

ICT infused Print to Audio Textbooks: Studying the Effect on English and Hindi Reading Comprehension in Inclusive Classroom

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Abstract

The present research attempts to study the effect of ICT based aural reading with the use of handheld device called "Smart Speak" through specially printed textbooks on the English and Hindi reading comprehension of students studying in class 5. Smart Speak looks like a thick pen which converts printed text into speech. This helps students' facing challenges in reading print to meaningfully engage with the printed text. A batch of 31 sighted students and 3 students with Visual Impairments (VI) studying in class 5, in inclusive education settings, formed the sample for this study.

After establishing the reading proficiency of participating students in English Braille, English Print, Hindi Braille and Hindi Print, researcher made Reading Comprehension Tests was administered as pre-test. The same reading comprehension test was used both as the pre-test and post-test. The purpose of pre-test was to establish non-familiarity of students with the text selected for the intervention. The use of the same test as post-test provided the measure of effect of intervention on the reading comprehension. The data analysis indicated that the ICT based aural reading intervention was found to be statistically extremely significant in enhancing the reading comprehension in both English and Hindi for students with and without VI studying in inclusive classroom.

Keywords: Reading comprehension, Talking pen, Print to Audio, Audio textbooks, studying language in inclusive classrooms

Introduction

For sighted persons, reading is usually understood as the skill of decoding the printed text and verbalizing the same. In the absence of sight, for Children With Visual Impairments (CWVI), reading is a tactile experience. CWVI touch the Braille script letter by letter and read it aloud. Another alternative available to CWVI for reading is, reading by hearing, which may be called as "Aural Reading".

A number of audio books in different style of production are available.

Cardillo Arniew et al. (2007) discussed that the Audio Books are available in read along, single voice narration and full cast audio production format. They also highlighted that audio books would be useful for adolescent readers by providing reading time during transit, serving as model of verbal fluency and by motivating the reluctant readers.

The usage of audio books (both, school-books and books of various genres, recorded on digital media) for preadolescents and adolescents

with developmental dyslexia, during experimental research showed a significant improvement in reading accuracy with reduced unease and emotional-behavioural disorders, as well as an improvement in school performance and a greater motivation and involvement in school activities (Milani, Anna. Luisa Maria et al., 2010), and improved reading fluency, expanded vocabulary, developed comprehension and improved achievement in the adolescents sighted learners (Wolfson. Gene, 2008).

Many studies reported that audio books would be useful in enhancing the language skills of students who are either struggling to read, require special attention, need help in vocabulary building, learning English as second language and need support to stay motivated to read (Milani, Anna; Luisa Maria et al., 2010; Winqwist, Therese, 2010; Wolfson. Gene 2008; Wellner. M, 2008). However, Winqwist, Therese (2010) reported that seventh grade students without disabilities favoured reading over listening as they can read at their own speed and see the pictures in the book. Another study (Wellner M, 2010) revealed that three kindergarteners' experience with audio books varied but they definitely developed positive attitude towards books and reading.

Renee et al. (1996) explored the possibility of including audio books in the children formal reading programme and found that audiotapes could be beneficial to all students but it was indispensable for those with special needs, like, children with low vision or with visual perceptual problems and

children who are auditory learner. Children with Attention Deficiency Hyperactivity Disorder (ADHD) can also benefit from audiotapes as it frees them from continuously sitting at one place to read.

The other benefits of using audio books include introduction of higher level material, including children with special needs (Hsien and Chen, 2004), motivating unwilling readers, enhancing listening comprehension, language competency and improvement in achievement (Maria and Signes, 2014). The challenges identified were accessibility of playback devices, cost involved, technical issues and production time.

No study could be located where usage of audio books was studied for CWVI.

Problems with Braille Books

The Braille textbook are quite bulky as compared to the printed textbooks and often needs to bound in different volumes for ease of handling by the child. It may happen that, in the absence of Braille and audio textbooks, the CWVI were bound to sit as passive recipients in the classroom. Even if children are using Braille Books seated in inclusive classroom than neither the teacher nor the sighted peers are aware of the page number in the Braille Book, of the text being focussed presently in the classroom. The text appearing in the Braille book on a particular page may not be same as the printed books.

Is Braille the only possible solution of addressing the issue of equity and equality for CWVI studying in the schools? Can the bulkiness of Braille books be reduced, so that they become student friendly? Is there a technology which allows usage of same printed material by both children with and

without VI? The present paper explores and studies the technology based solution that is usage of smart speak for CWVI, in inclusive classrooms.

Specific Objectives

1. To study the effect of technology based audio input on Hindi language comprehension of children reading print and aurally (ICT based).
2. To study the effect of technology based audio input on English language comprehension of children reading print and aurally (ICT based).
3. To study the preferred mode of reading (Braille or aural or print) along with reasons by children with and without Visual Impairment
4. To study the usage of Smart Speak by children with and without Visual Impairment

Hypotheses

The following were the hypothesis of this study:

1. There is no significant difference in Hindi Reading Comprehension of children with and without Visual Impairments reading from print and aural.
2. There is no significant difference in English Reading Comprehension of children with and without Visual Impairment reading from print and aural.

Operational Definitions

- Aural Reading: It has been defined as reading the printed text by

utilizing the sense of hearing. In simple words this may also be called as reading with the help of ears.

- Print to sound convertor: It is an interactive electronic device which can convert print into sound line by line or page wise. It is available in the market by the name smart speak.
- Aural reader: The printed text which is pre-coded or specially prepared for use with the smart-speak. The thickness of paper used for this text is slightly more than the normal printed paper used for printing textbooks.
- Comprehension: It is defined as the ability to understand, explain and retain the content read. This may be judged via test to be taken after the reading session is over.
- Children with Visual Impairments: For the purpose of study children with visual impairments are the ones who find it difficult to use vision for day to day activities and corrected glasses are not of much use to them. These children can't benefit from large or regular print text books. The children with blindness will form the sample of the study.

Methodology

Sample

Population comprised of students studying in class five in the schools of Delhi. Students with and without visual impairments studying in class 5 with similar level of education and reading efficiency in Hindi and English language

formed the sample of the study. In all, 3 students with VI and 31 students without VI (sighted) participated in the study.

Research Setting

The setting for this research comprised of the inclusive school. In inclusive school setting, the children with and without VI share the physical space of the classroom and study together through the teaching learning activities planned by the content teacher, engaged in the curriculum transaction. A school with 31 sighted students and 3 students with VI, studying in class 5, became the sample for the study.

Tools

1. Print reading efficiency test

Printed text consisting of a poem named "छोटी सी हमारी नदी" from "Rimjhim", NCERT textbook class 5, comprised of 22 lines and 170 words excluding title and name of the poet was used for establishing print reading efficiency in Hindi.

A text consisting of a poem titled "Sing a song of people" from "Marigold" NCERT English textbook for class 5 consisting 8 stanzas, 4 lines each, with a total of 120 words was used for establishing print reading efficiency in English.

Each sample child was provided the photocopy of the text to read and their errors, if any, were recorded, with their names, and the time taken to read the given text.

2. Braille reading efficiency test

Braille reading efficiency was also assessed for both Hindi and English Language. The texts used for assessing the print efficiency in Hindi "छोटी सी हमारी नदी" and English "Sing a song of people" printed in Braille served the purpose of Braille efficiency test.

3. Reading comprehension Test

Researcher made reading comprehension test from the selected chapters from the second termsyllabus in, Hindi and English for class 5. The items from the selected lessons (4 for English namely Class Discussion, The Talkative Barber, Topsy-Turvy Land and Gulliver Travel; 5 in Hindi namely एक दिन की बादशाहत चावल की रोटियाँ गुरु और चेला बिना बीज का पेड़ और स्वामी की दादी) were prepared and pilot tested. Initially the reading comprehension tests, in both languages, had more than 60 items. Pilot testing of the reading comprehension tests, and consequent difficulty index analysis, led to final selection of 35 items for each test. Each item was objective type, with four options. The respondents were requested to put a tick (✓) mark indicating their choice of option as their answer.

The same reading comprehension test was used both as the pre-test and post-test. The purpose in the use as pre-test was to establish non-familiarity of students with the text selected for the intervention. The use of same test as post-test provided the measure of intervention impact on reading comprehension.

4. Test for Preferred mode of reading

A separate tool was developed to assess the sample students' preference for print, Braille or Aural reading. This test comprised of 7 questions, and includes both objective and descriptive type of questions. This test was also field tested before finalization.

5. Usage of Smart Speak

During the research study the sample students were exposed to Smart Speak for the first time. Usage of Smart Speak Questionnaire gauged the students comfort level with the device used by them and to also seek suggestions for further improvements in the device and its output. Concerns related to different aspects of Smart Speak were listed in the questionnaire, such as pronunciation, pace of speech, handling the device; technology enabled printed text, tactile markings, earphone usage etc. Test comprised of 12 questions, where students were expected to rate the concerns on a 4 point rating scale as Never, Sometimes, Frequently and Always.

Variables

ICT based aural reading was taken as the independent variable. The dependent variables were the English Reading Comprehension and Hindi Reading Comprehension. Student's age and educational level was controlled by selecting purposive sample from the population of class 5 students studying in government aided and recognized school of Delhi.

Data Collection

The data collection, from 3 students with VI and 31 students without VI (sighted), was done in two phases, as detailed below:

- Pre-intervention phase
 - Reading efficiency Hindi (Print and Braille)
 - Reading efficiency English (Print and Braille)
 - Pre-test reading comprehension Hindi
 - Pre-test reading comprehension English
- Post-intervention Phase
 - Post-test reading comprehension Hindi
 - Post-test reading comprehension English
 - Usage of smart speak
 - Preferred mode of reading

Each child whether sighted or VI was given the same test, though the modalities varied as per the presence or absence of the impairment.

Data Analysis

Pre-intervention Analysis of reading efficiency of sample students

The print or Braille reading efficiency in Hindi and English, of the sample students depending on the presence or absence of impairments, was assessed. The time taken by each child to read the text, and the errors such as wrong pronunciation, omissions, additions, and require assistance for reading was recorded. Table-1 provides data for calculating the local norms for reading efficiency of the sample students.

**Table-1: Error Analysis of Print/Braille Reading
Efficiency Test (English)**

S. No.	Mispronounced		Omitted		Addition		Assisted		Total Mistakes		Time (in mins)	
	Eng	Hin	Eng	Hin	Eng	Hin	Eng	Hin	Eng	Hin	Eng	Hin
1.	2	20	18	1	1	0	2	1	23	22	2	2
2.	1	14	20	0	0	0	0	1	21	15	1	3
3.	0	7	18	2	1	0	1	1	20	10	1	3
4.	1	3	18	1	0	0	0	1	19	5	1	1
5.	0	6	19	1	0	0	0	0	19	7	1	3
6.	13	21	18	2	0	0	5	2	36	25	4	4
7.	1	10	16	4	0	0	2	6	19	20	1	3
8.	0	5	0	1	0	0	3	3	3	9	1	3
9.	0	7	1	2	0	0	1	0	2	9	1	3
10.	1	2	18	2	0	0	1	2	20	6	1	2
11.	0	7	1	0	0	0	1	0	2	7	1	3
12.	20	26	1	4	0	0	1	0	22	30	4	7
13.	4	27	18	2	0	0	0	0	22	29	1	4
14.	10	23	15	5	1	0	0	0	26	28	2	3
15.	1	18	19	3	1	0	0	0	21	21	1	2
16.	1	18	17	51	0	0	0	0	18	69	1	3
17.	1	8	19	1	1	0	0	0	21	9	1	3
18.	1	9	18	13	1	0	0	0	20	22	1	3
19.	0	12	19	3	1	1	0	0	20	16	1	2
20.	2	9	20	2	0	0	0	0	22	11	2	3
21.	0	3	1	2	0	0	0	0	1	5	1	1
22.	1	4	19	1	1	1	0	1	21	7	1	3
23.	4	21	19	2	0	0	1	0	24	23	2	12
24.	1	12	7	2	0	0	0	0	8	14	1	2
25.	2	13	22	6	0	0	0	0	24	19	1	2
26.	2	16	19	2	0	0	0	0	21	18	1	3
27.	1	4	20	1	1	0	0	1	22	6	2	1
28.	4	18	8	3	0	0	0	1	12	22	2	4
29.	4	15	0	3	1	0	0	2	5	20	3	3
30.	3	8	1	1	1	0	0	2	5	11	2	3
31.	1	20	3	0	0	0	0	0	4	20	1	3
32.	1	0	0	1	0	0	4	4	5	5	5	4
33.	2	9	0	2	1	0	5	0	8	11	4	8

34.	6	9	0	0	1	0	1	0	8	9	4	5	
Average	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	when N=34	
	2.67= 2.7= 3 (Eng)	12.11= 12 (Eng)	0.38= 0.4 (Eng)	0.82= 0.8 (Eng)	16 (Eng)	1.73 (Eng)							
	12 (Hin)	4 (Hin)	1.6 (Hin)	0.8= 1 (Hin)	16.7 (Hin)	3.35 (Hin)							
	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	when N=31	
	2.64 (Eng)	13.29 (Eng)	0.35 (Eng)	0.58 (Eng)	16.87 (Eng)	1.48 (Eng)							
	12.45 (Hin)	3.97 (Hin)	0.06 (Hin)	0.77 (Hin)	17.26 (Hin)	3.13 (Hin)							
	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3	when N=3
	3 (Eng)	0 (Eng)	0.67 (Eng)	3.34 (Eng)	7 (Eng)	4.34 (Eng)							
	6 (Hin)	1 (Hin)	0 (Hin)	1.34 (Hin)	8.34 (Hin)	5.67 (Hin)							

The data marked in bold in table above is for students with VI.

Local Norms

English Language

For inclusive classroom (all 34 students considered as one unit)

Students reading the given text within 1.7 minute with less than 16 mistakes of any kind were assumed to be efficient readers.

For print efficiency in reading English language (all 31students)

Students reading the given text within 1.48 minutes with less than 17 mistakes of any kind are assumed to be efficient print readers in English language.

For Braille efficiency in reading English language (3 students)

Students reading the given text within 4.34 minutes with less than 7 mistakes of any kind are assumed to be efficient Braille readers in English language.

Hindi Language

For inclusive classroom (all 34 students

considered as one unit)

The efficient reader would be a student making less than 16 mistakes and reading the given Hindi text in less than or equal to 3 minutes.

For print efficiency in reading Hindi language (31students)

Students reading the given text within 3.13 minutes with less than 17 mistakes of any kind are assumed to be efficient readers.

For Braille efficiency in reading Hindi language (3 students)

Students reading the given text within 5.67 minutes with less than 8 mistakes of any kind are assumed to be efficient Braille readers.

Inferences

English Print efficient readers = 6 students out of 31

English Braille efficient readers = 2 students out of 3

Hindi Print efficient readers = 16 students out of 31

Hindi Braille efficient readers = 1 student out of 3

Data analysis for reading comprehension-Pre and post intervention

Table-2 indicates that average mark scored by students in reading comprehension was 10.76 or 30 percent (English) and 10.35 or 29 percent (Hindi), out of maximum 35 marks. This average score might be due to objective nature of the test items, which has possibility of answering correctly even when the respondent is not aware or ignorant of the correct answers. Samuel B. Lysterly (1951), University of North Carolina, reported, an equation proposed by Hamilton for correction of error due to chance guessing of correct answers in objective type of tests. This equation known as Hamilton's equation is based upon the known or assumed distribution of examinee's knowledge, i.e. the distribution of scores which would be obtained if guessing were excluded and each respondent answered only those items which he/she "knew" and refrained from marking those which was not known.

According to Hamilton's formula, the estimated true score (S_i) can be calculated as:

$$S_i = (k R_{avg} - n) R_i / (k-1)R_{avg}$$

Where,

S_i = estimated true score of individual 'i'

k = number of alternatives per item =4 for present research

R_i = raw score (number of items correctly answered) of individual 'i'

R_{avg} = mean raw score =10.76 (English) and 10.34 (Hindi) for present research

n = number of items in the test =35 for present research

Applying this formula to the individual raw scores, for reading comprehension test in Hindi and English, S_i , for each responding student was generated.

The average for estimated pre-test true score (calculated for each respondent separately for Hindi and English, using Hamilton's formula) is 2.56 and 2.07 respectively, for Hindi and English. This establishes that the responding students were unfamiliar with the text planned for the intervention.

Post Intervention

As mentioned earlier, the post intervention phase, witnessed the administration of post-test for reading comprehension in English and Hindi language, preferred mode of reading and ease of use with smart speak device and customized textbooks.

The data analysed is presented in Table-2.

Table- 2: Average mark scored by students in reading comprehension

S. No.	Scores of English comprehension, Max marks = 35				Scores of Hindi comprehension, Max marks = 35			
	Ri (Post-test)	Ri (pre-test)	Si (Post-test)	Si (Pre-test)	Ri (Post-test)	Ri (Pre-test)	Si (Post-test)	Si (Pre-test)
1.	25	16	19.55	3.84	26	14	21.37	2.8
2.	16	9	12.51	2.16	23	11	18.90	2.2
3.	26	11	20.33	2.64	28	17	23.01	3.4
4.	19	16	14.86	3.84	26	12	21.37	2.4
5.	25	17	19.55	4.08	22	7	18.08	1.4
6.	27	13	21.12	3.12	25	10	20.55	2.0
7.	29	7	22.68	1.68	20	12	16.44	2.4
8.	19	16	14.86	3.84	13	11	10.68	2.2
9.	19	8	14.86	1.96	28	8	23.01	1.6
10.	27	14	21.12	3.36	17	11	13.97	2.2
11.	29	13	22.68	3.12	27	12	22.19	2.4
12.	20	10	15.64	2.4	21	9	17.26	1.8
13.	31	15	24.24	3.6	20	12	16.44	2.4
14.	16	9	12.51	2.16	21	7	17.26	1.4
15.	14	3	10.95	0.72	26	7	21.37	1.4
16.	11	10	8.60	2.4	24	12	19.72	2.4
17.	15	12	11.73	2.88	20	5	16.44	1.0
18.	9	10	7.04	2.4	20	10	16.44	2.0
19.	23	9	17.99	2.16	24	12	19.72	2.4
20.	14	7	10.95	1.68	27	11	22.19	2.2
21.	28	12	21.90	2.88	19	12	15.61	2.4
22.	23	12	17.99	2.88	22	8	18.08	1.6
23.	15	2	11.73	0.48	21	6	17.26	1.2
24.	21	4	16.42	0.96	27	12	22.19	2.4
25.	20	10	15.64	2.4	20	6	16.44	1.2
26.	22	13	17.20	3.12	26	8	21.37	1.6
27.	26	7	20.33	1.68	18	11	14.79	2.2
28.	27	15	21.12	3.6	26	10	21.37	2.0
29.	21	7	16.42	1.68	22	10	18.08	2.0
30.	25	9	19.55	2.16	23	11	18.90	2.2
31.	21	16	16.42	3.84	27	9	22.19	1.8
32.	17	10	13.29	2.4	24	11	19.72	2.2

33.	18	11	14.08	2.64	20	12	16.44	2.4
34.	22	13	17.20	3.12	23	16	18.90	3.2
	Ravg (Eng Pre test) 10.76 Ravg (Eng Post test) 21.17		Savg (Eng pre test) 2.56 Savg (Eng post test) 16.56		Ravg (Hindi pre test) 10.35 Ravg (Hindi post test) 22.82		Savg(Hindi pre test) 2.07 Savg (Hindi post test) 18.75	

The average value for the estimated true values of post-test was found to be much higher, as compared with the pre-test averages, this clearly indicates comparatively enhanced familiarity of students with the text. In other words, this indicates that students reading comprehension after the intervention was found to be much better.

t-test

Table-3: Reading Comprehension English Language

	Pre-test	Post-test
Mean	2.58=3	16.56=17
SD	0.92	4.29
SEM	0.16	0.74
N	34	34

t= 20.24, df=33, standard error of difference =0.69

Confidence interval:

The mean of post-test minus pre-test = 13.9759= 14

95% confidence interval of this difference: From 12.57 to 15.38

P value and statistical significance:

The two-tailed P value is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. In other words,

the probability of this difference in mean to occur by chance is one in thousand. Nine hundred ninety nine times, out of one thousand, the difference in mean is due to the intervention.

The null hypothesis "There is no significant difference in English Reading Comprehension of children with and without Visual Impairment reading from print, aural and Braille" is henceforth rejected.

Table-4: Hindi Language

	Pre-test	Post-test
Mean	2.07	18.76
SD	0.53	2.90
SEM	0.09	0.49
N	34	34

t=34.01, df=33, standard error of difference =0.49

Confidence interval:

The mean of pre-test minus post-test = 16.7

95% confidence interval of this difference: From 15.68 to 17.68

P value and statistical significance:

The two-tailed P value is less than 0.0001. This is statistically highly significant. Hence the null hypothesis that "There is no significant difference in Hindi Reading Comprehension of children

with and without Visual Impairments reading from print, aural and Braille” is rejected, and it can be inferred that the, 999 times out of 1000, the difference in mean is due to the intervention given, rather than the chance factor.

Data analysis for preferred mode of reading

All respondents admitted using the device that can read the printed text. Respondents were further probed for exposure of this device, prior to the present research. 27 sighted respondents (87 percent) mentioned that they have used this device in the classroom and the 4 sighted respondents (13 percent) indicated that they have used similar kind of device outside the classroom, that is, in fairs, home etc. On the other hand the three respondents with VI denied using similar device outside the classroom, prior to participating in the present research. This may indicate that a device that can convert printed text into audio is an upcoming technology, and is not easily available to the masses.

Further regarding comparison between the device used in the classroom as part of the research and outside the classroom, indicated that 24 (77 percent) of the responding sighted students preferred the classroom device while 3 (9 percent) students preferred outside classroom device and 4 (13 percent) chose not to respond. Majority of the sighted respondents indicated liking for the classroom device, this might be due to lack of exposure to any other similar kind of device. This part of the survey became redundant for the respondents with VI as they have denied using similar

kind of device outside classroom, prior to participation in the present research.

The reasons provided by the responding sighted students for liking the device varied from- can read through hearing (13 percent), novelty of the device (30 percent), sharing with friends (13 percent) and can read even if you have difficulty in pronunciation (13 percent). The sighted students with exposure to similar device outside classroom stated that the outside classroom device was better as it had added feature of explaining the rule of the game (Ludo, snakes and ladders) they were playing with the help of device. One respondent also mentioned that if he/she had to use the device outside the classroom than they have to spend money. The students with VI liked reading with the device as it could read the printed text, in other words the printed text became accessible to them.

The pie chart presents the experience of students with smart speaks inside the classroom. 100 percent of the responding sighted students had positive experience with the device though their responses indicated that their experience varied in degrees of good, very good and outstanding.

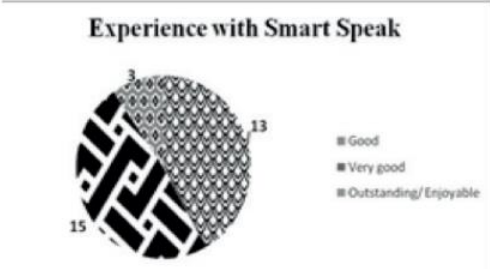


Figure – 1

Difficulties faced in the use of Smart Speak



Figure – 2

Figure-2 is for the responses seeking the opinion of the responding sighted students' regarding difficulties faced during the usage of smart speak, wherein the majority (25/31=80 percent) said no difficulty was faced. The remaining 20 percent indicated that the difficulty faced was due to ear phone not working (10 percent) and the device got switched off in between (6 percent).

On the other hand, the 2 students with VI out of three faced no difficulty while reading with smart speaks, in inclusive classroom setting. One student with VI who faced the difficulty in the use of smart speak, mentioned that though he/she enjoyed reading with smart speak the difficulty was faced due to the earphones.

Next, the responding sighted students were asked, "If given a chance how they would like to read with smart speak or without smart speak? And why". The response analysis is presented in figure -3.

Preferred Mode of reading

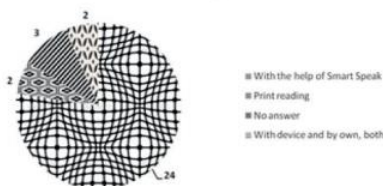


Figure – 2 Response analysis

Majority of the responding sighted students (77 percent), preferred reading with the smart speak. The reasons for preference varied from enjoyable to read with smart speak (16 percent), effortless reading (19 percent), ease of use (16 percent) and quick reading (6 percent). All the three students with VI, preferred to read with the smart speak. The reasons for choosing or preferring to read with smart speak over Braille, as mentioned by the responding students with VI includes reading through Braille is tough; this is more enjoyable and provides effortless reading.

Data analysis for usage of Smart Speak

To assess the ease in using smart speak, a 12 item checklist was administered in the inclusive classroom room. Around 50 percent of the responding sighted students found the voice of the device both, in Hindi as well as in English always clear where as 100 percent of the students with VI found the voice in both Hindi and English to be always clear, with clear pronunciation and audibility. The pronunciation and audibility in Hindi (64 percent) was always found to be better than in English (58 percent), by sighted students. Ease of identification of tactile markings was reported to be (always 33 percent, frequently 67 percent) for the pictures and (always 67 percent, frequently 33 percent) for the text, by respondents with VI. All the respondents with VI felt that the tactile markings were never in excess. The opinion of sighted students were found to be mixed with respect to the ease in identification of tactile markings (always 51 percent for texts, always 54 percent for pictures)

and number of tactile points (never 13 percent, always 45 percent). All the respondents with VI opined that the speed of speech was never fast where as 35 percent sighted students found the speed of speech to be never fast, the rest of the sighted respondents' were of mixed opinion (sometimes 16 percent, frequently 12 percent, always 33 percent). The respondents with VI expressed their willingness to use the device (always 100 percent), as it was convenient to use (67 percent), all keys on the device were easy to identify via touch and convenient use of earphone (67 percent).

Major Findings

- The null hypothesis “there is no significant difference in Hindi Reading Comprehension of children with and without Visual Impairments reading from print, aural and Braille” was rejected as the P values at the 0.0001 was indicating the difference in mean to be statistically extremely significant.
- The intervention was found to be beneficial for enhancing the reading comprehension in Hindi for students with and without VI studying in the inclusive education setting.
- The intervention was found to be beneficial in enhancing the reading comprehension in Hindi for students with VI studying in inclusive classroom.
- The intervention was found to be beneficial in enhancing the reading comprehension in Hindi for sighted students studying in inclusive classroom.
- The null hypothesis “there is no significant difference in English Reading Comprehension of children with and without Visual Impairments reading from print, aural and Braille” was rejected as the P values at the 0.0001 was indicating the difference in mean to be statistically extremely significant.
- The intervention was found to be beneficial for enhancing the reading comprehension in English for students with and without VI studying in the inclusive education setting.
- The intervention was found to be beneficial in enhancing the reading comprehension in English for students with VI studying in inclusive classroom.
- The intervention was found to be beneficial in enhancing the reading comprehension in English for sighted students studying in inclusive classroom.
- Majority of the responding sighted students (77 percent), preferred reading with the Smart Speak.
- The reasons for preference of Smart Speak over print by sighted students, varied from enjoyable to read with smart speak (16 percent), effortless reading (19 percent), ease of use (16 percent) and quick reading (6 percent).
- Students with VI (100 percent) preferred to read with the smart speak. The reasons for preferring to read with smart speak over Braille includes reading through Braille is tough; this is more enjoyable and

provides effortless reading.

- 27 sighted respondents (87 percent) mentioned using this device in the classroom only and the 4 sighted respondents (13 percent) mentioned using similar kind of device outside the classroom, in fairs, home etc. whereas as respondents with VI (100 percent) denied using similar device outside the classroom, prior to participating in the present research.
- 100 percent of the responding sighted students had positive experience.
- Students with VI (67 percent) faced no difficulty while reading with Smart Speak, in inclusive classroom setting, while the rest (33 percent) who reported facing difficulty in the use of smart speak, mentioned that though the experience of reading with smart speak was enjoyable the difficulty was faced due to the earphones.
- 100 percent of the students with VI found the voice in both Hindi and English to be always clear, with clear pronunciation and audibility.
- The pronunciation and audibility in Hindi (64 percent) was always found to be better than in English by 58 percent sighted students.
- Ease of identification of tactile markings was reported to be (always 33 percent, frequently 67 percent) for the pictures and (always 67 percent, frequently 33 percent) for the text, by respondents with VI.
- All the respondents with VI felt that the tactile markings were never in excess.
- The opinion of sighted students were found to be mixed with respect to the ease in identification of tactile markings (always 51 percent for texts, always 54 percent for pictures) and adequacy of number of tactile points (never 13 percent, always 45 percent).
- The respondents with VI expressed their willingness to use the device (always 100 percent), as it was convenient to use (67 percent), all keys on the device were easy to identify via touch and convenient use of earphone (67 percent).

Results

The ICT based aural reading modality in the format of customized textbooks and handheld device was experimented in the inclusive education setting with the purpose to observe the impact on reading comprehension in English and Hindi, for students studying in class 5. The data analysis indicated that the ICT based aural reading intervention was statistically extremely significant for both languages in inclusive education setting. The intervention was also found to be effective for students with and without VI.

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