Production of accessible reading materials including science and mathematics books for the students with print disability of class I-class-X through DAISY standard

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Abstract

Globally, Information Communication Technology (ICTs) is being leveraged to empower people and improve the quality of life of the citizens regardless of their age, sex, race, social status and physical ability. Use of ICTs has enables the visually impaired students to read and learn from their digital books. However, in developing countries, students with visual impairments are not encouraged to study mathematics and science. Our project intends to introduce Digital Accessible Information System (DAISY) based education materials as a useful tool to mainstream 'inclusive education' at school by ensuring accessible reading materials including mathematics and science books in Bangladesh.

Keywords

ICT in Education, disability, visual impairments, accessibility, multimedia talking books, DAISY

1 Introduction

Use of ICTs has exerted significant impacts in the vital sectors of human development e.g., education, health, agriculture, women's empowerment and human rights etc. Global experience shows that the implementation of ICTs empowers and develops the quality of life of every citizen regardless of their classes and physical disabilities [2]. The advent of new technologies has changed the learning pedagogy and improved the teaching-learning environment all across the world. As a tool for ICT in Education, DAISY has been used as a supplementary education material for the students with print

disabilities. DAISY helps to overcome the digital divide in developing regions of the world and to ensure accessing information for the people with print disabilities such as visually impaired, language minorities in a community, indigenous populations who do not have their own script, and those who are illiterate [3]. Our project aims to mitigate the problems of the students of Class-1 to Class-X who has print disabilities by providing DAISY standard accessible reading materials including science and mathematics books.

According to World Health Organization (WHO), visual functions can be classified into four categories e.g. Normal Vision, Moderate Visual Impairment, Severe Visual Impairment and Blindness. There are 248 million people with visual impairments living in the world. Among them, 39 million are blind and 245 have low vision. About 90 percent of visually impaired people are residing in the developing countries; around 65 percent of them are over 50 years old. It has been estimated that around 19 million children under 15 years are visually impaired [4].

While illustrating the particular scenario of Bangladesh, the WHO states that approximately 15% people are Persons with Disabilities(PWDs) among them Prevalence of Disability among Working-Age (18-65) Population Disability prevalence (expanded)19.6% in Bangladesh who has at least one disability [5] and 50 % of this population is visually impaired [6]. In addition to different physical disabilities, Bangladesh is moreover struggling with rampant illiteracy. The literacy rate is 48% (54% for male and 41.4% for female) which also requires an alternative education method rather that of the conventional one [7]. These issues hinder the efficiency of the excising massive human recourse in Bangladesh, and the increases unemployment [8]. As almost 52 in 100 people are illiterate, they are considered as "Print Disable" and need assistance while reading and writing. Accessible information and reading materials including science and mathematics book has not been available to this group.

The students with visual impairments are facing the following problems:
- Due to inadequate set-up of specialized schools, many of the students with visual impairments are semi-literate or illiterate
- Due to lack of supplementary education materials and teacher's training, the students with visual impairments are not encouraged to take science and mathematics
- Due to lack of primary and supplementary education materials, the students with visual impairments cannot properly study the curriculum of the normal students.

2 Related work:

(a) Education Policy 2010 of the Government of Bangladesh

The education policy 2010 has reference to the education of children with disabilities.

Article 21 states that *"The facilities of the schools including toilet and the scope of smooth movement will be adequately designed and created with special attention in order to fulfill the accessibility and special needs of the all Students with Disability"*. **Article 22** states that *"Special and preferential attention will be given to the needs of students with disability"* and **Article 23** states that *"At least one trainer will be recruited in each of the PTIs to facilitate the special teaching methods and needs of various types of challenged learners"*. **Section 18** of the education policy refers to the *"Education for challenged learners: Special education"*. The policy states that *"special education will be provided to the acutely handicapped children who cannot fulfill the demands of daily life due to their physical or mental disabilities. These children are incapable of studying in the usual schooling system. Other than special education, they will be brought under efficient remedial system, special care and nursing"*.

Government of Bangladesh (GoB) has also defined a wide range of some strategies within the policy to support the education of children with disabilities.

(b) Present Scenario on education systems of PWDs in Bangladesh

There are three alternative education systems for children with disability, i.e. Special, Integrated, and Inclusive educational systems. Besides, home based education program and distance education program is also practiced.

1.1 Special Schools: These schools provide education only to students with learning difficulties and physical disabilities. Under the Ministry of Social Welfare, 5 schools for visually challenged children functions in 5 major divisional cities of the country with hostel facilities to both boys and girls. The schools are in Dhaka, Chittagong, Barisal, Rajshahi and Khulna. Each of which has 20 seats for girls and 30 seats for boys [3]. Even though, Non Government Organizations (NGOs) operate special schools, there is not any reliable information about the number of schools and students [10].

1.2 Integrated Schools: Integrated education program is established by the Department of Social Services (DSS) to provide education for the visually impaired children along with sighted children. In the government sector, there are 64 integrated schools in 64 districts without any hostel facilities [6]. The number of children enrolled in these schools is unknown.

1.3 Inclusive Schools: Compared to integrated school system, in which a particular student has to adapt to the school, inclusive schools make changes to accommodate students with any kind of disability. In Bangladesh, many of these schools are operated by NGO's [10]. For example, the **Sightsavers** [11] is working through its partners and supports children with visual disability and low vision. The major supports include teachers' training on Braille and inclusive education, training of the resource teachers and/or house parents/teachers on inclusive education and Mathematics for blind students, establishment of computer resource center at a school to introduce children with disabilities, particularly blind children, to computers and ICT.

(c) Assistive Technologies and Global Initiatives

The technological development all over the world allow the print disable and visually impaired people to have equal access to information [17]. ICT is being introduced, or more appropriately, being experimented with as a cross cutting theme across all aspects of the development arena including poverty reduction and disability [18]. There are instances in global south countries (including Bangladesh) where ICTs have proved successful to improve the lives of PWDs, socially and economically [19].

In the developing countries, many visually impaired students are studying at different educational institutions. There is still a severe inadequacy of study materials and books for them both in markets and libraries [19]. Since class notes and lectures are uses as primary study materials, the students with print disabilities cannot access it.

A range of diverse initiatives and interventions have been introduced in Bangladesh and other South Asian countries to address the problems and the issues associated with disability and the people affected by it. The alternative formats to print are Braille [12], (DAISY based) Talking Books, E-text and Large Print [18].

Name	Description
Braille Production	The computerization of Braille production has been accepted method in all parts of the world.
DAISY based Talking Books	The Digital recording provides in numerable benefits the analog recording and therefore digital talking books recorded using PC and stored on CD are becoming common in the developed world. Efforts are also being made to provide the benefits of this technology to the developing countries.
E-text	The screen reading software loaded on a PC becomes an excellent reader of electronic text, which is easy to produce and distribute among persons with blindness or print disabilities.
Large Print [8]	The electronic text can be viewed as large print on a PC and the large font printing of the book in e-text has made large print production easier than ever before.

Table 1: Existing technologies for visually impaired people [18] [20] [21]

ICT based methods in the teaching and learning of Mathematics and numeracy is advancing at an exponential rate and is heavily examined in mid to high income countries, such as the United Kingdom and the United States. However, such technological based method focuses greatly on examining high-cost, technological solutions, such as the INFTY project (Suzuki 2011), or the TalkMaths initiative (Pfluegel 2011) [24].

3 Implementation:

(a) Goal and objectives:

The goal of our projects is to ensure accessible study materials including science and mathematics books for the students with visual disability, print disability, learning disability and deprived information of class I to class X. The objectives of the project are:

1. To initiate a process of developing and producing text books including science and mathematics books in accessible format for the students of class I to class X through the use of DAISY standard.
2. To ensure the availability of the multi-media text books and math books through Jatiyo E-Tothyakosh [13] (National E-content repository) in order to minimize inequality of information for the print disable, learning disable, visually impaired and information disadvantaged groups of students from class I to class X.
3. To develop an effective network for disseminating the multi-media DAISY reading materials across the country through community radio, union digital center and different institutions.

(b) YPSA as a partner of the DAISY consortium

DAISY [3] is a digital standard where books and other materials are recorded in order to be played back in audio form for print disabled and visually impaired persons. The contents are first selected to convert into the multimedia digital formats through the DAISY which enables to combine different

levels of text with the option of audio (MP3) that can be recorded with human narration or synthetic speech. DAISY standards consists of a (n): Audio file to convert from text and present aloud, synchronization file to link up text and audio and navigation control option to browse through the audio file with ease.

YPSA [14] is a voluntary, nonprofit, social development organization which has long been working with the poor and vulnerable population, particularly person with disabilities. YPSA partnered with DAISY consortium since 2005 and gathered experiences in producing and distributing DAISY Digital Talking Books (DTBs) to over 500 individual members and 20 organizational members. YPSA established the **I**nformation, Communication and Technology **R**esource **C**entre on **D**isability (IRCD) [15][16] in 2005 to serve people with a disability. IRCD [15][16] has practical experience in harnessing technologies to enable visually impaired people. With the existing expertise and experience, YPSA has been awarded the fund to produce primary level digital talking text books partnered with DAISY Consortium, a not-for-profit international organization dedicated to the promotion of advanced 'audio-books', also known as DTBs. The Consortium is comprised of 55 country and 110 NGO members. All members pay a fee for the development of new technologies and maintenance of the DAISY standard in all products. DAISY technologies promote a set of standards or functional specifications for production of software and audio-books and use of players. The YPSA-IRCD and DAISY [16] partnership launched the DAISY for ALL program to leverage text to speech technologies for converting written materials into audible works. Specifically, the initiative aims to develop DTBs for the print-illiterate throughout Bangladesh. DAISY Consortium provides YPSA [14] [16] with technical support through training and expert advice.

(c) The solution has been developed

Considering the situation, YPSA, along with a2i [22], Prime Minister Office, by the technical support of World Intellectual Property Organization (WIPO), Accessible Books Consortium (ABC), DAISY consortium and Global Alliance on Accessible Technologies & Environments (GAATES) has produced DAISY digital multimedia books, Accessible E-books, Digital Braille Books and math books for the student of class-I to class- X which proved much accessible and cost effective than the in accessible paper books for the students with visual disability, print disability and learning disability.

The project is transforming all the text books including science and mathematics books from class I-class X, to DAISY digital multimedia format, the contents can again be converted into DAISY full text full audio text books including science and mathematics books, Braille and accessible e-books from the source DAISY file. The digital text books are accessible for all including the students with visual disability, print disability and learning disability. It will be cost effective, less time consuming and universally designed so that all children can have an easy access to these reading materials all over the country.

Providing the same text in an audio version is a good alternative for many with these problems. Digital talking books are for 'everyone' who needs accessible information and loves to read. Readers can play the audio and simultaneously watch and highlight the corresponding text. The digital text books have been uploaded on the Jatiyo E- Tothyakosh [13] (National E content repository)

(d) PWDs have been included in different stage for developing the accessible reading materials and math books

80 percent of the staff members of the project are PWDs; 50 percent of them are women with disabilities. The program manager is also a person with disabilities. In preparing the project, planning meetings were held with Disabled Persons Organization (DPO) groups, student with disabilities

together their suggestions. The persons with disabilities were involved with a participatory process to identify problems regarding the existing books and formats. The DPO members, teachers of the Govt. school for the blind, worked hard to interact with the target group, collecting their feedbacks upon which the project has been designed. The PWDs were not only involved in the planning phase but also involved in every phase of the implementation stage such as production and dissemination of accessible reading materials, promoting the use of National E-Content Repository, Use of Digital Braille by the Braille press and implementation, monitoring and evaluation of the project etc. also engaged by the PWDs. It can easily be said that this project is designed by the Persons with Disability for the Persons with Disability.

(e) Why the solution is better than other existing solution

There was no technological solution for accessible book including science and mathematics books production in Bangladesh. The system of manual production of Braille books are not efficient and effective in terms of time, cost and volume of production.

Accessible e-books (E pub 3) including science and mathematics books are being developed that has created disability inclusive publication.

Unicode text with image will be developed which will easily converted into DAISY standard. It's a one-time investment which will reduce the cost.

Digital Braille [12] copies will be developed. Using this system, the Braille production houses can produce Braille books for the students with visual disability, print disability and learning disability. This has reduced 70 percent of the production cost.

DAISY full text full audio multi-media books accessible e books including science and mathematics books and digital Braille books will be developed for the accessibility to the information and education for the students with visual disability, print disability and learning disability of class I-class-X.

The multimedia class rooms can use these DAISY multimedia books for every student. The digital multi-media contents has been uploaded on the national content repository, Jatiyo E- Tothyakosh [13], under the tab 'Online e-book'. These books can be downloaded for free of cost by any person in the world.

(f) Challenges faced:
1) Lack of trained human resource, financial resources: The project is technically and financially supported by WIPO, ABC, Daisy consortium, GAATES and a2i program, Prime Minister Office.
2) Lack of high quality text to speech in Bangla language: We have used the 'Human Narration' for full text full audio Daisy multimedia books.
3) Lack of Unicode text: We have used volunteer to convert the books in Unicode text.
4) Absence of related copyright laws in the country: Project runs the advocacy to get the permission with Govt. and publishers to make the accessible books.
5) Political unrest, natural disaster can disrupt the production: We have rescheduled the activities.
6) Frequent power cut can also disrupt the production of the digital contents: we have arranged interrupter power back up (IPS).
7) Lack of established library service for distribution of accessible reading materials: we have uploaded all the books in alternative format such as e-book, Daisy multimedia books, digital Braille [12] books and Unicode text to national content repository for wider distribution.
8) Lack of awareness on digital contents: we are launching different awareness campaigns.

(g) Scope of the project

A total number of one hundred fifty five books including math books of class I-class X has been converted to multimedia books of DAISY standard which has further be converted into DAISY full text full audio text books, Digital Braille, accessible e-books and math books from the single source file of DAISY format. A process will be initiated for developing and producing the Full text-full audio multimedia books, Braille books accessible e-books, math books etc. through the use of DAISY.

Around one hundred thousand students with visual disability, print disability and learning disability and information disadvantaged group can improve their reading score. The literacy level of the students with print disability and learning disability will be improved also facilitated the implementation of inclusive education initiative.

The science and mathematics books, with necessary support from teachers and instructors will enable students to understand the complex topics of science and mathematics easily. It is expected that, with the introduction of such books, the students with visual impairments can have access to science and mathematics education.

Multi-media digital books including science and mathematics books for class I to class-X are available through Jatiyo E-Tothyakosh [13] to make them available to children with print disability and information disadvantaged groups. Availability of the contents in accessible format will make the students with visual disability, print disability and learning disability confident, self –dependant and literate.

(h) Implementing Authority

Free accessible books (Audio and Braille) including math books for visual impaired students have been made available by a2iI project of the Prime Ministers' Office, through its innovation fund, in 2014. National Curriculum and Text Book Board (NCTB) needs to take on the main responsibility to provide these books to the children. GoB should ensure the steady production of Multimedia Books, Large print, Braille [12] books for the visually challenged at all tiers of education in the country. Also the government needs to support the children with reading materials, including writing frames and stylus. GO and NGOs should also set up Braille library at the national and local levels. There is a need for all educational institutes to have obligatory Braille library. There is a need to facilitate a process with the GoB to ensure these as well as support Civil Society Organizations (CSOs) and DPO's to advocate for ensuring these by the GoB.

(i) Awards and prizes that have been won by YPSA
1. National e-Content and ICT4D champion Award 2010 for DAISY For All in Social Inclusion and participation categories
2. Innovation Grant by access to Information program (a2i) of the Prime Minister Office for DAISY book Production in 2013
3. Manthan Award South Asia, awarded for DAISY for All in Bangladesh[23] in the e-inclusion category
4. 'Youth Solutions! Technology for Skills and Employment', 2013, World Bank and Microsoft Srilanka.
5. Service Innovation Fund (SIF) Award 2015 by A2I, Prime Minister Office.
6. Accessible Books Consortium Award for Accessible Publishing Initiative at the International Excellence Award 2015 held in London Book Fair (LBF)

4 Conclusion

There is huge potential to get students with visual impairments into the human resources through supporting them to be literate. Expeure to mathematics and science education will enable them to get prepared as the 21st century citizen and contribute to future workforce. There are opportunities for NGOs/CSOs/GoB to promote access for the students with visual disability, print disability and learning disability to new information and communications technologies and systems, introduce accessible reading materials incuding science and mathematics books in DAISY standard.The current initiaive has proven an effective solution by ensuring accessible reading materials in our country and it could be replicable to other parts of the world. The DAISY based initiative can certainly reduce the digital devide between the students with visual impairments and students with normal vision, and thus set a positive example for the global South.

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He has specialization in issues of disability and development, disaster and disability, ICTs for development, e-Accessibility and Information accessibility for persons with disability. He is the founder of Chittagong Computerized Braille production Centre and ICT and Resource Centre on Disability. He is actively involved with a number of local, national and international agencies ranging from Bangladesh Visual Impaired Society to APCD Foundation in Thailand. He is also a regular author of National ICT publications like The Monthly Computer Jagat etc. Furthermore, he is a renowned disability training specialist, resource and speaker who regularly contributes these skills at national and international platforms. He can be reached at vashkar79@hotmail.com and/or vashkar79@gmail.com or through cell no +8801718345035.

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