CHAPTER V

SUMMARY AND CONCLUSIONS

“What surgeons start, educators have to finish”

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5.1 Introduction

“Caitanyam sarva bhutanam shabda bramheti me matihi”

“Shabda (Sound) is an integral part of our life” is the meaning of the statement from Hindu scriptures. According to Dandi, a Sanskrit scholar, “If sound is removed from the world, then the world becomes dark” (Prasad, 2011). It carries information and is given utmost importance in day to day life and spiritual development by the sages of Sanatana Dharma. Hearing is an essential sense for human beings for safety, communication, education, social interactions, and many more. Ear, one of the five sense organs in the human body is designed structure to receive sounds. When there is some problem in the ear, hearing process is hampered which may be tentative or permanent and which leads to a condition called hearing loss, hearing impairment or deafness. Technically normal hearing is considered as from -10 to 25dB and hearing loss is considered from 26 to 91dB and above. There are different types and different degrees of hearing loss.

5.2 The effect of hearing impairment on development

Deafness interferes with language development due to lack of auditory feedback hampers speech development. It has adverse effects on a child’s potential for literacy and educational development (Dominguez & Algeria, 2010; Ruggirello & Mayer, 2010). It leads to problems in social integration, vocational choices, and
personal achievements. Other great detriment of hearing impairment is that it is an invisible handicap, hence more difficult to identify early in life especially in children. Hearing loss results in tragic waste of human potential, particularly when parents, teachers, and other professionals have not been provided information that will assist them in serving their child (Hull & Dilka, 1984). Therefore, as it is a serious concern it has to be identified as early as possible and remediated i.e., to improve both ‘functional and psychological’ contributions leading to quality of life (Francis et al., 2002).

5.3 Linguistic Skills in children with hearing impairment

Linguistic Skills: Linguistics is the scientific study of human language. According to Adrian et al (2010), Linguistics can be broadly divided into three categories: Language form-phonology, morphology, and syntax; Language meaning – semantics and pragmatics; Language in context – language manipulation by cultural, historical, and social factors. According to Quigley and Paul (1984), language handicap is the biggest hurdle in the education of the hearing impaired. It is observed that in spontaneous written language, hearing impaired children commit many syntactic errors. It is almost similar to telegraphic language i.e., with omission of prepositions, conjunctions, case and tense markers etc. They are unable to write complex and compound sentences. Therefore, the present study is focused on Linguistic Skills in children with cochlear implants. And the primary focus of this study is to concentrate only on three aspects of linguistics i.e. phonology, syntax and semantics as these form the basics of language and considered as problematic areas of children with hearing impairment.
5.4 Reading in children with hearing impairment

Reading: According to Leipzig (2001), Reading is making meaning from print. It requires identifying the words in print- a process called word recognition, Construct an understanding from them- a process called comprehension, and Coordinate identifying words and making meaning so that reading is automatic and accurate – an achievement called fluency. Reading Comprehension basically refers to an understanding of the information. The ultimate goal of reading is to comprehend and respond. For Reading Comprehension to occur, written words need to be correctly decoded, and comprehension is required in order to understand the message conveyed by words and sentences (Wass, 2009). As mentioned earlier, hearing loss also negatively affects the development of reading abilities because phonological processing, one of the fundamental prerequisites for reading takes place in the auditory areas of the brain (Werker & Tees, 2005). Neural imaging has shown a strong relationship between phonological processing and reading skills (Gabrielli, 2009; Strickland & Shanahan, 2004). Therefore, the present study is focused on Reading Comprehension in children with cochlear implants. Moreover, Linguistic Skills and reading skills form strong basis for education. Factors or details like age at onset of deafness, length of auditory deprivation, age at implantation, duration of implant use, main mode of communication and school setting etc., are important to study as many of these factors identify their relative contribution to implant benefit. And the present study is focused on child and family related factors, clinical related factors and Educational related factors.

5.5 Hearing from cochlear implants

When a child is diagnosed with hearing loss, he is fitted with an appropriate amplification device like body level hearing aids, behind the ear hearing aids (BTE’s)
or cochlear implant etc. Technological advancement has led to invention of cochlear
implant as a boon to many of children with hearing loss. But whether the child should
be fitted with a cochlear implant (CI) or not is usually decided by cochlear implant
teams based on child’s medical reports, observation reports in clinics, evaluation of
hearing on a regular basis and communication development of the child after
attending regular speech and language therapy and listening training. A cochlear
implant is an advanced amplification device. It consists of two main parts: an external
part and an internal part. A speech processor which is an external part has a
microphone which selects the sound and transforms the same sounds into electrical
signals. These signals move to the receiver which is implanted and then they are
transmitted to the cochlear wherein the electrode array is situated. The active
electrodes in the array stimulate the auditory nerve cells and then they are transmitted
to the brain. Perception and Interpretation of sounds is done in the brain (Arlinger,
2007). The listening from a cochlear implant of a child is not the same as normal
listening. One strong reason being cochlear implant is a device. These signals from
the cochlear implant do not possess the similar fine acoustic signals as the speech-
signal in normal hearing. Thereby, a degraded signal is received by the brain
affecting speech sounds and the development of spoken words symbols and in the
long-term memory (Harnsberger et al, 2001; Pisoni et al, 2008). To facilitate spoken
language development is the primary goal of paediatric cochlear implantation
(Yanbay et al., 2014). Early exposure to word-learning opportunities is severely
restricted in persons with profound hearing loss. But the experience is reflected as
different in most of the children with cochlear implants. It is reported that there are
numerous benefits of the cochlear implant, most notable improvements are access to
more fine sounds, spoken language, social skills, and greater confidence (Bosco et
al., 2005; Archbold, 2008; Spencer, Tomblin, & Gantz, 2012). This suggests that the improved access to speech from a CI helps in achieving better sense of well-being, quality of life, and increase in confidence and social activity (Francis et al., 2002). Furthermore, it is noted that many children with cochlear implants develop language skills that enable to function in mainstream environments along with hearing peers (Geers et al., 2009).

5.6 Need and importance of the study

According to Census of India 2001, there are over one million people in India with hearing loss which accounts for 0.1%. Within the age range of 0-14 years, there are 16.7% children with the hearing loss (Government of India, 2001). As per NSSO 2002 report there were 30.62 lakhs persons with hearing impairment. As per AYJNIHH & KEM, Mumbai (2006) the incidence of hearing impairment in high risk neonates is 3.97%. As per WHO project -POCD, AIISH (1996 to 2007), the incidence of Hearing impairment is 3.29% to 7.67% in infants and 9.07% to 38.1% in school going children (Basavaraj, 2007). In recent times, there are many options available for individuals with hearing impairment with the advancement in technology. One of the noteworthy advances in amplification technologies is a cochlear implant which has become popular in both paediatric and adult persons with hearing impairment. A vast amount of literature highlights the benefits derived from cochlear implants in most of the areas: spoken language, language, communication, and in social context (Archbold, 2008; Bosco et al., 2005; Fortum et al., 2007; Hess et al, 2014; Phillips et al, 2009; Spencer, Tomblin & Gantz, 2012;). By December 2010, the number of people wearing cochlear implant worldwide was 2, 19,000 of which more than half are children (Raeve et al., 2012). However, in spite of the large benefits, cochlear implants still remain a challenge for many persons with hearing
impairment in India. There are variety of reasons such as majority of the population are located in rural areas (i.e.72%), low literacy rate, limited access to medical technology, and high birth rate (Vaid et al., 2009), and the cost. In majority of cases, the cost of implant is borne by the families of cochlear implant receiver. In India, as per the estimate, approximately 3000 individuals are implanted as compared to 30,000 adults and 30,000 children implanted in United States in the year 2009 (Jeyaraman, 2013).

India is a country of 1.14 billion with a cultural and linguistic diversity which stands as another important challenge for cochlear implantation in children. Majority of the clinics involved in cochlear implant habilitation programs preferred only the caregiver’s language as the choice of language for therapy (Jeyaraman, 2013) which would be a regional language in most of cases other than English language despite the fact that most of the parents of children with cochlear implants would prefer their children to get enrolled and study in English medium schools. Although majority of children take training in caregiver’s language would end up in English medium schools. One main reason could be non-availability of quality regional language schools in the local areas. Even though in India for majority of them English is not the caregiver’s language, children are being enrolled in English medium schools. Considerable research has been carried out in early screening of children with hearing loss and children with cochlear implants, majority of these studies were on speech development, audiology and related technological aspects. But very few studies have examined the educational related aspects as to how parents work with these children in home how these children exist in regular schools etc. Even though the rate of cochlear implantation in young children with severe and profound hearing loss have been rising due to the reported success rates in speech and language acquisition,
questions remain about the long term benefits of this device in terms of educational related benefits for these children in India.

5.7 Synthesis of Review of Literature

An extensive literature review presented has given an insight into the research studies carried out in the field of children with hearing loss and particularly children with cochlear implants. To summarize, many studies have emphasized the potential benefit of cochlear implants in various areas for children with hearing loss (Archbold, 2008; Archbold et al., 2002; Bosco et al., 2005; Fortum et al., 2007; Geers et al., 2011; Hess et al., 2014; Phillips et al., 2009; Spencer, Tomblin & Gantz 2012). One study by Fitzpatrick et al., (2012) emphasized the benefit of hearing aids compared to cochlear implants. Numerous studies have highlighted the reasons of parents for getting their children implanted (Hardonk et al., 2011; Hyde, Punch & Komesaroff., 2010; Hyde, Punch & Komesaroff., 2010; Hyde, Punch & Grimbeek., 2011; Wass et al., 2008). In children with hearing loss, as mentioned in the previous chapter, major struggles were related to speech, language, reading development. To understand them with evidence, researcher had reviewed literature, several studies that focused on these aspects and which were carried out research in variety of ways were found (Cannon & Kirby, 2013; Fitzpatrick et al., 2011; Hogan et al., 2010; Jackson & Schatschneider., 2014; Jerger et al., 2013), and related to reading development (Banner & Wang, 2011; Cawthon, 2011; Dominguez & Alegria, 2010; Easterbrooks & Beal-Alvarez, 2012; Friedmann & Szterman, 2011; Harris & Terleksiti, 2011; Lederberg et al, 2014; Nikolaraizi, Vekiri & Easterbrooks, 2013; Palmer, 2000; Parault & Williams, 2010; Park, Lombardino & Ritter, 2013; Swanwick et al, 2012; Wang et al, 2013; Watson, 1999). In addition to this, the researcher tried to understand through reviewing the literature the impact of cochlear
implants in enabling children with hearing loss to overcome their challenges with respect to speech, language development (Bell et al., 2001; Boons et al., 2012; Castellanos, 2014; Chillosi et al., 2013; Clendon et al., 2003; Francis & Lam ho et al., 2003; Guo, Spencer & Tomblin, 2013; Kronenberger, 2014; Nittrouer et al., 2014; Remine et al., 2003; Spencer & Guo, 2013; Tobey et al., 2004; Yoon et al., 2004) and reading development (Asker-Arnason et al., 2007; Asker-Arnason et al., 2010; Bouton et al., 2011; Kant et al., 2010; Dillon, Jong & Pisoni, 2012; Geers & Hayes, 2011; Lyxell et al., 2008; Lyxell et al., 2009; Lyxell et al., 2011; Nittrouer et al., 2012; Wass et al., 2010). While reviewing, researcher found various studies emphasizing the factors influencing speech, language and reading development in children with cochlear implants such as early diagnosis of hearing loss, family involvement, early implantation, and mode of communication (Harrington et al., 2010; Yanbay et al., 2014; Ching et al., 2014; Davidson et al., 2011; Dunn et al., 2014; Geers et al., 2013; Mikic et al., 2014; Ruggirello & Mayer, 2010; Salas-Provance et al., 2014; Lesinski-Schiedat et al., 2004; Watson et al., 2006), duration with cochlear implant (Fagan & Pisoni, 2010; Percy-smith, 2010), and other combined factors (Powers, 2011; Tobey et al., 2011; Wang et al., 2011). Furthermore, researcher also found studies related to communication, psychosocial, emotional, pragmatic, social relationship in children with cochlear implants. (Dammeier, 2010; Edwards et al., 2006; Huttunen & Valimaa, 2010; Jeddi et al., 2014; Most, August & Meilijson, 2010; Nunes, Pretzlik, & Olsson, 2001; Percy smith et al., 2008; Wiefferink et al., 2013). Numerous studies have emphasized on the need of educational support to be provided to them (Archbold & Mayer, 2012; Anderson et al., 2004; Bennett & Lynas, 2001; Checker et al., 2009; Convertino et al., 2014; Giezen, Baker & Escudero, 2014; Ingber & Dromi, 2010; Inscoc et al., 2009; Yoshinaga-Itano, 2014; Marschark & Knoors,
From the review above, it was realized by the researcher that there were very few studies conducted on Linguistic Skills and Reading Comprehension in children with cochlear implants in Indian context. In addition to this, researcher developed the curiosity to explore the educational support being provided to these children in Indian context as they were studying along with normal hearing children in regular schools. Very few studies have been conducted that examines and highlights the educational support required for these children with cochlear implants in mainstream schools. It is well known fact and many research studies have highlighted that children with hearing impairment have linguistic and literacy problems which might not be a new area to be investigated but main purpose or the uniqueness of the present study is to understand in Indian context whether the advancement in amplification technology i.e., use of cochlear implants could in anyway remediate linguistic and reading difficulties of children with severe or profound hearing loss. Consequently, not many studies have been conducted in these areas for children with hearing impairment. Review of literature in Indian context in these terms needs further investigation. Hence, a need was felt to undertake the present study.

5.8 Statement of the problem

The present study is proposed to investigate Linguistic Skills and Reading Comprehension in Kannada children with cochlear implants between the age ranges 6 to 11 years, living in and around Mysore and Bangalore cities. They are unilaterally implanted, reported to have no other additional disabilities, and were studying in regular English medium schools along with normal hearing children. The influence and the relationship between Linguistic Skills and Reading Comprehension in children with cochlear implants with respect to child and family related factors,
clinical related factors and educational related factors was also proposed to be examined.

5.9 Objectives of the study

Based on the literature discussed, following objectives and hypotheses were framed:

1. To compare the Linguistic Skills and Reading Comprehension of children with cochlear implants with standard norms.
2. To examine the relationship between Linguistic Skills and Reading Comprehension in children with cochlear implants.
3. To examine relationship of factors namely, number of siblings, age at testing, age at diagnosis of hearing loss, duration of deafness, age at using of hearing aid, duration with hearing aid, age at implantation, duration with cochlear implant, and duration of training with Linguistic Skills and Reading Comprehension.
4. To study the influence of factors namely, gender, father’s occupation, mother’s occupation, father’s education, mother’s education, cause of hearing loss, mode of communication, speech intelligibility, type of training before formal schooling, class in school, and academic achievement on Linguistic Skills and Reading Comprehension.
5. To study individual cases of high performers and low performers in Linguistic Skills and Reading Comprehension.
5.10 Hypotheses of the study

Before framing the following hypotheses for the study, it was assumed that children with cochlear implants performance neither significantly influenced nor significantly related by any of the 20 factors listed in the table 3.1. Therefore, the null hypotheses are framed.

1. There is no significant relationship between Linguistic Skills and Reading Comprehension in children with cochlear implants.

2. There is no significant relationship of factors namely, number of siblings, age at testing, age at diagnosis of hearing loss, duration of deafness, age at using of hearing aid, duration with hearing aid, age at implantation, duration with cochlear implant, and duration of training with Linguistic Skills and Reading Comprehension.

3. There is no significant influence of factors namely, gender, father’s occupation, mother’s occupation, father’s education, mother’s education, cause of hearing loss, mode of communication, speech intelligibility, type of training before formal schooling, class in school, and academic achievement on Linguistic Skills and Reading Comprehension.

5.11 Operational definitions

To convey the explicit meaning, an attempt has been made by the researcher to explain the key terms used in this study.

**Children with or using cochlear implants:** In this study, children with cochlear implants will include those children who are implanted and who do not have any additional disabilities.

**Linguistic or Language skills:** In the present study, it refers to the ability to perform the tasks related to phonology, syntax, and semantics
Phonology refers to identifying and discriminating the sounds and includes phonemic discrimination and expression.

Syntax refers to grammar rules of language and includes morphophonemic structures, Persons Number Gender markers, plural forms, tenses, case markers, intransitives, Transitive’s causatives, predicative’s, sentence types, conjunctives, quotations and comparatives, participle constructions, conditional clauses, and

Semantics refers to meaningfully using words and sentences and includes semantic discrimination, and expression.

Reading Comprehension: It refers to the ability to comprehend and respond to the questions about a story passage presented in the form of stimulus to the child. Those questions are related to literal comprehension which refers to answering direct questions, reorganization which refers to answering indirect questions, and inferential comprehension refers to using one’s own thinking and experiences to answer the questions.

Cause of hearing loss: It refers to the suspected reason which might have caused hearing loss in a child with hearing loss in the present study.

Age at testing: It refers to the chronological age of the child with cochlear implant at the time of administering Linguistic profile test and Kannada Reading Comprehension test.

Age at diagnosis of hearing loss: It means the age of the child at which child was diagnosed or identified as having hearing loss by an authorised doctor.

Duration of deafness: It refers to the length of the time the child had suffered deafness without any formal diagnosis by an authorised doctor.

Age at using of hearing aid: It refers to the age of the child at which an appropriate hearing aid suitable to the child was fitted by an authorised audiologist.
Duration with hearing aid: It means the length of the time the child was using the hearing aid fitted to him in his day to day life.

Age at implantation: It refers to the age at which cochlear implantation surgery was done to the child and cochlear implant device was fitted.

Duration with cochlear implant: It means the length of time the child had been using the cochlear implant device in his day to day life.

Mode of communication: It refers to the way to communicate, in the present study it specifically refers to using oral way or speech, and oral way as well as sign language to communicate.

Speech intelligibility: It means the speech clarity in children with cochlear implants i.e., how clearly others are able to understand the speech of these children. In the present study, it was divided into three categories for the purpose of assessing children: Good, if children speech is like any other normal hearing speaking child except for few sounds; Average, if children speech is neither very clear like normal hearing speaking child nor very poor to understand, and below average, if children speech is very poor to understand most of the time.

Type of training before formal schooling: It refers to any form of training attended by the child with cochlear implant before getting admission into a regular school for normal hearing children. However, the difference between the categories i.e., early training refers only to listening training and speech language therapy whereas early training and special school refers to training in listening through cochlear implant, speech language therapy, and also training in educational concepts such as pre-academics (reading, writing, and mathematics) with pre-education concepts( for e.g. basic concepts in environmental sciences)
**Duration of training:** It means the length of the time the child with cochlear implant had attended any form of training before getting admission into a regular school for normal hearing children.

### 5.12 Variables of the study

Linguistic Skills consisting of three aspects namely phonology, syntax, and semantics; Reading Comprehension and 20 factors as listed in table 3.1 are the variables under study.

### 5.13 Procedure of the study

For the present study, both Quantitative and Qualitative methods were used and the study is descriptive in nature. The study was conducted in two extensive stages as follows.

**Stage 1 Selection of participants:** It consisted of selecting the participants as per the inclusion criteria using purposive and snowball sampling techniques. It includes sampling procedure, inclusion criteria for selecting participants, description of participants and the tests.

**Stage 2 Data collection:** It involved collecting the necessary data by administering standardized tests on the participants, description of the tests, and procedure for data collection.

### 5.14 Sampling Procedure

As mentioned earlier, in India the rate of cochlear implantation is quite low due to many reasons and the major reason being cost involved. Therefore, to fit the purpose of the study, *purposive sampling technique* was used to choose the sample based on the inclusion criteria. In this regard, two clinics, two institutes and one early intervention school working in the area of children with cochlear implants were
contacted. Sixty three children’s details were obtained. Using *snowball sampling technique* from parents, a list of additional five children was obtained.

In total, a list of 68 children with cochlear implants was obtained. To find out as to whether these 68 children can be included in the study as per the inclusion criteria, each child was contacted over phone to obtain their details. Among them four had invalid contact numbers, 31 did not satisfy the inclusion criteria hence were not eligible to be included as sample, five expressed their unwillingness to participate in the study. Therefore, out of 68 children, 40 were not included and the remaining 28 children who satisfied the inclusion criteria were included. Accordingly, appointments were taken from their parents as per their convenience for data collection. Repeated calls were made to remind and confirm the appointment dates and timings. The researcher visited the house of each child personally to collect the necessary data for the study. Locating each child’s home address was very challenging and time consuming. Travelling took major time to reach the children. In case of some children, researcher had to travel to remote and interior places to locate the homes of children. When tested for intelligence, one of the inclusion criteria, three children were found to be below average. Hence, finally for the study, data was collected from 25 children with cochlear implants.

5.15 Participants

Children with cochlear implants were selected as sample for the study based on the following inclusion criteria:

1) Children diagnosed with severe to profound hearing loss.

2) Unilaterally implanted

3) Chronological age range: 6 to 11 years

4) Average or above average intelligence
5) No reported physical or sensory additional disabilities
6) Use of cochlear implant at least for one year
7) Native speakers of Kannada
8) Medium of instruction at school is English
9) Language chosen for training after implantation for one year is Kannada
10) Geographically living in Mysore and Bangalore cities in the state of Karnataka, India.
11) Studying in regular schools for normal hearing children

5.16 Description of participants

Twenty five pre-lingual profound children with hearing impairment (15 boys and 10 girls) age ranging from 6 to 11 years (mean age 7.8 years) participated in this study. They were diagnosed with severe to profound bilateral hearing loss before 36 months of age. Among 25 children, only three children had acquired hearing loss and the remaining 22 had congenital hearing loss i.e., by birth. The cause of hearing loss was unknown in 11 children, hereditary and consanguinity in 8 children and caused by infectious diseases and other reasons like delay in birth cry etc in 6 children. As is routine practice, all the children were fitted with bilateral conventional Behind the Ear Model hearing aids. Later, they were recommended for cochlear implant. All 25 children had unilateral implants. The children were implanted between the age of 1 and 7 years (mean age at implantation 4.1 years). They had been using their implants more than 1 year (mean duration of implant use 3.1 years). All children had early training. Eighteen of them attended special preschool for children with hearing impairment. Their main mode of communication was oral mode but two children also used sign language. Only one child had deaf parents and all other 24 children had
hearing parents. For inclusion as a sample of the study, a normal IQ was essential, as measured by Raven’s progressive coloured matrices (Raven, 1986).

5.17 Details of the Tests

1. To test intelligence as inclusion criteria for the sample, Colour Progressive Matrices (CPM) developed by Raven (1986) was used.

2. To test Linguistic Skills in children with cochlear implants, Linguistic Profile Test (LPT) developed by Karanth (1980) was used.

3. To test Reading Comprehension in children with cochlear implants, Kannada Reading Comprehension Test (KRCT) developed by the Ramaa (1984) was used.

4. Case history form prepared by the researcher was used to collect the relevant information of children with cochlear implants.

5.18 Statistical Analysis

The data was analyzed quantitatively and qualitatively using appropriate statistical techniques like Descriptive statistics, Frequencies, Percentages and Non-parametric tests including Mann-Whitney U test, Kruskal-Wallis one way ANOVA, and Spearman’s correlation coefficient. These tests were used as the sample size in the study was small and also due to the non-availability of normal distribution curve.

5.19 Findings of the study

There were five challenges namely children with cochlear implants are very small in number and are heterogeneous; Logistical challenges; Availability of only few limited studies in India in the area of cochlear implants; Availability of few standardized tests which are of Indian origin; Limited research from educational perspective. In order to overcome these challenges, to get the best as well as to
increase the internal validity of the study, an attempt was made to analyze and interpret the data from every potential angle as far as possible. Analysis was done at three different levels at Group level – overall and general conclusions, at sub-group level – comparison and in-depth knowledge of different groups at case study level – individual level to get new theoretical views of different cases. Therefore, the analysis of the data was discussed in six sections in order to get the best theoretical views out of the data. In summary, the major findings of the study are as follows

1. Majority of children with cochlear implants lag behind in Linguistic Skills and Reading Comprehension as compared to standard norms of hearing peers i.e., 84% performed below and 16% of children with cochlear implants performed above. And in Reading Comprehension: 88% performed below and 12% of children with cochlear implants performed above.

2. It also highlights that in Linguistic Skills majority of children with cochlear implants had very less problem with phonology component, that means the sound signals that they are receiving from a cochlear implant to a large extent is beneficial, but they had more problems with syntax and semantics components.

3. When Running speech in LPT were qualitatively analysed i.e., when transcribed, there had been problems in children with cochlear implants with clusters and they were committing substitution, omission, distortion and addition (SODA) errors. The interesting thing is all children with cochlear implants in majority exhibited similar errors.

4. The present study also highlights that in Reading Comprehension majority of children with cochlear implants had no problem with literal
comprehension questions i.e., those questions which are direct and clear (e.g. What, Who and How many question forms) but they had considerable difficulty in reorganization and inferential questions where they had to synthesize and use their own thinking (e.g. How and Why question forms).

5. When Influence of factors on Linguistic Skills and Reading Comprehension was tested, significant influence of speech intelligibility was found on Linguistic Skills.

6. When Correlation of factors between Linguistic Skills and Reading Comprehension was tested, significant relationship was found between Linguistic Skills and Reading Comprehension. Furthermore, significant relationship was found of factors namely number of siblings, Duration of implant use with Linguistic Skills. Significant relationship was also found between age at testing and Reading Comprehension.

7. From the case study analysis, the researcher noted that the most important aspects for child’s progress are parent’s involvement, dedication and their practicality; Parents education; child’s personal qualities and interest, absence of siblings; use of oral mode or speech; Pre-implant training; Positive environment in home as well as school; Ongoing training at home, and Social participation.

8. The present study emphasizes to be aware of the specific areas where support is required so that appropriate support is provided to these children if they have reach to their full potential personally, technically, educationally, and socially.

9. While interacting with the parents of these children with cochlear implants, researcher realized that even though most of the parents
expressed their happiness about their child’s progress they also expressed the need for the long-term maintenance of the device and technical support as well as the educational support for their children.

10. It is very important to understand the limitations and benefits of cochlear implant device.

11. None of the children with cochlear implants had any additional educational support from their regular schools such as availability of teacher of the deaf in school, special training in school subjects at an intervention centre etc.

12. Findings from the present study support the notion that parents and professionals should work together to provide meaningful, intentional language and literacy skills to children with cochlear implants from the very young age.

13. In order to improve the quality of training for these children after implantation, the present study strongly advocates for implementation of Response to Intervention (RTI) so as to promote evidence based training practices and accountability on part of professionals involved.

5.20 Educational implications

1. The results highlight the usefulness of the cochlear implants in improving the quality of life of children with severe to profound hearing impairment as they are able to study along with normal hearing children in regular schools.

2. The LPT and KRCT tests were able to identify above performers and Poor performers in children with cochlear implants in comparison with the standard norms.
3. The study reveals that there is a need to: Improve the existing educational support for children with cochlear implants in regular school, teaching learning environment and process; Focus on developing adequate language comprehension; Reading skills, and ultimately improve their quality of life.

4. The tests were able to find the areas where majority of children with cochlear implants were lagging behind in Linguistic skills and Reading comprehension.

5.21 Limitations of the study

1. Small sample size: Considering the rate of implantation in children in India especially in Karnataka state, collecting the details of twenty five children had been very challenging for the researcher from the stage of contacting clinics, institutes and schools for their details till the end stage.

2. Geographical constraints: In and around Mysore and Bangalore cities.

5.22 Suggestions for Future research

1. A study in planning for intervention programs to remediate the problem areas identified by LPT and KRCT tests for children with cochlear implants can be taken up. Later, it would be important to study the effects of such type of intervention program.

2. In the present study, in children with cochlear implants their native language i.e., their proficiency in Kannada has been tested using LPT and KRCT tests. However, if their language proficiency in their school language i.e., English language can also be done which can provide more insights about their language and reading abilities.
3. Not only restricting it to parent’s interactions, it would be very interesting to know the performance and behaviour of these children with cochlear implants if these interactions can be extended to their school teachers and authorities as these children are enrolled in regular school and spend most of the time there.

4. It would also be valuable to study the differences in Linguistic Skills and Reading Comprehension among more number of children with cochlear implants across the different states in India.

5. A comparative study between the performance of children with cochlear implants and hearing aids differences in Linguistic Skills and Reading Comprehension would also give us important information how an cochlear implant is different from a hearing aid.