SDNP-IUCN

PAN Asia ICT R&D Grant Project

ICT Assisted Learning Tool for the Deaf in Pakistan

Final Project Report

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Synthesis

The visual Pakistan Sign Language (PSL) forms an integral part of communication of Pakistan's deaf/hearing impaired people. PSL presently contains approximately 4000 different gestures with diverse dialects. The project started with a challenging multi-purpose aim of not only coming up with a selected set of usable Pakistan's sign language gestures but also introduce information technology in the overall context of utilizing research techniques for evolving usable information technology for education tools for the community. To facilitate uniformity in use and enhance the access to PSL for improving literacy of the deaf, ICTs as a communication medium and learning instrument were explored through this project in a formal manner for the first time in Pakistan.

The project phase-I explored, developed PSL's symbol set. To infuse environmental concerns for the first time in the deaf curriculum, new PSL for environment terms were developed as a pioneering activity. A literature review of available PSL resources and a document detailing the methodology for compiling a representative set of new and existing PSL are included with this report. These results were the basis for evolving technological education variants under Phase-II work that pertains to modeling of PSL for CD packs using the Web medium. Urdu alphabets to PSL converter software and PSL font structure were developed. The last two phases focused on researching to evaluate the multiple teaching approaches involving ICTs and exploring the various options of online/offline instruction techniques for the deaf. Thus the study findings resulted in the development of a quality CD based learning tool for hearing impaired, which is now being distributed through the Pakistan Association of the Deaf for the benefit of the community.

Research Problem

The visual/gestural PSL forms an integral part of communication of Pakistan's deaf people. For linguists however, PSL is a relatively new area of investigation as it is in a developing stage and like any other language is subject to changes, improvement and growth. Due to incoherent efforts in history, available literature on PSL was never synthesized to formulate a holistic view. Presently the deaf community in the country is divided due to the difference in sign languages used, and ways to teach deaf children in schools. As a result isolated communities of deaf people have developed their own dialects that are not easily understood by others. So gathering of standard signs set was an essential constituent of the project.

Noticeably, more and more domain information experts and deaf educators and teachers are acknowledging the need to improve the situation for the next generation of deaf children. Although there are some excellent examples of schools for deaf children in Pakistan, it is not possible in the near future to provide sign-language assisted education for all deaf children in separate schools for economic, cultural and logistical reasons. The ICT assisted approach hence is an effort to explore cost-efficient method having greater magnitude of outreach.

This project had two basic research and development objectives. First, we had proposed to conduct an analysis to integrate a representative set of Pakistan Sign Language symbols through collation of existing and development of new signs. This set the basis for the next two phases, which simulated these symbols on CD using web technologies and reviewed through a micro and a macro level research respectively, the relative efficiency and effectiveness of variants of information technology as a communication medium and learning instrument for deaf in Pakistan.

Research Findings – Phase I

Phase 1 of our project is based on the established fact that deaf people encounter difficulties in communication and as a result suffer from sub education. Being able to synthesize and make accessible their language would undoubtedly be of major use in both achieving goals of this

project and in augmenting education and daily communication of deaf. Accordingly we undertook to gather existing PSL as well as develop new standard signs. We have now compiled representative PSL data sets. Work on Phase 2 in progress at present, focuses on PSL interface designing and creating connectivity with the application for CD production. Major findings with reference to the process so far have been:

- Data collection by observation of signing is one of the most important kinds of data to obtain. During the standardization process, it was measured that, it is also one of the most difficult methods and requires persistence, trust building and alignment with the SL interpreters.

- Pakistan Sign Language is an independent language in which the signs directly represent the concepts. The signs of PSL are the equivalent of the words in Urdu.

- We can postulate three categories of signs in PSL. arbitrary; indexic & iconic. Arbitrary symbols share no physical characteristics with the things that they symbolize and iconicity is only possible in signs with meanings that lend themselves to visual characterization. Deaf people find it easier to remember / invert signs of which they can perceive an iconic relation between the sign and its referent. Accordingly, when explaining terms (environment terminologies in our case) for developing new signs, it was easily comprehendible for PSL learners when either pictorially demonstrated or provided sufficient details and definition through signing. This inference was useful since the environmental concerns were being introduced to deaf through PSL for the very first time. During the development of new signs it was also observed that specific rules apply within the PSL and are unconsciously known by PSL users. Most signs are made in a limited area extending from the top of the head to just below the waist; the signing space is limited on the sides so as to form an imaginary square with the top and bottom.

- The history of PSL can be outlined through major processes undertaken by Sir Syed Deaf Association (SDA), Anjuman Behbood-e-Samat-e-Atfal (ABSA), National Institute of Special Education (NISE), and the Pakistan Association of Deaf (PAD). The developments include:

    - SDA work undertaken by Syed Iftikhar Ahmed was a pioneering initiative towards development of PSL. Of the 750 signs constituting the work, the Urdu alphabetic signs are recognized to date without controversy. However the other signs are the ones specific to the Rawalpindi region and thus not used commonly all throughout the country.

    - In 1986, ABSA compiled the first ever research manual on PSL in form of a dictionary. The work continued and translated over the following eleven years to publish seven booklets comprising signs of dictionary words, relationships, seasons, anatomy, and numeration. Attempt was also made for the first time to present a story in sign language covering full sentence structure.

    - NISE, established in 1976 realized the need for developing a standard PSL to prevent adoption of a wide range of differing signs for expressing the same meaning. In 1991 first publication carrying 1350 signs encompassing 27 topics was brought out through mutual consensus by representatives of 21 deaf associations all over the country. Regional variations were also recorded. A second PSL volume comprising 1600 signs bearing higher abstractions of specific terms used in subjects like science, mathematics, social studies and islamiat as well as grammatical terms was brought out in 1994.

    - PAD, started as a voluntary deaf club, continues to focus efforts towards

increasing the receptive and cognitive language development of deaf students as an aim to improve their level of education. It has worked in conjunction with Institute of Educational Development (IED), Aga Khan University at Karachi for raising the need to subsume PSL as an integral mode of instruction in our educational system. This was emphasized to discourage failure rate due to hampered tutoring that comes by way of merely using speech. PAD studied teaching methodologies at different deaf schools in the country and reassessed and updated the existing signs through a team of PSL experts. As part of this Project, signs for environment terms were also developed, which is a pioneering work in the field carried out in collaboration with SDNP – IUCN. PAD has compiled and will be publishing its work in form of several books.

All these efforts have strengthened PSL as a representative language of Pakistani deaf and reasserted its importance as an indispensable instrument for enhancing the learning of deaf. All the available resources have been documented in the form of a repository. The works by NISE, PAD and ABSA provide comprehensive and standardized data on various subjects. The lesson plans are being modeled on themes selected from these resources and will be sequenced according to the system of education.

Research Findings – Phase-II

I – Findings on efficacy of using ICTs for teaching to and learning of deaf

Groups of children took part in a Sign Demonstration Task Phase (SDTP), administered as a pre and post test exercise. The SDTP was not computer based, but was text-based and used similar alphabets and words as that of the software. Participants' sign language achievement in the pre and post-tests was scored for signing errors, which gave the following results:

Table: Making Sign Errors

Experimental Group – EG

Students	Pre test	Post test
E1	08	02
E2	19	05
E3	16	05
E4	05	01
E5	15	07
E6	13	02
E7	11	02
E8	04	00
E9	21	05
E10	16	08

EG Pre-test Values	**EG Post-test Values**
$\sum \mathbf{x} = 128$	$\sum \mathbf{x} = 37$
$\boldsymbol{\mu} = \sum \mathbf{x} / n = 128 / 10 = 12.8$	$\boldsymbol{\mu} = \sum \mathbf{x} / n = 37 / 10 = 3.7$
$\boldsymbol{\delta} = \sqrt{1934/10 - (128/10)^2} = 5.4369$	$\boldsymbol{\delta} = \sqrt{201/10 - (37/10)^2} = 2.53$

Control Group – CG

Students	Pre test	Post test
C1	17	14
C2	11	11
C3	09	07
C4	15	16
C5	07	05
C6	24	22
C7	20	20
C8	23	21
C9	20	16
C10	16	13

CG Pre-test Values	**CG Post-test Values**
$\sum \mathbf{x} = 162$	$\sum \mathbf{x} = 145$
$\mu = \sum \mathbf{x} / n = 162 / 10 = 16.2$	$\mu = \sum \mathbf{x} / n = 145 / 10 = 14.5$
$\delta = \sqrt{2926/10 - (162/10)^2} = 5.49$	$\delta = \sqrt{2397/10 - (145/10)^2} = 5.4268$

The results of the study revealed that subjects in the experimental group, made fewer sign errors in the post-test. The mean number of errors was reduced significantly (pretest 13, posttest 4, Difference in mean = 9). The standard deviation of the score was also minimized from 5.43 in pretest phase to 2.5 at posttest.

These results are remarkable not only group-wise but also at individual level. For example, in experimental group, the highest achievement was recorded in two cases. In E9 case, the number of error was recorded 21 on pretest but his posttest results showed 05 errors, means he learned 16 Urdu alphabets and related words with the help of software during the 15-days training session. High achievement was observed in E2 case as well where the deaf child learnt 14 alphabets and words during the period of fifteen days.

On the other hand, the results of control group children remained almost same in the pre and post text scenario. The mean error score of this group was 16 on pretest and 15 on posttest. The standard deviation was also 5.49 and 5.43 respectively. The results show that learning sign language normally is a slow process. It was difficult for a teacher to handle children in a group. Once children were distracted it was difficult to regain their attention and interest level.

An exceptional result was observed in Control Group's C8 case. This child had severe discrimination problems in four Urdu alphabets. His teacher reported that during the last three weeks she worked with him but a continuous failure depressed her. The child was later made to learn through the ICT tool. The teacher admitted that this software attracted child's attention a lot. He practiced again and again but felt secure to practice alone. Finally he learnt these four alphabets over a period of 8 days. The inference we draw in this particular case is that child felt anxious in front of other children who were quicker than him is learning and responding. He had made a self- impression that he cannot learn these alphabets and suffered from an inferiority complex. But when he was provided an opportunity to learn through a Tool where he had the option to revise the signs as many times as he wanted and learn the alphabets and words, he felt more confident, his self-esteem became stronger and in working alone he left expectancy of failure and made fewer errors.

Some children faced difficulty in processing and accommodating to the pace of a single alphabetic episode. According to them sign and speech are fleeting and then gone. But we like pictures and printed words. The software provides an interactive Tool that the deaf students can tangibly maneuver to study, manipulate and make some sense of. Even though they may not adjust themselves with the speed, they enjoy seeing an alphabet or word connected to a picture and its sign.

With the exception of teachers who noted improvements in the quality and quantity of language learning through manual system, the investigator failed to effectively document noticeable changes in the performance of control group children. Teachers' remarks may be influenced due to the part of their job.

II – Findings on efficacy of Tool technology

In experimental group, the CD based application required extensive resources and supporting softwares to run. Some of the systems also generated errors because of varying software configurations. Following were the most common errors encountered on the PAD lab computers:

- Java Script error;
- Error due to unsupported Media Player version
- Space limitation

Overall the interface design was not very appealing to the young deaf students. The color and picture features actually captured their interest and attention level but also need improvement in terms of presentation and size. The instructions were also not clearly displayed and therefore the participants required more help while they used the CD.

Owing to time and resource limitations, instead of using two approaches (one each for web and CD versions), it has been concluded that Flash Application is a more appropriate technology as opposed to Media Player. There are several reasons for that:

- In Flash environment, as we will not be using Java Script being used in the present Application, the errors arising due to different system configurations will not be there;
- The size of the various components and of the entire application can be greatly reduced.
- Using Flash, the Application interface can be designed more attractively and will provide users more flexibility.

Moreover, the procedure of copying the entire CD manually onto the systems and running from index file was complicated and users faced problems in getting started to use the CD. It is therefore required that an Autorun setup be accompanied with the Tool to make it user-friendly.

The CD is thus now a flash based to incorporate the above mentioned points.

A discussion on the efficacy of ICT Tool was conducted with the teachers of the deaf. Following impressions were recorded: People with impaired hearing have difficulty in developing satisfactory language skills because some of them hear only loud sounds mostly as vibrations rather than as tonal patterns and have to rely on vision rather than hearing as their primary means of communication. Since an obvious advantage of using ICT Tool is that computers can interact through both written and sound media, thus this

technology can be of big help in using total communication approach for communicating with deaf people both academically and generally. Furthermore, the teachers pointed out that for students even in advanced classes, a major problem is seen in the spelling of Urdu and English vocabulary. They therefore suggested exercises to be included that can test this aptitude of students.

The students also filled out a questionnaire. According to the feedback on the potential uses of the Tool, mostly the deaf people would like to use the Tool academically and to facilitate communication amongst themselves and with the hearing people.

Order of priority	Potential uses of ICT Tool for Deaf	Percentage
1	To learn PSL vocabulary according to academic level for ease in understanding course materials	36%
2	To assist communication between deaf and hearing people	33%
3	To learn Urdu language	25%
4	Miscellaneous	6%

Research Findings – Phase-III

- The third phase impact of using electronically available sign language for enhancing learning/teaching was studied at a macro level. It included deaf individuals, parents of deaf and deaf teachers/interpreters belonging to various deaf institutions of Pakistan. Selected data sets were published in CD and web.
- The study was conducted in Karachi, Islamabad and Quetta.
- The apparatus of the macro study was a structured (pre-coded) questionnaire which was available to the participants in both English and Urdu languages. For deaf participants interpretation in sign language was provided by Pakistan Association of the Deaf (PAD). The purpose of the apparatus was to measure the respondents' preferences, understanding and opinion related to ICT Tools based on Pakistan Sign Language. Mainly it concerned to evaluate the role played by Information and Communication Technology in the learning of deaf people.
- Reliability and validity for the apparatus have not been reported in-depth. The apparatus was not focus on measuring and assessing learning rates. It means that it was not prepared as an assessment test, it rather provided participants' opinions related to developed ICT Tools.
- The results indicated that majority of the teachers and schools' principals found the ICT tools easy or fairly easy to use while half of the parents and deaf students' group also have the same feelings (54% and 51% respectively). The remaining participants either felt it difficult or not easy to use. The results indicated that majority of the teachers in schools and students find the tool easy to use.
- The role of ICTs in deaf people learning was also recognized and ICT tool is considered as a useful tool in the overall learning of deaf people.
- The features of ICT tools pertaining to video plus audio, competency exercises, pictures, instructions, text and sketches were considered as helpful features by the parents, deaf students and teachers.

- The integration of ICT tools was considered as an important element in deaf institutions.
- Overall the tool was considered a revolutionary in context of Pakistan. The repetition provision in the tool was appreciated and the usage of original videos was considered an excellent idea to communicate the exact sign.

Overall the tool was seen more popular with pre-primary and primary grades. Secondary grade students found certain sections such as learning grammar and traffic signs more interesting. For more details, please see the accompanying document on the macro-level study.

Fulfillment of Objectives

Overall the objectives have been fulfilled. The key outputs of the project are:

- A well researched Pakistan Sign Language Compendium/dictionary of 500 words
- 50 New Environmental terms were compiled and thus enriched the Pakistan Sign Language.
- Font Conversion Utility that converts a character into its sign language variant
- ICT based Pakistan Sign Language learning tool consisting of alphabets, basic Urdu/PSL grammar and traffic signs.

Project Design & Implementation

The project has been designed to go through three phases of development

Phase 1 Survey and collection of Pakistani Sign Language (PSL) symbols:
The compilation was scheduled for the initial four months and stands completed. The Phase implicated research; collection and documentation of existing/ new PSL symbols from all over Pakistan. The research on the history and development of Pakistani Sign Language to date was scientifically documented. Research methodology relied upon a literature review and feedback from a number of stakeholders that were selected to reflect the milestone PSL progress work. Interviews were conducted with key professionals, PSL experts and teachers from special organizations. Interviews examined many of the problems related to current practices and gathered views and perspectives on potential options for the accessibility of PSL by the sector. Data was collated by analyzing available PSL resources and observations of deaf people using those PSL symbols.

For developing and standardizing new PSL symbols for Environmental terms as well as updating grammar / general vocabulary a national seminar was organized by SDNP-IUCN in collaboration with PAD. Through a presentation, relevance of environmental knowledge as part of Deaf education was deliberated and accentuated keeping in view SDNP-IUCN's goals of sustaining development. The working sessions to devise national Pakistani sign language (environment) that all are capable of learning and understanding were led by experts from Pakistan Association of the Deaf. The session was well represented by sign language experts from nine cities of the country namely Larkana, Karachi, Lahore, Rawalpindi, Sukkur, Sargodha, Hasilpur, Pind Dadenkhan, & Bahawalpur. Selected environmental terms had been provided by SDNP-IUCN to PAD in advance. PAD had shared these terms with the representatives of deaf associations, and teachers of hearing impaired children all over Pakistan so as to allow ample time to them to come

prepared in the seminar. The signs were discussed and agreed upon by common consensus before being finalized and recorded. Each participant's analysis was included to represent a sign. Important regional variations were also recorded. Subsequently, a compendium of 55 new environmental signs was produced. In later sessions signs for grammar and several other themes were also revisited and updated. A memorandum of understanding was signed between P.A.D. & the participants once all signs were finalized. A professional artist was engaged for illustrating the signs developed and standardized. During the course of the session, participants emphasized the value of signing for teaching the deaf children & also mutually agreed that deaf people needed signing for communication even though some of them had speech and were fluent with their oral communication.

Available standardized PSL and newly developed environmental signs are appended with this report. The principal investigation was led by researcher Dr. Nasir Sulman, in collaboration with IUCN Education Programme and SDNP. SPL signs have been organized and gone through for scan and animation to be linked up with the CD application.

The event received much recognition within the community and relative sectors. It was also picked up by local press and electronic media both nationally and internationally.

Phase 2 — CD-ROM production & research on impact of ICT assisted learning / teaching of Deaf – Spread over a 5-month period. The subtasks of PSL interface designing and creating connectivity with the application for CD production was finished in July. Urdu-to-PSL converter utility software for converting typed Urdu to Pakistan Sign Language (PSL) was developed.

The small-scale/micro research on effectiveness of ICT used in teaching/learning by deaf was conducted.

Phase 3 — Wider research on impact of ICT assisted learning / teaching of Deaf – macro research was conducted and thus the ICT base learning tool CD was modified based on the results.

Project Outputs & Dissemination

Following Projects outputs were disseminated.

- A well researched Pakistan Sign Language Compendium/dictionary of 500 words
- 50 New Environmental terms were compiled and thus enriched the Pakistan Sign Language.
- Font Conversion Utility that converts a character into its sign language variant
- ICT based Pakistan Sign Language learning tool consisting of alphabets, basic urdu/psl grammar and traffic signs.

The launching of the CD ROM got wider coverage in the most widely distributed English language of Pakistan. The link is following

http://www.dawn.com/2004/03/08/local10.htm

The website www.special.net.pk also contains the contents of CD in downloadable form.

Project Management

The Project Management Team consisted of the following staff & resources:

- Project Head/Team Leader: overseeing the overall conceptualization and implementation of the project
- Research Specialist/Consultant: a PhD in Special Education was inducted in the team to conceptualize, conduct and implement the research component.
- Research Coordinator: looking after the research aspects of the project and coordinated the research efforts among the learners, research specialist and teachers.
- IT Coordinator: overseeing the development of the ICT Tools for Special Education
- A graphic designer firm was hired for the purpose of graphic designs and implementation
- An illustrator was hired for drawing the necessary illustrations.

In addition, technical and thematic input was sought from appropriate staff of SDNP/IUCNP as and when required.

Throughout the project our main thrust has been to promote the use of ICTs for sustainable development. Our observations and learning through the duration of the project period have been following:

- The special sector in Pakistan is fragmented. It was our observation that the political dynamics was complex.
- Special sector work is taken as a charity exercise and the institutions involved in this sector are used to charity frameworks and they act accordingly. In our opinion our approach was more development oriented – something that was a bit new in Pakistan's special sector.
- IT is taken as an elite tool – but now the situation is improving with the introduction of computers in the schools.

The resources provided for the project were sufficient.

Impact

The tools developed through the process of the project have introduced a major incremental step in the overall learning designs for deaf. ICT is being taken as a tool for empowerment and our efforts have contributed to that. The launching ceremony of the CD was attended by many dignitaries who will influence on the development process. The children, teachers and parents of deaf children have appreciated the efforts and they will be the main advocates. In the context of environment and conservation – the major impact pertains to the introduction of environmental signs in the Pakistan Sign Language.

Overall Assessment

Our Assessment is following:

- The project has strengthened the foundation of research in special sector by building up a compendium of Pakistan sign language on CD
- The project has laid down the foundation of the use of ICT tools for hearing impaired/deaf in Pakistan's context
- For the first time proper environmental awareness terms have been introduced in Pakistan Sign Language.
- The project has been able to interlink the efforts of many people who are working for the development of sign language.

Recommendations

Following are our recommendations:

- The PAN Asia Program needs to disseminate and showcase the work of the project at various forums outside Pakistan. For that purpose financial support needs to be provided.
- A new project can also be suggested based on the outcome of the existing project.

Accompanying Documents

Document 1: Micro Research Study

Document 2: Macro Research Study

Document 3: CD – Pakistan Sign Language learning tool

Sustainable Development Networking Programme, Pakistan

The Sustainable Development Networking Programme (SDNP) Pakistan is a part of the Education, Communication and Knowledge Management Group of IUCN - The World Conservation Union's Pakistan Programme. Formerly a global programme of UNDP, SDNP has been working since 1992 to promote access to information on sustainable human development among different sectors of society. It has been the pioneer of email and offline Internet in Pakistan, but lately its focus has been on developing knowledge management systems to strengthen development information services in Pakistan.

Apart from launching the Pakistan Development Gateway (PDG), SDNP has trained more than 260 organizations from the development sector to set up, maintain and update their websites, contributing significantly to the local content about Pakistan on the Web. This training in Web publishing has also been conducted in Urdu and Sindhi. More than 160 information rich Pakistani websites - related to both Government and NGO sectors – have been set up as a result of this activity. Other initiatives undertaken by SDNP include the creation of district websites and cyber community centres, promotion of open software like Linux, special training for women in Information and Communication Technologies (ICTs), work on District Management Information System (DMIS), and development of information gateways on the themes of water and northern areas of Pakistan.

IUCN – The World Conservation Union

IUCN - The World Conservation Union was founded in 1948 and brings together 79 states, 113 government agencies, 754 NGOs, 36 affiliates, and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership. Its mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable. Within the framework of global conventions IUCN has helped over 75 countries to prepare and implement national conservation and biodiversity strategies. IUCN has approximately 1000 staff, most of whom are located in its 42 regional and country offices while 100 work at its Headquarters in Gland, Switzerland.

In Pakistan, the Union seeks to fulfill this mission by empowering communities to participate in the implementation of the National Conservation Strategy.

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