student can save the document.
5. The student can print out the document.
6. The student can close the document.
7. The student can open an existing document.
8. The student can close the word processor.

Level 3: The student is able to carry out basic editing tasks.

1. The student can select text.
2. The student can copy text.
3. The student can cut text.
4. The student can paste text.

5. The student can undo and redo changes to the document.

Level 4: The student is able to carry out basic formatting tasks.

1. The student can format text.
    a. The student can select font face and font type.
    b. The student can make text bold, italicized or underlined.
    c. The student can apply bullets and numbering to text.
    d. The student can set different colors for text.
    e. The student can highlight the text.
2. The student can format text layout.
    a. The student can set alignment.
    b. The student can indent text.
3. The student can format document pages.
    a. The student can set headers and footers on a page.
    b. The student can set page numbering.
    c. The student can set borders on a page.
    d. The student can set margins on a page.

Level 5: The student can use objects in a document.

1. The student can use images in a document.
    a. The student can insert an image in a document.
    b. The student can remove an image from a document.
    c. The student can resize an image.
    d. The student can move and adjust placement of images as desired.
2. The student can use tables in a document.
    a. The student can insert a table.
    b. The student can add/delete a row/column.
    c. The student can delete a table.
    d. The student can resize a table.
3. The student can insert lines in a document.
4. The student can insert special characters/symbols in a document.
5. The student can use other objects provided by the word processor (clip art, charts etc).

Level 6: The student can use the document in different views.

1. The student can change to print layout.
2. The student can change to web layout.
3. The student can set rulers in document.

4. The student can zoom in/out.

Level 7: The student is capable of rudimentary level troubleshooting.

1. The student can re-start the word processor if it freezes.
2. The student can attempt recovery if the document gets corrupted.

Level 8: The student is aware of ethics and etiquette in the context of producing documents.

1. The student is aware of copyrights and licensing.
2. The student is aware of plagiarism.
3. The student knows of referencing procedures.

A.6 Competency levels for graphics editing

Entry Criteria

1. The student has basic computer knowledge.
2. The student is familiar with basic computer technology.
3. The student knows how to use computer peripheral devices (mouse in particular).
4. Student is familiar with basic operating system use.
5. A drawing editor is installed with appropriate language support.

Exit Criteria

1. The student can create a simple image.
2. The student is capable of rudimentary level troubleshooting.

Competency Levels

Level 1: The student understands the concept of a graphics editor.

1. The student knows what a graphics editor is.
2. The student understands the benefits of using a graphics editor.

Level 2: The student knows how to create a new document.

1. The student can open the graphics editor.
2. The student can create a new document.
3. The student can draw basic shapes on the drawing area.
4. The student can save the document.
5. The student can open a saved document.
6. The student can print out a document.

Level 3: The student can use objects available through the graphics editor.

1. The student can draw lines and arrows.
2. The student can draw text boxes.
3. The student can insert images into the document.
4. The student can set a background for the drawing area.
5. The student can compose a drawing by using a combination of objects.

Level 4: The student can format lines and arrows.

1. The student can set the width for lines and arrows.
2. The student can set the style for lines and arrows.
3. The student can set colors for lines and arrows.
4. The student can resize lines and arrows.
5. The student can change the direction of arrows.
6. The student can adjust the placement for lines and arrows.
7. The student can flip and rotate arrows.
8. The student can cut, copy, paste and delete lines and arrows.

Level 5: The student can format and manipulate basic shapes.

1. The student can format basic shapes.
    a. The student can place and arrange multiple shapes in the drawing area.
    b. The student can set colors for different shapes.
    c. The student can set the width, style and color for borders of different shapes.
    d. The student can adjust the placement of shapes.
    e. The student can resize shapes.
2. The student can rotate and flip shapes.
    a. The student can rotate in both directions
    b. The student can flip the shape around in both directions.
3. The student can group/ungroup sets of shapes.
4. The student can cut, copy, paste and delete basic shapes.
5. The student can arrange the placement of shapes.
    a. The student can place a shape to the front of a set.
    b. The student can place a shape behind a set.
6. The student can insert text into basic shapes.

Level 6: The student can format and arrange text in the drawing area.

1. The student can format text in the drawing area.
    a. The student can insert text into the drawing area.
    b. The student can set font face and font type for the text.
    c. The student can write bold, italicized and under-lined text.
    d. The student can apply bullets and numbering to text.
    e. The student can set colors for text.
    f. The student can set alignment for text.
    g. The student can select, cut, copy, paste and delete text.
    h. The student can group/ungroup the text box with other sets of objects.

2. The student can rotate and flip text in all directions.
3. The student can adjust the arrangement of text (move to foreground or background).

Level 7: The student can use text art (e.g., Fontwork Gallery in OpenOffice.org Draw, WordArt in MS Office).

1. The student can format text art.
    a. The student can insert text art.
    b. The student can set font face and font type.
    c. The student can apply effects (underline, strikethrough etc.)
    d. The student can set colors and textures for text art.
    e. The student can adjust line color and design for the borders in text art.
    f. The student can adjust the shape of text art.
    g. The student can adjust the height of text art.
    h. The student can align text art.
2. The student can group/ungroup text art with other sets of objects.
3. The student can flip text art.
4. The student can rotate text art.

Level 8: The student can work with images in a document.

1. The student can insert images into a document.
2. The student can remove images from a document.
3. The student can resize an image.
4. The student can rotate an image.
5. The student can adjust the placement of an image.
6. The student can align images.
7. The student can group/ungroup an image with a set of objects.
8. The student can flip images.
9. The student can adjust the layout of images (move them to the front or back of a set).
10. The student can insert text on an image.
11. The student can use multiple images in a document.

Level 9: The student can modify combinations of objects.

1. The student can merge objects to create a new one.
2. The student can extract a part of an object.
3. The student can intersect objects.

Level 10: The student can save drawings in common formats.

1. The student can save a file in some common formats (e.g., jpg, gif etc.)
2. The student can change the format of any file using the facilities provided by the graphics editor.

Level 11: The student is capable of rudimentary level troubleshooting

1. The student can undo any action.
2. The student can attempt to recover a corrupt file.
3. The student can restart the application if it is causing problems.

Level 12: The student is aware of ethics and etiquette in the context of creating images.

1. The student is aware of plagiarism.
2. The student is aware of copyrights and licensing.
3. The student knows how to properly reference content that has been created by someone else.

A.7 Competency levels for webpage development

Entry Criteria

1. The webpage development application is installed on the computer.
2. The computer is connected to the Internet.
3. The student is familiar with basic computer terminology.
4. The student has basic computer skills.
5. The student uses the Internet for web browsing and email.

Exit Criteria

1. The student is aware of basic webpage development concepts (e.g., client and server relationship, webpage development languages).
2. The student is capable of developing a simple webpage.

Competency Levels

Level 1: The student is aware of the concept of webpage development.

1. The student is aware of the basic procedure of creating a webpage.
2. The student is aware of data on the Internet with respect to a web client and a web server.

Level 2: The student is aware of the basic concept of webpage development independent of an webpage development application.

1. The student is aware of HTML and can recognize some basic tags, e.g.,
    a. <html>, </html>
    b. <title>, </title>
    c. <body>, </body>
    d.
, </br>
    e. ,
    f. <h1>…<h6>, </h1>…</h6>
2. The student can create a simple page using these tags and a text editor.
3. The student is aware of more advanced concepts (e.g., CSS, javascript), but is not necessarily able to use them.

Level 3: The student is aware of the concept of encoding.

1. The student has a sufficient concept of encoding in order to understand that creating web pages in languages other than English may require a different encoding than the default provided.

Level 4: The student is able to create a simple webpage using a webpage development application

1. The student is able to create a simple webpage (containing only text) using a webpage development application.
2. The student can upload the webpage.
3. The student can test the webpage in more than one browser.

Level 5: The student is able to use some advanced features of the webpage development application to create a website with more components.

1. The student can create a webpage that includes the following components.
    a. Hyperlinks
    b. Buttons
    c. Formatted
    d. Images
    e. Tables

Level 6: The student is aware of the significance of design and ethics in the context of webpage development

1. The student is aware of the significance of design in the context of webpage development, and is aware of the significance of choice of colors, contrast and content layout.
2. The student is aware of plagiarism, copyright and licensing, and knows how to use and reference content created by others.

Level 7: The student is capable of rudimentary level troubleshooting.

1. The student can troubleshoot minor uploading problems (Internet not connected, incorrect upload path, etc.
2. The student can diagnose and fix problems that arise due to encoding.
3. The student can correct simple tag errors if needed.

APPENDIX B: List of Participating Schools

B.1 Schools in District Sargodha

1. Govt. Boys Higher Secondary School Chak No. 88/SB Tehsil Sargodha
2. Govt. Girls Higher Secondary School Chak No. 88/SB Tehsil Sargodha
3. Govt. Boys High School Chak No. 10/ML Tehsil Bhalwal
4. Govt. Girls High School Chak No. 10/ML Tehsil Bhalwal
5. Govt. Boys High School Kud Lathi Tehsil Sahiwal
6. Govt. Girls High School Kud Lathi Tehsil Sahiwal
7. Govt. Boys School Chak No. 152 North Tehsil Sillanwali
8. Govt. Girls School Chak No. 152 North Tehsil Sillanwali

B.2 School in District Chakwal

9. Govt. Boys High School Hasil, District Chakwal

B.3 School in District Attock

10. Govt. Girls High School Maluwala, Tehsil Pindi Gheb, District Attock

APPENDIX C: Lab Equipment Provided to each School

1. 8 refurbished desktop computers, where seven are set up as workstations, and one is set up a server.
2. 8 keyboards with both Urdu and English letters printed on the keys
3. 1 printer
4. 1 scanner
5. 1 network switch
6. 16 power extensions
7. 8 network cables
8. 2 sets of speakers
9. 8 headphones
10. 1 telephone set and connection
11. 4 desks (each desk designed to accommodate 2 desktop computers)
12. 4 benches (each bench designed to accommodate 4 secondary school students)

APPENDIX D: Training Program Schedule

This appendix gives the schedule of the Dareecha training sessions as executed. Each location listed contains two schools, one for boys and one for girls. Therefore, each student training indicated in the plan represents two parallel sessions by two different training teams. The topics covered during each training phase are:

1. Training phase 1
    a. Basic computing
    b. Web browsing
2. Training phase 2
    a. Email
    b. Instant messaging
3. Training phase 3
    a. Word processing
    b. Graphics editing
    c. Webpage development

Training Schedule			
School Teacher Training 1	3 days	3-Nov-08	5-Nov-08
Student Training 1 Chak 88/SB	5 days	10-Nov-08	14-Nov-08
Student Training 1 Bhalwal	5 days	17-Nov-08	21-Nov-08
Student Training 1 Sahiwal	5 days	1-Dec-08	5-Dec-08
Student Training 1 Chakwal & Attock	5 days	29-Dec-08	2-Jan-09
Student Training 1 Sillanwali	5 days	12-Jan-09	16-Jan-09
School Teacher Training 2	3 days	28-Jan-09	30-Jan-09
Student Training 2 Chak 88/SB	5 days	2-Feb-09	6-Feb-09
Student Training 2 Bhalwal	5 days	16-Feb-09	20-Feb-09
Student Training 2 Sahiwal	5 days	2-Mar-09	6-Mar-09
Student Training 2 Sillanwali	5 days	16-Mar-09	20-Mar-09
Student Training 2 Chakwal & Attock	5 days	30-Mar-09	3-Apr-09
School Teacher Training 3	3 days	8-Apr-09	10-Apr-09
Student Training 3 Chak 88/SB	5 days	13-Apr-09	17-Apr-09
Student Training 3 Bhalwal	5 days	27-Apr-09	1-May-09
Student Training 3 Sahiwal	5 days	11-May-09	15-May-09
Student Training 3 Sillanwali	5 days	25-May-09	29-May-09
Student Training 3 Chakwal & Attock	5 days	8-Jun-09	12-Jun-09

APPENDIX E: OMg Analysis of Dareecha Project

The Boundary Partners of the project include female students, male students, female teachers and male teachers. The Boundary Partners (students and teachers) are segregated across gender to ensure that any potential differences in their competency, attitude towards ICTs and capacity building, due to the existing social and cultural factors, are explicitly captured through the course of the project. For example, as noted from discussions during the Dareecha training sessions, girls are often prevented from using computers at their homes, though such restrictions do not apply to boys, thus providing more opportunity to the latter to practice and learn. While planning, separate Outcome Challenge[20] statements were developed for boys and girls, due to these potential differences. As an example, the outcome challenge defined for girl students is given below:

> *The program intends to see that female students are able to use localized software for ICT access. Female students are demonstrating competency in basic computer skills. They are using Internet as a medium of communication and are generating web content in the local language. Students are also able to use word processing and graphics editing software to create content in the local language. They are using ICT skills in their routine activities. They have a need for more localized software to advance their skill level. They act as new learners of ICT within their school and motivate other female students to learn the skills through localized software.*

A graduated list of Progress Markers[21], divided into expect-to-see, like-to-see and love-to-see levels, were then developed for each of the four Boundary Partners. These Progress Markers define interim steps graduating from the current status towards achieving the Outcome Challenge for each Boundary Partner, and are helpful in monitoring progress towards achieving the project targets. The Progress Markers for the female students are listed in Table E.1 below.

While monitoring the development of the technical skills, these Progress Markers were used as a guide to formulate and ask relevant questions of the participants to gauge the change in their general behavior and comfort with using ICTs, e.g. by asking if they were using ICTs for their school work or extra-curricular activities, etc., as mentioned in the love-to-see Progress Markers.

[20] Description of the ideal changes in the behavior, relationships, activities and/or actions of the Boundary Partner. It is the program's challenge to bring about these changes.

[21] A set of indicators of behavior change for a Boundary Partner that focus on the depth or quality of change (Earl et al., 2001).

Table E.1: Progress Markers for Female Students

EXPECT TO SEE	
1.	Female students are regularly attending training sessions conducted by project trainer
2.	Female students are using lab facilities on a regular basis during program trainings
3.	Female students are actively participating in program training sessions.
LIKE TO SEE	
4.	Female students are able to make basic use of computers (turn on/off, handle mouse. etc)
5.	Female students are able to access websites and retrieve required information
6.	Female students are able to send and receive emails
7.	Female students are able to communicate using instant messaging facility
8.	Female students are able to create simple documents using word processor
9.	Female students are able to produce simple pictures using a graphics editing program
10.	Female students are able to develop websites
11.	Female students are actively participating in competitions
12.	Female students are aware about the internet etiquette (security issues, sending files, etc.)
13.	Female students are comfortable with use of localized software terminology
LOVE TO SEE	
14.	Female students are showing more awareness about different scenarios (entertainment, sports, world and current affairs etc) then they did before receiving training
15.	Female students are using localized software for their school work
16.	Female students are asking for more opportunities in localized software
17.	Female students demonstrate the desire to take computer as a subject in further studies
18.	Female students are sharing learning with others encouraging using localized software

Each Progress Marker has been monitored periodically during the project and progress recorded using the Outcome Journal(OJ). Within each journal, a low, medium or high value was assigned to each Progress Marker, every time it was monitored. Nine OJs were recorded for male and female students during the project monitoring phase, while seven OJs were recorded for female and male teachers, longitudinally assessing their progress through the course of the project. Figure 3.1 below indicates the times at which Outcome Journals were recorded for the female and male students. One OJ was compiled before each training session e.g. OJ1 for students was filled before Phase 1, OJ4 before Phase 2 and OJ7 before Phase 3. This ascertained the baseline competency of the trainees in particular learning areas. In addition to acquiring a measure of the baseline competency of the skills

being taught in second and third training sessions, OJ4 and OJ7 also helped record observations regarding retention of skills taught in the preceding training.

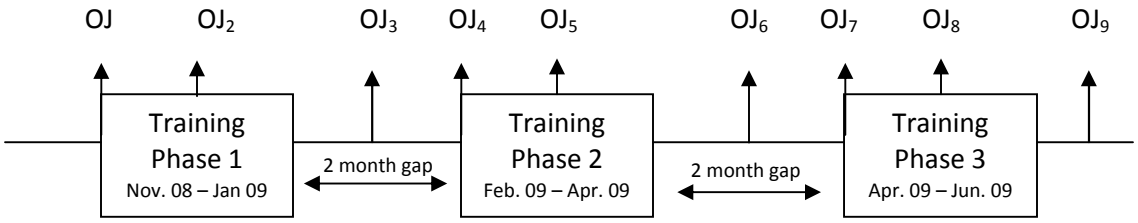

Figure E.1: Timeline for Recording Outcome Journals for Students

In addition, OJ2, OJ5 and OJ8 for students were compiled during the training. Finally, one set of OJs were filled during the two month's gap between two training phases. OJ3 was recorded during the gap between Phases 1 and 2, OJ6 was recorded between Phases 2 and 3, and OJ9 was recorded after the training completion. This last journal also contributed to computing the final score against the Progress Markers developed for the students.

Outcome Journals were also recorded for male and female teachers separately. Figure 3.2 presents the timeline for the seven OJs for the teachers. In addition to the skills acquired, the OJ also recorded the changes in attitude towards learning and using ICTs.

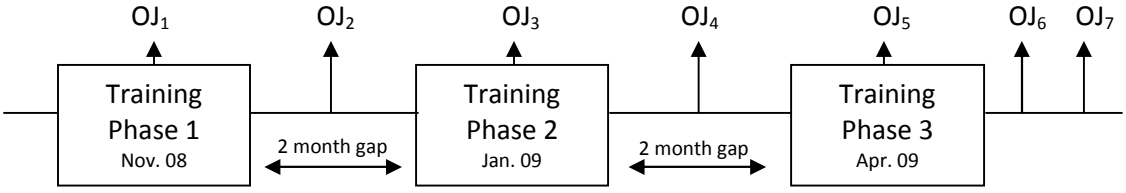

Figure E.2: Timeline for Recording Outcome Journals for Teachers

Various data gathering tools were developed and used to assess progress against the different Progress Markers for each Outcome Journal. These measures included ICT literacy tests, in-class competitions, attendance sheets, daily observation forms, surveys and face to face interviews. Attendance records and daily observation forms were used to monitor progress against expect-to-see markers. Progress against most of the like-to-see markers, the core of the outcome challenge, was recorded based on ICT literacy tests and competitions. Face-to-face interviews were used to assess progress along the love-to-see markers.

APPENDIX F: Challenges in Software Localization into Urdu

The localization process included the identification of English text to be translated, translation of this text into Urdu, incorporation of the Urdu text back into the software application and testing the software for any translation errors. A total of 38,000 multi-word phrases were translated from English to Urdu in the localization process, as per details given in Table F.1.

Table F.1: Number of Multi-Word Strings Translated per Software Application

Suite of Applications/Application	Phrases Translated
SeaMonkey (includes Navigator, Mail & Newsgroups and Composer)	10,000
OpenOffice.org (includes Writer and Draw)	26,000
Psi	2000

After translations had been incorporated into the applications, they were tested to identify any problems with the localization. Some examples are explained below.

1. **Misplaced placeholders:** Figure F.1 below shows an example where the source string to be translated is *The web site %S does not support encryption for the page you are viewing.* Here *%S* is a placeholder for a variable, and is misplaced during translation as shown in the figure. The string inserted for the placeholder *www.google.com.pk* appears at a linguistically incorrect position in the translated version. Errors of this type can occur due to linguistic (lack of knowledge about the nature of the placeholder) or technical (due to insufficient bidirectional support for right-to-left languages like Urdu) reasons.

2. **No capitalization in Urdu:** When a button is being referred to in English, the capitalization of the first letter and the syntax makes it clear that a button is being referred to. For example, in the text from SeaMonkey: *Click Finish to create this new profile.* It is clear that *Finish* refers to a button due to capitalization. However, Urdu does not have capitalization so there is no straightforward way to identify the button in the translated text. Single quotes were used in the translation to make such cases unambiguous. So the sentence was translated as

یہ نئی پروفائل بنانے کے لیے 'تکمیل کریں' کلک کریں

3. **Context dependency:** A word may be translated differently into Urdu based on the context in which it is being used. Knowledge of such context is available during the *review but may not be available to transl*ators during the translation process. This also introduces the possibility of multiple

translations for the same word, making the translation process more complex, even with automated translation memory tools. For example, the term *View* is translated as منظـر in the NLA glossary, which is fine when the term is a noun but when it is a verb as in *View Attachments*, this translation can be incorrectly extended into the verbal form منظر کریں. One could translate it differently in the latter context, but in the case of the project the word was translated into ـر which works for both contexts.

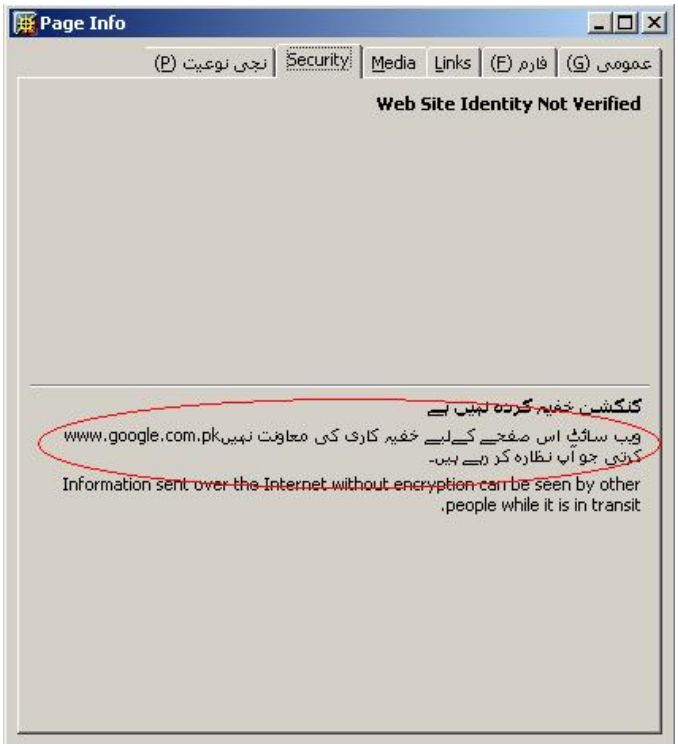

Figure F.1: Misplacement of Placeholder in Translation during Localization

4. **Non-existence of concept in Urdu:** The sound associated with the English word *Beep* does not exist in Urdu, and has been translated as پیں by the NLA glossary, which is close but sounds awkward in this context. The string Beep twice was encountered in Psi and was eventually transliterated into بیپ for this reason.

Many categories of issues were found, which were resolved in the localization process. Care was taken to incrementally develop a translation policy document so that such issues could be resolved consistently across different translators and over time (see Huda et al. (2010) for details of the localization process).