Development of Communication Strategies Training (CST) module for adults with hearing impairment: A preliminary study on training efficacy in offline and online modes

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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Abstract

Effective communication is essential for social interaction, participation and overall quality of life. However, individuals with hearing impairment often experience frequent communication breakdowns that can lead to frustration, withdrawal and reduced psycho-social well-being. The use of communication strategies (CS) can significantly mitigate these difficulties, but structured training programs tailored to specific languages and cultural contexts are limited. This study aimed to develop and evaluate a Communication Strategies Training (CST) module for native Kannada speaking adults with acquired hearing loss, delivered through both face-to-face and tele-intervention modes.

Forty native Kannada-speaking adults using hearing aids participated in the study. Six self-reported questionnaires- [International Outcome Inventory for Hearing Aids (IOI-HA), Hearing Handicap Questionnaire (HHQ), Self-Awareness of Communication (SAC), Participation Questionnaire (PQ), Assessment of Quality of Life (AQoL-4D), Communication Strategy Scale (CSS) and Communication Scenario Questionnaire (CSQ)] were used to measure hearing handicap, participation, quality of life, use of CS, and application of CS in specific scenarios respectively. These questionnaires were used as outcome measures of CST.

The CST module comprised 6 to 10 hours of hierarchically structured training across eight real-life scenarios, each with three levels of difficulty. These scenarios reflected situations where individuals with hearing impairment commonly face communication challenges. Participants were divided into face-to-face and tele-CST groups based on their choice and were assessed at three time points: pre-training, immediate post-training, and at one-month post-training, using the above-mentioned outcome measures.

Results indicated significant improvements in communication performance, especially in the scenario-based CS application and overall communication ability. While immediate

post-training outcomes were positive, more pronounced benefits were observed at the one-month follow-up, highlighting the importance of continued practice and time for generalization. Importantly, both face-to-face and tele-CST modes were equally effective, supporting the feasibility of remote delivery.

To conclude, this study demonstrates the effectiveness of a culturally and linguistically tailored CST module in improving communication outcomes among native Kannada-speaking individuals with hearing impairment. The comparable benefits across delivery modes suggest that tele-CST can serve as an accessible and scalable alternative to in-person auditory rehabilitation.

Keywords. Communication, quality of life, adults, hearing loss

CHAPTER-1

INTRODUCTION

According to World Health Organisation (WHO), about 80% of the individuals with hearing-impairment live in low and middle-income countries (WHO, 2021), with an ever-increasing disabling hearing loss in India. As per the most recent Indian census presented by National Sample Survey Organization (NSSO, 2021), approximately 63 million (0.3 % of 1.28 billion population) individuals suffer with disabling hearing impairment, which often goes untreated owing to factors like lack of awareness, financial constraints and hesitancy to use hearing aids. To compound these factors, there is severe shortage of Audiologists and hearing health care professionals in the country, causing a significant delay in early identification and rehabilitation. In India, according to Indian Speech and Hearing Association (ISHA, 2021), there are 4036 registered Audiologists and Speech Therapists. While Audiology in India has grown exponentially in terms of manpower development, service delivery and public awareness, there is a dearth of Audiologists that serve a population of 1.28 billion. As a result, many people with hearing impairment are untreated or are unable to utilize their hearing aids to their maximum benefit. Also, National Sample Survey Organization (NSSO, 2021) estimated that about 60 % of individuals with hearing impairment are still not using any type of amplification. One of the recent advancements which bridges the gap of limited professionals is the delivery of the hearing care services (assessment and rehabilitation) through digital platforms known as 'Telehealth services'.

Telehealth is a method of providing healthcare services remotely via distance technologies and has been demonstrated to allow for remote screening, diagnosis, intervention, counselling, education and specialised interdisciplinary care (Ratanjee-Vanmali & Laplante-Levesque, 2020). It also holds promise in addressing the supply and demand of intervention services by increasing access of families with adults who have hearing impairment to

appropriately trained clinicians (Govender & Mars, 2017). This method of remote service delivery is referred to as tele-intervention. With the advent of 4G and 5G internet connectivity and cost effective internet services, tele-assessment and tele-intervention services are increasingly becoming popular in settings where it is difficult or unnecessarily expensive to have the healthcare provider and the patient meeting in person. The application of tele-audiology heightened during the COVID19 pandemic, owing to reasons such as physical distancing, lockdowns etc, where providing audiological services using digital platforms unleashed a new potential of delivering hearing health-care services.

Hearing-health service delivery during COVID-19 is of much relevance to the hearing impairment, whose communication was adversely affected by the government polices to curb COVID transmission including: physical distancing, the use of face masks and shields as well as the increased use of telephone and videoconferencing for distance communication. Consequently, the hearing impaired population experienced greater communication breakdowns and increased social isolation (Pinsonnault-Skvarenina et al., 2021).

Due to the shortage of hearing health services and the pandemic induced delays being significant on hearing aid repair and follow ups (Alqudah et al., 2021) , many hearing impaired individuals cannot fully maximize the benefits of their hearing aids, Audiologists increasingly rely on teaching communication strategies. These strategies serve as a valuable complement to hearing aid use, helping individuals to achieve greater overall hearing benefit. Once learned, these communication strategies can be practiced independently, reducing the ongoing need for direct audiological supervision while enhancing the individual's ability to communicate effectively in various listening situations.

A communication strategy (CS) refers to an approach used to enhance communication, support conversational interaction or address issues that arise during a conversation. It involves

both verbal and nonverbal behaviours aimed at improving communication effectiveness. Individuals with hearing impairment often employ three main types of communication strategies to reduce or avoid communication breakdowns: facilitative strategies, repair strategies and corrective strategies (Hande et al., 2018).

Facilitative strategies involve guiding the speaker and organizing the listening environment to improve the listener's ability to understand. These strategies encompass behaviours aimed at preparing for and managing ongoing conversations, including both anticipatory and attending techniques. They also include efforts to control environmental factors such as lighting, background noise, and reverberation to the greatest extent possible (Hande et al., 2018). Examples of facilitative strategies include informing communication partners about hearing difficulties, adjusting the physical setting and providing information about the topic and terminology prior to the conversation (Erber, 1988).

Repair strategies are actions taken to resolve communication breakdowns between communication partners. While some communication difficulties can be anticipated, others may arise unexpectedly, especially in unfamiliar conversational contexts. Such strategies can be used by either the speaker (expressive strategies) or the listener (receptive strategies), depending on who needs to address the breakdown. Receptive repair strategies are employed by the listener, typically someone with hearing impairment when they do not understand the message being conveyed. In contrast, expressive repair strategies are used when the hearing-impaired individual produces unclear speech, making it difficult for the listener to comprehend the message. Common repair strategies include asking for clarification, speaking more clearly, rephrasing or using synonyms, providing additional explanation, using non-verbal cues or body language, giving contextual information and spelling out or writing the message (Erber et al., 1988; Hande et al., 2018).

Corrective strategies are approaches designed to address errors, misconceptions, and performance gaps across various professional and educational contexts. These strategies have evolved from simple error correction to complex evidence-based systems that consider psychological, organizational, and contextual factors. These strategies operate across multiple dimensions simultaneously: the cognitive dimension which addresses what information needs correction, while the emotional dimension manages how corrections are received and processed, and the behavioural dimension focuses on translating corrective feedback into sustained performance improvements. Modern approaches integrate meta-cognitive awareness, helping hearing impaired understand not only what was incorrect but also developing their capacity for self-correction and error prevention. The corrective strategies include physical proximity, visual contact, facial expressions and providing confirmation and feedback (Tye-Murray & Witt, 1992).

1.1 Need for the study

Although Audiologists encourage hearing impaired listeners to learn and make use of CS to maintain good interactions with their communication partners, it is often not feasible to practice in daily listening environment as there is no structured module for instruction on CS usage. Such an instruction module can help in counselling, evaluating, tracking and monitoring the usage of the CS in hearing impaired (Tye-Murray et al., 1992). Training and the use of CS needs to be encouraged in hearing-impaired population across all age groups as it can improve the overall communication, psychological well-being and quality of life of an individual . But the lack of CS assessment tools in Indian languages and specific training modules for the same limit its wide-spread applications.

The use of CS in adults is linked to their emotional and social life (Bandura, 1991), both of which are culturally dependent. A review by Chundu et al., (2021) on the social

representation of hearing loss across four countries revealed that help seeking behaviour of hearing impaired in India is strongly influenced by the attitude and actions of significant others much more than their age. As such the listening needs in Indian population are rather different than western world (owing to factors related to general environmental noise levels and communication needs stemming from strong cultural and familial bonds in India). Although alternative communication education programs for rehabilitation of hearing-impaired adults (other than hearing aids) such as Active Communication Education (ACE) programme (Hickson et al., 2007) have been found to be effective at reducing communication difficulties, they cannot be directly applied to suit the needs of all ethnic groups, especially so in India which is multi-cultural and multi-lingual. Thus, it becomes imperative to understand cultural adaptations considering the local context in Indian scenario, the public healthcare system, the socio-economic level of the target population and the settings and situations in which listening and communication take place before designing communication training modules. To address this lacuna, present study was designed.

1.2 Aim of the study

The present study aimed to develop and test the efficacy of a culturally sensitive and linguistically appropriate Communication Strategies Training (CST) module for adults with hearing loss using hearing aids who are native speakers of Kannada. In particular, the efficacy of the CST module in conventional face-to-face vs tele mode was explored.

1.3 Objectives of the study

The specific objectives of the study were:

(1) To develop a CST module in Kannada language in conventional face-to-face and tele- mode with an emphasis on improving communication of hearing-impaired adults

(2) To compare the efficacy of CST between groups, trained using conventional face-to-face mode and tele-intervention

(3) To identify the effect of CST on hearing handicap, participation and overall quality of life and use of CS immediately after the CS training in conventional face-to-face vs tele mode

(4) To study the retention effects of CST on self-reported outcome measures at one-month post-training in tele vs conventional face-to-face mode

CHAPTER-2

REVIEW OF LITERATURE

2.1 Prevalence of Hearing Impairment across the Globe and in India

Hearing impairment (HI) in adults represents a significant and growing public health concern worldwide, with far-reaching social, economic and health impacts. Epidemiological studies indicate that the prevalence of hearing loss increases substantially with age, making it a critical issue in aging populations (World Health Organization, 2021). According to the World Health Organization's World Report (2021) on hearing, over 1.5 billion people globally experience some degree of hearing loss, with around 430 million requiring rehabilitation services. Projections suggest that by 2050, nearly 2.5 billion people will have some degree of hearing loss, of whom 700 million will need rehabilitation (World Health Organization, 2021).

Previous research studies reveal considerable variability in the prevalence of adult hearing impairment across regions due to differences in study methodologies, definitions of hearing impairment and demographic factors. A systematic review and meta-analysis estimated the global prevalence of disabling hearing loss (defined as thresholds >35 dB HL in the better ear) in adults at approximately 15%, with prevalence rising sharply with age (Smith & Hoffman, 2012). For adults aged 65 years and older, the prevalence often exceeds 30–40% in many countries (Lin et al., 2011). Recent Global Burden of Disease (GBD) analyses by Vos et al. (2020) confirm these trends. Svinndal et al. (2018) estimated that age-related and noise-induced hearing loss together accounted for over 43 million years lived with disability, making it the third leading cause of years lived with disability globally. These findings underscore the enormous health burden posed by hearing impairment in adult populations.

Regional disparities in hearing impairment prevalence are well documented. In high-income countries, cohort studies provide robust prevalence estimates. For example, the Beaver Dam Offspring Study in the United States reported a prevalence of speech-frequency hearing

loss of 14.1% in adults aged 21–84 years, with increasing prevalence in older age groups (Valentijn et al., 2005). Similarly, the UK Biobank study found a prevalence of self-reported hearing difficulty of approximately 16% in adults aged 40–69 years (Sindhusake et al., 2001). In low- and middle-income countries, the prevalence of adult hearing impairment is often higher, compounded by factors such as limited access to healthcare, higher rates of untreated ear infections and occupational noise exposure (Chundu et al., 2021). For example, a population-based study in India found the prevalence of adult hearing impairment (thresholds >40 dB HL in the better ear) to be around 14% in urban and 21% in rural populations (Tsimpida et al., 2020).Whereas in sub-Saharan Africa, prevalence estimates vary widely but can exceed 20% in some older adult populations (Nieman et al., 2017).

Age-related hearing loss or presbycusis, is the most common cause of hearing impairment in adults and is strongly associated with age. Lin et al. (2011) reported that the prevalence of presbycusis nearly doubles with each advancing decade of life after 50 years of age. As global populations age, the number of older adults with hearing impairment is expected to increase dramatically. By 2050, approximately 16% of the world's population will be over 65 years old (World Health Organization, 2021), which will significantly amplify the global burden of presbycusis.

2.2 Global Burden of Hearing loss and Availability of Professionals

From an audiologist perspective, the burden of adult hearing impairment is compounded by underdiagnosis and undertreatment. A significant proportion of adults with measurable hearing impairment remain undiagnosed or do not use hearing aids or other rehabilitation services. For example, in the United States, only around 20% of adults who could benefit from hearing aids actually use them (Lin, 2013). Barriers include cost, stigma, limited access to audiological services, and lack of awareness. Recent research highlights the importance of routine screening and early intervention. The World Health Organization (2021),

recommends integrating hearing care into primary health systems to improve early detection and management. Tele-audiology rehabilitation and mobile-based hearing screening tools are also emerging as viable strategies to address access gaps, particularly in low-and middle-income countries (Govender & Mars, 2017).

Hearing impairment in adults is associated with significant economic and social costs. Globally, unaddressed hearing impairment was estimated to cost over 980 billion annually in healthcare costs, educational support, productivity losses, and social impacts (World Health Organization, 2021). Hearing impairment in adults is also linked to social isolation, depression, reduced quality of life, and cognitive decline (Nkyekyer et al., 2019).

To compound these factors, there is severe shortage of Audiologists and hearing health care professionals in the country, causing a significant delay in early identification and rehabilitation. In India, according to Indian Speech and Hearing Association (ISHA, 2021), there are 4036 registered Audiologists and Speech Therapists. While Audiology in India has grown exponentially in terms of manpower development, service delivery and public awareness, there is a dearth of Audiologists that serve a population of 1.28 billion. As a result, many people with hearing impairment are untreated or are unable to utilize their hearing aids to their maximum benefit. Also, National Sample Survey Organization (NSSO, 2021) estimated that about 60 % of individuals with hearing impairment are still not using any type of amplification.

Due to the shortage of hearing health services and the pandemic induced delays being significant on hearing aid repair and follow ups (Alqudah et al., 2021), many hearing-impaired individuals cannot fully maximize the benefits of their hearing aids. Audiologists are increasingly relying on teaching communication strategies. These strategies serve as a valuable complement to hearing aid use, helping individuals to achieve greater overall hearing benefit. Once learned, these communication strategies can be practiced independently, reducing the

ongoing need for direct audiological supervision while enhancing the individual's ability to communicate effectively in various listening situations (Tye-Murray & Witt, 1992).

2.3 Communication Challenges faced by Adults with Hearing Impairment

One of the most prominent consequences of HI is degraded auditory input, which disrupts speech perception and spoken language processing. Individuals with HI often experience reduced access to the acoustic cues necessary for phoneme discrimination and prosodic comprehension, especially in noisy conditions. This deficit is particularly evident in age-related hearing loss, where temporal and spectral resolution decline, compromising speech intelligibility even when audibility is restored through amplification (Alqudah et al., 2021). Similar findings were observed in adults with post-lingual HI, who frequently demonstrate word retrieval difficulties and reduced verbal working memory (Pichora-Fuller & Souza, 2003).

Communication difficulties extend beyond auditory and linguistic domains to affect psycho-social functioning. Adults with HI are more likely to report loneliness, social withdrawal and depressive symptoms due to communication breakdowns (Gopinath et al., 2009). In a study, Choi et al. (2019) found that individuals with untreated hearing loss had higher odds of social isolation compared to hearing peers. The stigma associated with HI further compounds these issues. Jones et al. (2019) noted that fear of appearing incompetent often leads individuals to conceal their hearing difficulties, resulting in reduced help-seeking and poorer psycho-social outcomes. Among older adults, this concealment is linked with heightened anxiety in group conversations and decreased participation in social activities (Humes et al., 2019).

Communication challenges are exacerbated in everyday environments that are acoustically and visually complex. For example, in workplaces, social gatherings and educational settings, background noise, reverberation, and poor speaker visibility are

significant barriers (Kramer et al., 2005). Research indicates that even when using hearing aids, individuals often report persistent difficulties understanding speech in group discussions and meetings (Santos et al., 2014). In public spaces, inadequate accommodations such as lack of assistive listening systems or poor captioning create further obstacles. Olson et al. (2013) emphasized that environmental modifications and communication partners training are crucial but frequently underutilized supports.

To overcome these challenges, the rise of digital communication platforms, particularly during the COVID-19 pandemic, has introduced new opportunities but has complexities for people with HI. Video conferencing often lacks high-quality audio, reliable captioning, and visible cues, resulting in increased listening effort and fatigue (Holman et al., 2023). Furthermore, asynchronous communication methods, like voice messages, can be inaccessible without transcripts. Shende et al. (2021) highlighted that while some platforms have incorporated accessibility features such as automatic captions, the accuracy remains variable, creating frustration and barriers to participation. Studies also report that older adults with HI experience compounded challenges due to limited digital literacy (Coco et al., 2020; Ratanjee-Vanmali & Laplante-Levesque, 2020).

2.4 Communication Strategies and their Types

A communication strategy (CS) refers to an approach used to enhance communication, support conversational interaction, or address issues that arise during a conversation. It involves both verbal and nonverbal behaviours aimed at improving communication effectiveness. They are techniques used by individuals with hearing loss and their communication partners to facilitate effective exchange of information, reduce communication breakdowns and enhance participation in everyday conversations (Öberg et al., 2014). Historically, research on CS emerged from broader socio-linguistic and psycho-linguistic

traditions that viewed them as plans to overcome difficulties in communication (Erber et al., 1988).

Boothroyd (2007) describes CS with respect to audiologic rehabilitation as a set of client-centered tools and behaviors designed to help manage listening demands and compensate for hearing-related limitations. Individuals with hearing impairment often employ three main types of communication strategies to reduce or avoid communication breakdowns: facilitative strategies, repair strategies and corrective strategies (Hande et al., 2018).

Facilitative strategies involve guiding the speaker and organizing the listening environment to improve the listener's ability to understand. These strategies encompass behaviours aimed at preparing for and managing ongoing conversations, including both anticipatory and attending techniques. They also include efforts to control environmental factors such as lighting, background noise, and reverberation to the greatest extent possible (Hande et al., 2018). Examples of facilitative strategies include informing communication partners about hearing difficulties, adjusting the physical setting and providing information about the topic and terminology prior to the conversation (Erber, 1988).

Repair strategies are actions taken to resolve communication breakdowns between conversation partners. While some communication difficulties can be anticipated, others may arise unexpectedly, especially in unfamiliar conversational contexts. Such strategies can be used by either the speaker (expressive strategies) or the listener (receptive strategies), depending on who needs to address the breakdown. Receptive repair strategies are employed by the listener, typically someone with hearing impairment when they do not understand the message being conveyed. In contrast, expressive repair strategies are used when the hearing-impaired individual produces unclear speech, making it difficult for the listener to comprehend the message. Common repair strategies include asking for clarification, speaking more clearly, rephrasing or using synonyms, providing additional explanation, using non-verbal cues or body

language, giving contextual information and spelling out or writing the message (Erber et al., 1988; Hande et al., 2018).

Corrective strategies are approaches designed to address errors, misconceptions, and performance gaps across various professional and educational contexts. These strategies have evolved from simple error correction to complex evidence-based systems that consider psychological, organizational, and contextual factors. These strategies operate across multiple dimensions simultaneously: the cognitive dimension which addresses what information needs correction, while the emotional dimension manages how corrections are received and processed, and the behavioural dimension focuses on translating corrective feedback into sustained performance improvements. Modern approaches integrate meta-cognitive awareness, helping hearing impaired understand not only what was incorrect but also developing their capacity for self-correction and error prevention. The corrective strategies include physical proximity, visual contact, facial expressions and providing confirmation and feedback (Tye-Murray et al., 1992).

2.5 Relevancy and Importance of Communication Strategies in Audiological Rehabilitation

CS are foundational to person-centered audiologic rehabilitation. Their importance arises from the reality that even with optimal amplification (e.g., hearing aids, cochlear implants), many people with hearing impairment continue to experience communication challenges, particularly in noisy or complex environments (Chisolm et al., 2003). Robust evidence supports the role of communicative strategies training (CST) in reducing self-perceived hearing handicap. Hickson et al. (2007) conducted a randomized controlled trial of the Active Communication Education (ACE) program, finding significant reductions in hearing handicap compared to controls. Aazh and Moore (2017) demonstrated that Audiological Rehabilitation (AR) programs including CST improved self-reported communication ability

and listening confidence in older adults. These findings validate including CS in AR programs to achieve patient-centered outcomes.

One of the most important roles of CS is reducing the frequency and impact of communication breakdowns. Breakdowns can occur when listeners miss words or phrases, leading to confusion, frustration or conversational withdrawal. Training CS such as asking for clarification, confirming understanding or rephrasing questions improves conversational flow and reduces misunderstandings (Caissie et al., 1994; Olson et al., 2013). CST also fosters self-efficacy, the belief in one's ability to manage listening challenges (Bandura, 1991). Many people with hearing loss experience communication anxiety or avoidance due to fear of misunderstanding or embarrassment. Teaching the use of CS provides them with tools and confidence to actively participate in conversations and advocate for their needs (Öberg et al., 2014). In modern audiologic practice, promoting client autonomy is an ethical priority. The International Classification of Functioning, Disability and Health (ICF) framework emphasizes enabling participation, rather than simply treating impairment (World Health Organization, 2021). Communication strategies align with this model by addressing activity and participation limitations holistically.

AR is not only about restoring hearing but also about enabling participation (World Health Organization, 2021). Untreated or poorly managed hearing loss is linked to social withdrawal, loneliness and reduced well-being (Jones et al., 2019). Recent studies emphasize that CST can reduce these participation restrictions. Ferguson et al. (2016) reviewed aural rehabilitation/interventions and found that CST significantly improved social participation and reduced communication difficulties. Laplante-Levesque et al. (2013) highlight that including CS in rehabilitation promotes more active, confident participation in daily life. By teaching people to manage breakdowns proactively, CS training enhances social connection and quality of life, which are the main goals of AR.

A critical feature of effective CST is the inclusion of communication partners (CPs). Family members, friends and caregivers play a central role in supporting or hindering successful communication. CPs can be trained to adopt facilitative behaviors, such as speaking clearly, gaining attention before speaking or checking for understanding (Olson et al., 2013). In line, Kramer et al. (2005) demonstrated that CST for both the individual with hearing impairment and their CPs produced better outcomes than individual-only interventions. Also, Öberg et al. (2014) argue that CS are collaborative and relational, involving not only the person with hearing impairment but also frequent and familiar CPs (family, friends, coworkers). This collaborative dimension distinguishes audiologic CST from individual speech or language training.

Numerous studies confirm that even with advanced hearing aids (HA) and cochlear implants (CI), users face persistent challenges in real-life conversations, particularly in background noise or multi-talker settings (Laplante-Levesque et al., 2013). Residual difficulties are a key reason for hearing aid non-use. While hearing aids provide amplification, they do not fully restore normal hearing, especially in challenging listening environments. Many hearing aid users report ongoing communication difficulties, which can lead to frustration and its non-use (Albuali, 2021). Teaching the use of CS complements technology by giving HA users practical skills to manage difficult listening situations (Boothroyd, 2007). For example, the HA users learn to anticipate challenging settings, control the environment (e.g., turn off competing noise), and educate CPs about effective communication behaviors (e.g., maintaining eye contact). Such training has been shown to increase satisfaction with hearing aids and reduce rates of its non-use (Laplante-Levesque et al., 2013). Similarly, Aazh and Moore (2017) found that older adults receiving CST used their Has more consistently and reported greater benefit. In line, Ferguson et al. (2016) note that training in environmental control and anticipatory strategies complements device use, reducing frustration and dropout.

Thus, CST is relevant not only as a standalone skill set but also as a critical support for HA outcomes.

Finally, CST aligns with the person-centered, holistic approach central to contemporary AR. The World Health Organization (2021), ICF framework encourages clinicians to address not only impairment but also activity and participation limitations. Recent guidelines and review (e.g., Ferguson et al., 2016) consistently recommend including CST as a standard component of comprehensive AR. By teaching patients and partners to anticipate, manage and repair breakdowns, clinicians support autonomy, self-efficacy and participation, hallmarks of ethical, modern audiology practice.

2.6 Role of training for Communication Strategies in Adults with Hearing Impairment

Communication breakdown is a pervasive challenge for adults with HI, impacting social participation, emotional well-being, and overall quality of life (QoL). Beyond technological solutions like hearing aids and cochlear implants, structured training in CS has emerged as a crucial component of comprehensive AR (Boothroyd, 2007).

Hearing aids alone do not fully resolve communication difficulties, particularly in complex listening environments (Chisolm et al., 2003). Many adults with HI continue to struggle with speech understanding in noise, group conversations and emotional frustration arising from frequent miscommunication (Pichora-Fuller & Souza, 2003). Structured CST modules address this gap by explicitly teaching techniques such as anticipatory strategies (e.g., planning ahead for noisy environments), repair strategies (e.g., asking for repetition or clarification), and environmental modification (e.g., reducing background noise) (Tye-Murray et al., 1992). Recent evidence suggests that unstructured advice or face-to-face counseling is insufficient to develop these skills effectively. Preminger and Ziegler (2008) argued that structured training, which includes goal-setting, practice and feedback, is necessary to enable lasting behavior change. Importantly, structured modules also help normalize and destigmatize

the use of CS, empowering clients to advocate for their communication needs (Ferguson et al., 2016).

Research consistently supports that CST improves the communicative competence of adults with HI. Hickson et al. (2007) conducted a randomized controlled trial of a group-based CST program, showing significant improvements in participants' self-reported CS use and reduced activity limitation. More recent meta-analyses study confirms these benefits. Ferguson et al. (2016) reviewed group and individual aural rehabilitation programs and found that participants consistently reported reduced hearing handicap and improved communicative confidence. They concluded that CST complements technological interventions by building the practical and psycho-social skills needed for effective real-world communication. CST also reduces listening effort, a critical benefit given the cognitive demands of effortful listening in HI (Pichora-Fuller & Souza, 2003). Adults who complete CST programs often report greater ease in conversations, reduced anxiety about communication breakdowns and greater willingness to participate in social interactions (Ferguson et al., 2014).

Communication is inherently interactive, and the burden of managing breakdowns often falls on both parties in a conversation. Consequently, CST increasingly includes training for CPs, such as spouses or family members (Olson et al., 2013). Studies show that including CPs in training improves outcomes for both parties. Preminger and Ziegler (2008) found that couples who participated in CST together reported better dyadic communication, greater partner understanding of HI challenges, and reduced conflict. CP training helps develop mutual strategies (e.g., clear speech, confirming understanding) that reduce frustration and improve relationship satisfaction. Moreover, including CPs can reduce the sense of stigma and blame sometimes experienced in communication breakdowns. It fosters empathy, shared responsibility, and collaborative problem-solving (Humes et al., 2019).

The benefits of CST extend beyond communication itself to overall well-being and life satisfaction. HI is associated with social withdrawal, loneliness and depression (Gopinath et al., 2009). By improving communicative success, CST reduces these risks. Hickson et al. (2007) reported that CST participants experienced significant improvements in the emotional subscales of most of the self-report outcome questionnaires, indicating reduced distress over communication problems. Similarly, a systematic review by Boothroyd (2007) found that CST was associated with enhanced QoL, as measured by reduced participation restrictions and greater social engagement. Satisfaction with audiological services is also enhanced by CST. Patients often perceive training as highly valuable because it directly addresses persistent communication challenges that technology alone cannot resolve (Ferguson et al., 2016). This perceived value may increase hearing aid uptake and its consistent use (Laplante-Levesque et al., 2013). Furthermore, CST promotes self-efficacy, the belief in one's capacity to manage communication difficulties. Self-efficacy is a strong predictor of rehabilitation success and is associated with sustained use of CS over time.

2.7 Delivery modes of Communication Strategy Training

CST is a core component of audiologic rehabilitation that aims to help individuals with HI to manage conversational breakdowns, optimize listening environments, and improve quality of life (Boothroyd, 2007). Traditionally aural rehabilitation is delivered in face-to-face settings and has increasingly been adapted for tele-rehabilitation to improve access, especially in underserved and remote populations (Nihara & Seethapathy, 2022)

2.7.1 Traditional Face-to-Face (offline) CST Approaches

Historically, CST has been delivered in person through individual or group sessions facilitated by audiologists or trained clinicians. This typically includes anticipatory strategies, repair strategies, environmental modifications, and assertiveness training (Tye-Murray et al., 1992). Face-to-face CST offers unique advantages, including in-person modeling, real-time

feedback and interpersonal support among group participants. For example, Hickson et al. (2007) evaluated the Active Communication Education (ACE) program, a structured group-based face-to-face CST module, and found significant improvements in hearing handicap and CS use among older adults with HI. Participants also reported enhanced confidence and reduced emotional distress. Counseling-based group rehabilitation has been shown to reduce social isolation and improve quality of life (Preminger & Ziegler, 2008). Group sessions promote peer learning and normalization of HI experiences, which can reduce stigma and increase CS use (Ferguson et al., 2016). However, barriers remain, like the logistical challenges such as travel time, limited clinician availability and scheduling conflicts can limit participation (Santos et al., 2014). These challenges disproportionately affect older adults with mobility issues or people living in rural regions.

2.7.2 Tele-Rehabilitation (online) CST Approaches

Tele-rehabilitation (or tele-audiology) refers to delivering audiologic services remotely through phone, video or web-based platforms. In recent years, CST programs have increasingly adopted tele-rehabilitation to improve access, reduce costs, and accommodate user preferences. Ng and Loke (2015) noted that tele-audiology approaches for CST often use synchronous video calls, asynchronous modules or blended formats. For example, participants might attend live video counseling sessions or access self-directed online modules with embedded exercises and quizzes. Evidence supports the feasibility and acceptability of tele-rehabilitation for CST. Ferguson et al. (2014) conducted a systematic review of computer-based auditory training (CBAT) interventions, including CST elements, and found improvements in speech perception and self-reported communication outcomes. During the COVID-19 pandemic, demand for tele-rehabilitation surged. Nihara and Seethapathy (2022) demonstrated that tele-audiology can overcome geographic barriers while maintaining clinical effectiveness. Holman et al. (2023)

argued that providing remote CST reduced hearing disability and social withdrawal during lockdown periods.

2.7.3 Comparison Between Face-to-Face (offline) and Tele-Rehabilitation (online)

Research directly comparing face-to-face and tele-rehabilitation delivery of CST is still emerging, but evidence indicates comparable outcomes in many contexts. Saunders and Forsline (2012) conducted a randomized controlled trial comparing in-person versus internet-based delivery of an adapted ACE program. Both groups showed significant and similar reductions in self-reported hearing handicap, improved CS use, and high satisfaction. Participants valued the flexibility of online delivery, while some preferred face-to-face interactions for social support. Other studies highlight potential advantages of tele-rehabilitation in reaching underserved groups. Nihara and Seethapathy (2022) argued that tele-audiology reduces disparities in service access for rural and low-resource communities. Moreover, online CST can be scaled cost-effectively, making group-based models more sustainable. However, tele-rehabilitation is not without challenges. Digital literacy, internet access, and platform usability remain barriers for some older adults with HI. Also, research suggests that clinician-patient rapport, group dynamics, and hands-on demonstrations may be more difficult to replicate online (Ferguson et al., 2016). Overall, the literature suggests that both delivery modes can be effective, but choice of mode should consider client preferences, technological access, and clinical context. A hybrid or blended model combining in-person and remote components may offer the best of both approaches (Ng & Loke, 2015).

2.8 Outcome Measures and its Efficacy in Communication Strategy Training

CST is a core component of AR aiming to improve conversational success and quality of life (QoL) for adults with hearing loss. Evaluating its efficacy requires reliable outcome measures that can capture subjective and objective improvements. Outcome measurement in CST research is multifaceted, combining validated quantitative instruments (e.g., IOI-HA,

HHQ, SAC, CSS) with qualitative user experience data. Standardized tools enable consistent evaluation of CST efficacy, while qualitative methods enrich understanding of acceptability and contextual factors. It also includes evidence-based long-term retention effects and use of CS.

2.8.1 Quantitative Outcome Measures of Aural Rehabilitation

a. International Outcome Inventory for Hearing Aids (IOI-HA). Although originally designed for hearing aid outcomes, the IOI-HA has been used to evaluate CST as part of broader rehabilitation (Cox & Alexander, 2002). Items on benefit, satisfaction, and residual participation restrictions overlap with communication challenges. Recent studies indicate that integrating CST with hearing aid fitting, reflects, but not significantly in IOI-HA scores compared to amplification alone (Ferguson et al., 2016). This suggests IOI-HA can sensitively capture benefit (lesser) from CST when used alongside hearing aids. Ferguson et al. (2016) found combined hearing aid and CST interventions produced significant IOI-HA scores (mean difference ~1.5 points) than hearing aid use alone at follow-up. The IOI-HA has been widely translated and validated; The IOI-HA has been translated into Kannada and evaluated for semantic equivalence and clinical use. The Kannada version demonstrated good internal consistency and is used in clinical practice in Karnataka (Thammaiah et al., 2016). Validated versions exist in Hindi, Tamil, Telugu, Malayalam, Bengali, Chinese, Arabic, Spanish, French, German, and many more (Cox & Alexander, 2002). These translations make IOI-HA a truly global tool for CST outcomes in diverse settings.

b. Hearing Handicap Questionnaire (HHQ). The HHQ (Gatehouse & Noble, 2004) assesses emotional and social consequences of hearing loss. CST interventions have repeatedly demonstrated significant reductions in HHQ scores, suggesting decreased perceived handicap. For example, (Thammaiah et al., 2017) reported effect sizes of 0.4–0.6 on HHQ improvements in online CST groups, indicating moderate benefit. The HHQ is valued for being short,

validated cross-culturally, and sensitive to change after CST. The HHQ has been adapted into multiple languages, including Mandarin, Swedish, and Brazilian Portuguese (Gatehouse & Noble, 2004). In India, Thammaiah et al. (2016) translated Hearing Handicap Inventory was adapted into Kannada through rigorous back-translation.

c. Self-Assessment of Communication (SAC). The SAC (Schow & Nerbonne, 1982) is a 10-item scale assessing perceived communication difficulty. It is widely used in clinical research to evaluate CST. Hickson et al. (2007) demonstrated significant SAC score reductions post-CST in group training models, with mean improvement of ~10 points sustained at 6 months. Recent digital CST programs continue to use SAC to demonstrate pre-post gains (Nachtegaal et al., 2009). SAC has been translated into Kannada with validation showing good reliability (Thammaiah et al., 2016). Other languages include Portuguese (for Brazil), Spanish and Chinese (Schow & Nerbonne, 1982) These translations enable culturally appropriate measurement of communication difficulties in local populations.

d. Participation Questionnaire (PQ). PQ is designed to assess participation restrictions experienced by individuals with hearing impairment (Van Brakel et al., 2006). It is aligned with the WHO's ICF model, which emphasizes activity and participation domains. PQ items typically explore communication in social, occupational and daily life contexts where hearing challenges limit participation. It is widely used to evaluate outcomes of audiologic rehabilitation, including CST, as participation improvement is a key goal of such training. For example, Kramer et al. (2005) used the PQ in assessing outcomes of CST and reported significant reduction in participation restrictions, supporting CST's impact beyond impairment measures. The PQ complements measures like the HHQ and SAC by providing a broader functional perspective on intervention outcomes. PQ has been translated and culturally adapted in several languages, including Dutch, Swedish and Portuguese (Kramer et al., 2005).

Thammaiah et al. (2016) made a pioneering effort in translation and validation of PQ in Kannada.

e. Assessment of Quality of Life – 4D (AQoL-4D). Generic QoL measures like AQoL-4D (Hawthorne, 2000) assess health-related quality of life domains, including independent living, mental health, relationships and senses. AQoL-4D has been used to evaluate broader CST impact. Ferguson et al. (2016) used AQoL-4D in their RCT of face-to-face vs tele-mode CST, finding both modes produced small but significant improvements over waitlist control. While less hearing-specific, AQoL-4D helps contextualize CST outcomes in general health frameworks. The Assessment of Quality of Life (AQoL-4D) has validated versions in multiple languages including Hindi, Mandarin, Spanish, and Japanese (Hawthorne, 2000). Thammaiah et al. (2016) made a pioneering effort in translation and validation of AQoL-4D in Kannada.

f. Communication Strategies Scale (CSS)- A sub-scale of Communication Profile for the Hearing Impaired (CPHI). The CSS is a sub-scale of CPHI (Demorest & Erdman, 1986) that measures frequency of using facilitative, repair and maladaptive strategies. It is highly relevant for CST outcome evaluation. Hickson et al. (2007) reported increased use of facilitative and repair strategies and decreased maladaptive strategies post-CST using CSS. Recent tele-CST trials also show CSS improvements, supporting its use in monitoring CS use (Coco et al., 2020). CSS has fewer published translations but has been adapted in research contexts for several languages including Portuguese and Swedish. Pilot work by Pinto (2025) has been done in India to adapt the scale into Kannada for CST training programs, ensuring item relevance and linguistic equivalence.

2.8.2 Qualitative Outcome Measures of Aural Rehabilitation

Quantitative scales often fail to capture the complexity of communication strategy use. Qualitative methods include open-ended interviews, focus groups and free-text survey feedback which are essential for understanding CST user experience. A systematic review by

Ferguson et al. (2016) highlighted qualitative feedback indicating that participants valued learning practical skills, building confidence and sharing experiences in group CST formats. Recent studies have also employed user experience interviews in tele-CST programs. Qualitative methods are particularly valuable in assessing acceptability, cultural adaptation and sustainability of CST in both the intervention mode.

2.9.3 Standardized Tools used in Aural Rehabilitation

A wide range of standardized measures has been used across CST studies to ensure comparability and rigor. Commonly used tools include IOI-HA (Cox & Alexander, 2002), HHQ (Gatehouse & Noble, 2004), SAC (Schow & Nerbonne, 1982), and CSS (Demorest & Erdman, 1986). These instruments have demonstrated robust psychometric properties and sensitivity to CST interventions in diverse populations. Their inclusion in research enables cross-study comparison and meta-analyses. For example, a review by Ferguson et al. (2016) included studies using IOI-HA, SAC and HHIE to demonstrate moderate-certainty evidence of CST benefit.

2.9.4 Long-Term Follow-Up of Communication Strategies Use and its Retention

Evaluating the sustained use of CS is critical for demonstrating CST efficacy. Long-term follow-up studies show mixed but generally positive retention. Hickson et al. (2007) found that SAC and CSS improvements were largely maintained at six months, with slight regression. Similarly, Olson et al. (2013) demonstrated continued reduction in PQ scores at 6-month follow-up. However, some studies indicate that practice and booster sessions may enhance long-term retention. Laplante-Levesque et al. (2013) suggest integrating CST with ongoing audiological care to maintain the learnt skills.

Online and tele-health CST may improve retention through on-demand refreshers and reminders. Studies have reported sustained HHQ and SAC benefits at 3-month follow-up in online CST users, supporting its role in promoting long-term CS use. Evidence supports

significant improvements in communication outcomes, hearing handicap, partner perspectives, and quality of life following CST. Long-term follow-up studies show generally positive retention of communication strategies, though ongoing support may enhance sustainability. These findings underscore the importance of multi-dimensional outcome evaluation to demonstrate CST's value in adult audiologic rehabilitation.

Emerging evidence highlights online and tele-health delivery of CST as promising, especially in contexts with geographic, linguistic or logistical barriers. Ferguson et al. (2016) reviewed RCTs showing that online CST can produce comparable benefits to face-to-face delivery in improving CS use and reducing handicap. In India, tele-rehabilitation addresses barriers such as: rural-urban healthcare disparities, limited availability of trained audiologists, need for local-language adaptation and CP scheduling conflicts.

Tele-audiology initiatives have expanded in India, with institutions like AIISH piloting tele-rehabilitation services in regional languages (Annual report, All India Institute of Speech and Hearing, 2022). Interactive features such as videos, quizzes, and role-plays can model effective communication behaviors. Despite strong evidence, CP inclusion and tele-mode of CST remain underutilized, especially in low- and middle-income settings like India due to low awareness of CST among individuals with HI and professionals, scheduling and transport challenges for CPs, limited audiologist trained in CST delivery and digital divide and internet access issues. Hence, the recommended possibilities are: embed CST (including CP training) in standard audiology curriculum, develop culturally adapted CST manuals in local languages, provide flexible delivery options: group, individual, online and promote public awareness about the value of CST.

2.11 Limitations in research regarding Communication Strategy Training

Traditionally delivered face-to-face (offline) CST has increasingly been adapted for tele-rehabilitation (online) delivery. While both modes show promise, research evaluating their

effectiveness reveals several limitations. While both face-to-face and tele-rehabilitation CST modes are supported by evidence of effectiveness, the research base has important limitations. Face-to-face CST studies often struggle with small samples, short follow-up, cultural generalizability and limited CPs involvement. Tele-CST research, though promising for increasing access, faces challenges around digital inclusion, linguistic adaptation, intervention fidelity and CPs integration.

2.11.1 Limitations of Face-to-Face (offline) CST

a. Limited Generalizability Across Cultures and Languages. Many face-to-face mode of CST studies have been conducted in high-income, English-speaking settings, with limited adaptation to other languages and cultural contexts. Hickson et al. (2007) conducted a landmark RCT in Australia showing CST effectiveness in older adults, but its materials were designed for English-speaking, urban populations. Recent efforts in India (Thammaiah et al., 2016) have translated outcome measures into Kannada, but fully validated, culturally adapted CST protocols remain limited. This restricts generalizability to multilingual, low-literacy, and rural populations.

b. Small Sample Sizes and Limited Power. Several studies of face-to-face mode of CST interventions have used small, convenience samples, limiting statistical power and external validity. Ferguson et al. (2016), in a systematic review, noted that many included trials had less than 50 participants per arm, making it difficult to detect small-to-moderate effect sizes confidently.

c. Short Follow-up Periods. Research on CST often focuses on short-term outcomes, with limited long-term follow-up to assess CS retention and behavior change. For example, Hickson et al. (2007) reported maintenance of benefits at 6 months follow-up, but few studies extend beyond this timeframe. Longer-term follow-up is crucial to understand how strategies

are maintained, adapted, or abandoned in real-world communication (Preminger and Ziegler, 2008).

d. Underrepresentation of Communication Partners. Despite evidence that including CPs improves outcomes (Hickson et al., 2007; Preminger & Ziegler, 2008), many face-to-face mode of CST studies exclude CPs or do not analyse their outcomes separately.

e. Variability in Intervention Content and Delivery. Ferguson et al. (2016) found wide variability in CST content, duration, number of sessions and delivery modes across studies. This heterogeneity makes meta-analysis and cross-study comparison challenging. There is also limited standardization in outcome measures, though recent work (e.g., IOI-HA, HHQ translations; Govardhan et al., 2019)aims to address this limitation.

f. Limited Research in Low- and Middle-Income Countries. Most of the face-to-face mode of CST research has been conducted in high-income settings, with few robust trials in low- and middle-income countries like India. While pilot programs exist, large-scale, controlled trials are scarce. Factors such as language diversity, limited audiologist availability and cost barriers in low- and middle-income countries remain underexplored in CST research design.

2.11.2 Limitations of Tele-Rehabilitation (online) CST

a. Digital Divide and Accessibility Issues. While tele-mode of CST promises improved access, research often underestimates digital literacy barriers. In India, rural internet access, device ownership and language-localization remain major barriers (All India Institute of Speech and Hearing, 2022). Few tele-mode of CST studies explicitly address these issues or design interventions for low-resource settings.

b. Limited Cultural and Linguistic Adaptation. Most tele-mode of CST research has been conducted in English, with minimal adaptation to other languages. While translation work exists for outcome measures (Thammaiah et al., 2016), few tele-mode CST platforms provide

culturally adapted training in local languages such as Kannada, Hindi or Tamil. This gap limits both reach and effectiveness in multi-lingual populations.

c. Variability in Intervention Design and Fidelity. Digital CST programs differ widely in content, duration, interactivity and clinician involvement. Ferguson et al. (2016) note that some are fully self-guided, while others are led by the clinicians. This variability complicates conclusions about effectiveness. Moreover, few studies monitor intervention fidelity (i.e., whether participants complete modules as intended), limiting internal validity.

d. Small and Selective Samples. Many tele-mode of CST trials have recruited small, convenience samples, often excluding individuals with cognitive impairment, low digital literacy or severe degree of hearing loss.

e. Short Follow-up Durations. Similar to face-to-face mode of CST, tele-mode of CST studies often reports short-term outcomes (e.g., 3–6 months). Research on long-term retention of strategies and real-world communication outcomes remains limited (Ferguson et al., 2016).

f. Limited Focus on Communication Partners. Despite the recognized importance of CPs involvement, many tele-mode of CST programs are designed for single user. While some platforms suggest shared participation, research rarely reports CPs recruitment, engagement or outcomes. This is a missed opportunity, as online formats could in theory improve CPs accessibility by reducing logistical barriers (e.g., travel, scheduling).

g. Privacy and Ethical Considerations. Tele-rehabilitation raises data security and privacy concerns, especially in low-and middle-income country settings where regulatory frameworks may be weak (World Health Organization, 2021).

Hence, addressing these limitations through well-designed, inclusive research is essential for optimizing CST delivery, benefits and outcomes globally, particularly in multilingual, resource-constrained settings such as in India.

2.12 Need for the Structured Communication Strategy Training Modules

In high-income countries, structured CST programs like the Active Communication Education (ACE) program have been widely tested. ACE includes a manualized curriculum with defined session structures, learning objectives and facilitator guidance (Hickson et al., 2007). Ferguson et al. (2016) showed that structured CST interventions consistently out-perform unstructured counselling, highlighting the importance of well-designed, replicable training modules.

Despite strong global evidence, structured CST module remains rare in India. Audiologists often rely on informal counselling or advice rather than systematic training, partly due to a lack of standardized, culturally appropriate modules. Thammaiah et al. (2017) note that audiologic rehabilitation in India has traditionally focused on device provision, with limited emphasis on psycho-social and behavioral counselling. This gap reflects historical training priorities and health system constraints.

India's vast linguistic and cultural diversity presents unique challenges to CST module. Over 22 official languages and hundreds of dialects necessitate adaptation of training materials and its delivery to local contexts. Thammaiah et al. (2016) demonstrated the need for linguistic adaptation by translating and validating the Hearing Handicap Questionnaire (HHQ) into Kannada. Similarly, (Thammaiah et al., 2016) adapted IOI-HA for Kannada speakers. While these efforts improve measurement, there remains no widely adopted, structured CST module in Indian languages for routine clinical use, highlighting an urgent development need.

2.12.1 Need for Structured Face-to-Face (offline) CST Modules

Structured training modules ensure consistent, evidence-based delivery across training providers. In India's mixed public-private audiology landscape, standardized CST content can improve quality and reduce variability. Ferguson et al. (2016) emphasize that modules with clear learning objectives, session plans and facilitator guides support fidelity and replicability.

In India, where audiologist training varies widely, structured materials can ensure best practices are maintained even by less experienced training providers.

CST modules in Indian context must address local communication norms (e.g., indirect speech, respect hierarchies and multilingualism) and everyday communication contexts (e.g., markets, religious gatherings, public transports). Studies highlight the need to use locally meaningful examples, role-plays and culturally appropriate scenarios to increase engagement and understanding (Thammaiah et al., 2017).

Structured modules can systematically embed CPs training, ensuring partners learn facilitative strategies and understand hearing loss impacts. Hickson et al. (2007) and (Preminger and Ziegler, 2008) demonstrated that combined approaches improve CS use, reduce handicap, and increase relationship satisfaction. Without structured guidance, CP inclusion in India remains inconsistent.

In Indian context, HI often include older adults with limited formal education. Hence, structured modules must use simple, clear language, incorporate visuals and be available in multiple languages (Thammaiah et al., 2016). Structured face-to-face CST module can also help address low health literacy by using interactive teaching methods such as demonstrations, role-plays and group discussions.

2.12.2 Need for Structured Tele-Rehabilitation (online) CST Modules

Tele-audiology is expanding rapidly in India, driven by smartphone penetration and pandemic-era adoption. However, Research on CST and practice have lagged behind other tele-health services such as hearing aid fitting or diagnostics. Structured online CST modules can reduce geographical barriers, enabling access for rural and remote populations underserved by audiologists. In India, tele-mode of CST holds particular promise for sparse audiology services.

Tele-rehabilitation allows centralized development of high-quality modules that can be deployed nation-wide. Standardized digital content reduces variability across clinicians and

ensures fidelity to evidence-based approaches (Ferguson et al., 2016). India's multilingual population necessitates local-language digital CST materials. While outcome measures have been translated into Kannada and other languages (Thammaiah et al., 2016), there are few validated, structured tele-mode of CST modules in local languages. Developing these kind of modules can ensure linguistic inclusivity and cultural relevance, using local examples and culturally appropriate illustrations or videos.

Tele-rehabilitation offers flexible, family-friendly scheduling options. Structured digital CST modules can explicitly involve CPs through shared logins, joint sessions and interactive exercises. While tele-mode of delivery expands access, structured training modules must account for India's digital divide. Design considerations include: mobile-friendly interfaces, low-bandwidth content (audio/video compression), simple navigation for older adults and multi-lingual support.

2.12.3 Limitations in Existing Research Supporting the Need of Structured Communication Strategy Training Module

Most CST effectiveness trials come from high-income settings (Ferguson et al., 2016; Hickson et al., 2007). There is a scarcity of large-scale, controlled studies in India evaluating either face-to-face or tele-mode of CST. While outcome measures like IOI-HA and HHQ have been translated (Govardhan et al., 2019; Thammaiah et al., 2016) full CST training manuals in Indian languages are rare. This creates a major implementation barrier. Research rarely includes rural, low-literacy and multilingual population which is the key target groups for audiological services in India. CST module development in Indian context needs to integrate CPs training systematically, giving strong family roles in daily life (Thammaiah et al., 2017).

Hence, to fill in the above-mentioned gaps, there is a need to develop structured CST modules for both face-to-face and tele-rehabilitation delivery in India that are evidence-based and manualized, culturally adapted with local examples, available in major Indian languages,

designed for low literacy and low digital literacy, inclusive for CPs and adaptable for both urban and rural settings. Investing in structured CST module development, validation, and dissemination is critical to improve rehabilitation outcomes for India's millions of adults with hearing impairment.

CHAPTER-3

METHODS

Based on the aim and objectives of the study, the method of the study included three phases: Phase 1: Development of the Communication Strategies Training (CST) module-Kannada [conventional (face-to-face) mode], Phase 2: Development of a web-based Communication Strategies Training (CST) module- Kannada [tele-rehabilitation mode] and Phase 3: Administration of the CST module-Kannada in face-to-face mode and tele-rehabilitation mode.

Phase 1: The development of the Communication Strategies Training (CST) module-Kannada [conventional (face-to-face) mode]

3.1 Preparation of materials

The materials for CST-Kannada module was developed through an extensive review of literature, focus group discussions of audiologists, individuals with hearing loss, their family members and significant others [Communication Partners (CPs)] on the topic 'where / which situations do individuals with hearing loss experience maximum difficulties in communication?'. Using an array of the above said techniques, eight different situations including Personal Environments (PE) like home and during phone calls, Office or Workplace (OW), Hospital Settings (HS), Social Settings (SS) like gatherings and crowd, at Hotels and Outings (HO), in Public Transportation (PT), Exhausted Conditions (EC) and Educational Settings (ES) where the hearing-impaired individuals frequently encountered communication breakdown were chosen to be incorporated into the module. In each of the eight situations multiple scenarios were prepared. The corresponding pictures were clicked by the audiologist after taking the written consent from the individuals, which later were developed into anime illustrations using a free web-based application and image generator, Fotor AI Art Generator. It is easy to use with quick login accounts. The material thus composed was translated to

Kannada by a subject expert (an Audiologist with 2 years of experience in auditory rehabilitation) and subjected to content validation process.

3.2 Content Validation of the translated materials

A total of fifteen experts were enrolled for the validation process: five audiologists (AUDs), five communication partners (CPs) of adults with hearing impairment, and five adults with hearing impairment (Adults with HI). All the experts were native Kannada speakers meeting the following inclusion criteria:

Expert Group I (AUDs):

1. Minimum of five years of experience in auditory rehabilitation.
2. Familiarity with the use of different modules for rehabilitation.

Expert Group II (CPs):

1. Primary caregivers of adults with hearing impairment.
2. Minimum educational qualification of tenth grade in Karnataka.

Expert Group III (Adults with HI):

1. Adults with acquired sensorineural hearing loss (SNHL) using digital hearing aids.
2. Minimum educational qualification of tenth grade in Karnataka.

AUDs (Expert Group I) were briefed about their role in the validation process, and written consent was obtained. They rated the eight situations, presented in random order, on a 5-point Likert scale (0–4)(Joshi et al., 2015) as depicted in Table 3.1, across 18 parameters using a feedback rating questionnaire adapted and modified from the field testing of Manual for Adult Non-fluent Aphasia Therapy in Kannada (MANAT-K) (Goswami et al., 2010):

1. Simplicity (comprehensibility of the scenarios),
2. Familiarity (familiarity of the scenarios),
3. Size of the picture (appropriateness of the picture size),
4. Colour and Appearance (appropriateness of size and colour of the pictures),

5. Arrangement (visual appeal, engagement and the order of the scenarios),
6. Presentation (the appropriateness of scenarios in each situation),
7. Volume (the overall size of the module),
8. Relevance (cultural and ethical appropriateness),
9. Complexity (the difficulty order of scenarios),
10. Iconicity (accuracy and recognizability of the scenarios),
11. Accessibility (user friendliness of the module),
12. Flexibility (ease of modification of scenarios),
13. Trainability (uses in rehabilitation),
14. Stimulability (capacity of scenarios to elicit responses related to the target),
15. Feasibility (viability of the scenarios),
16. Generalization (generalizing the module to other adult hearing disorders and various settings),
17. Scope of practice (the use of module in personal or professional settings),
18. Scoring pattern (scoring of scenarios).

Ratings were interpreted using five levels as shown in table 3.1. Adults with HI (Expert Group III) and their CPs (Expert Group II) were shown scenario illustrations and engaged through structured questioning to obtain ratings on the same parameters.

Table 3.1

Interpretation and codes for the parameter ratings (Likert scale 5)

Rating	**Interpretation**	**Code** (Based on Yusoff's (2019))
0	Very poor	0= item not suitable/acceptable
1	Poor	
2	Fair	1= item suitable/ acceptable
3	Good	
4	Excellent	

The ratings obtained from the three expert groups were compiled in Microsoft Excel. The data were coded, with ratings of 2 or above categorized as '1' (acceptable) and ratings below 2 as '0' (unacceptable), as shown in Table 3.1. This coding converted the five-point ordinal scale into dichotomous responses ("pass" or "fail") to facilitate further analysis.

The data was subjected to content validation analysis using two quantitative measures: Item-Level Content Validity Index (I-CVI) and the Modified Kappa Coefficient (K) (Polit et al., 2007; Wynd et al., 2003; Yusoff, 2019)

a. Item-Level Content Validity Index (I-CVI)

I-CVI was calculated as the proportion of experts rating an item as acceptable:

I-CVI = Number of experts in agreement/ Total number of experts

b. Modified Kappa Coefficient (K)

To account for chance agreement, the Modified Kappa Coefficient was computed as follows:

K= I-CVI –Pc/ 1-Pc

Where Pc is the probability of chance agreement:

Pc= [N! / A! (N-A)!] *0.5^N

Here, N= Number of experts

A= Experts in agreement

A Kappa value of >0.75 was considered indicative of strong or excellent strength of agreement (Cicchetti & Sparrow, 1981). This approach provided a robust assessment of the clarity, cultural appropriateness, and potential therapeutic utility of the developed module.

Based on the ratings from all the three expert groups, a weightage of 2 was given for ratings from adults with HI, 1 for their CPs and 0.5 for the AUDs. Accordingly, in each situation, the scenarios were classified under 3 levels: least difficult- average weightage score ranged between 3.5 to 4.5 (level 1), medium difficult –average weightage score ranged between 5 to 6.5 (level 2) and most difficult- average weightage score ranged between 7 to 8.5 (level 3). The weightage data for classifying into levels is depicted in Table 3.2.

Table 3.2

Weightage data for classifying scenarios into difficulty levels

Scenario (n=87)	**AUD (n=5)**	**CP (n=5)**	**HI (n=5)**	**Average**	**Difficulty rating**	**Difficulty level**
PE_1	1.5	1	2	4.5	Least	Level 1
PE_2	1.5	1	2	4.5	Least	Level 1
PE_3	1.5	1	2	4.5	Least	Level 1
PE_4	1.5	1	2	4.5	Least	Level 1
PE_5	1	2	2	5	Medium	Level 2
PE_6	1.5	2	2	5.5	Medium	Level 2
PE_7	1.5	2	2	5.5	Medium	Level 2
PE_8	1	1	2	4	Least	Level 1
PE_9	1.5	1	6	8.5	Most	Level 3
PE_10	1.5	1	4	6.5	Medium	Level 2
PE_11	1.5	2	2	5.5	Medium	Level 2

PE_12	0.5	1	6	7.5	Most	Level 3
PE_13	1.5	2	4	7.5	Most	Level 3
PE_14	1	1	6	8	Most	Level 3
PE_15	0.5	1	6	7.5	Most	Level 3
OW_1	1	2	2	5	Medium	Level 2
OW_2	1.5	2	2	5.5	Medium	Level 2
OW_3	1	1	2	4	Least	Level 1
OW_4	1.5	2	2	5.5	Medium	Level 2
OW_5	1.5	1	2	4.5	Least	Level 1
OW_6	1.5	2	4	7.5	Most	Level 3
OW_7	1	2	4	7	Most	Level 3
OW_8	0.5	1	2	3.5	Least	Level 1
OW_9	0.5	1	2	3.5	Least	Level 1
OW_10	1	1	2	4	Least	Level 1
OW_11	1	1	4	6	Medium	Level 2
OW_12	1.5	1	4	6.5	Medium	Level 2
OW_13	1.5	1	4	6.5	Medium	Level 2
OW_14	1.5	1	6	8.5	Most	Level 3
OW_15	1.5	1	6	8.5	Most	Level 3
OW_16	0.5	1	6	7.5	Most	Level 3
OW_17	1.5	1	6	8.5	Most	Level 3
OW_18	1.5	1	2	4.5	Least	Level 1
HS_1	1	1	2	4	Least	Level 1
HS_2	1.5	1	6	8.5	Most	Level 3

HS_3	1.5	1	6	8.5	Most	Level 3
HS_4	1.5	1	2	4.5	Least	Level 1
HS_5	0.5	1	2	3.5	Least	Level 1
HS_6	1	1	4	6	Medium	Level 2
HS_7	1	2	2	5	Medium	Level 2
HS_8	0.5	1	6	7.5	Most	Level 3
HS_9	1.5	1	4	6.5	Medium	Level 2
SS_1	1.5	1	2	4.5	Least	Level 1
SS_2	1.5	1	2	4.5	Least	Level 1
SS_3	1.5	2	2	5.5	Medium	Level 2
SS_4	1.5	2	2	5.5	Medium	Level 2
SS_5	1	2	2	5	Medium	Level 2
SS_6	1	2	4	7	Most	Level 3
SS_7	0.5	1	2	3.5	Least	Level 1
SS_8	1	1	6	8	Most	Level 3
SS_9	1.5	1	6	8.5	Most	Level 3
HO_1	1.5	1	2	4.5	Least	Level 1
HO_2	1	1	2	4	Least	Level 1
HO_3	1	2	2	5	Medium	Level 2
HO_4	1.5	2	2	5.5	Medium	Level 2
HO_5	1.5	2	2	5.5	Medium	Level 2
HO_6	1.5	2	4	7.5	Most	Level 3
HO_7	0.5	1	2	3.5	Least	Level 1
HO_8	1	1	6	8	Most	Level 3

HO_9	0.5	1	6	7.5	Most	Level 3
PT_1	1	1	2	4	Least	Level 1
PT_2	1	1	2	4	Least	Level 1
PT_3	0.5	1	2	3.5	Least	Level 1
PT_4	1.5	1	4	6.5	Medium	Level 2
PT_5	1.5	1	4	6.5	Medium	Level 2
PT_6	1.5	2	2	5.5	Medium	Level 2
PT_7	1.5	1	6	8.5	Most	Level 3
PT_8	1.5	1	6	8.5	Most	Level 3
PT_9	1	1	6	8	Most	Level 3
EC_1	1.5	1	2	4.5	Least	Level 1
EC_2	1.5	2	2	5.5	Medium	Level 2
EC_3	1.5	2	2	5.5	Medium	Level 2
EC_4	1	2	2	5	Medium	Level 2
EC_5	1	1	2	4	Least	Level 1
EC_6	1	1	2	4	Least	Level 1
EC_7	1.5	1	6	8.5	Most	Level 3
EC_8	0.5	1	6	7.5	Most	Level 3
EC_9	0.5	1	6	7.5	Most	Level 3
ES_1	1.5	1	2	4.5	Least	Level 1
ES_2	1.5	1	2	4.5	Least	Level 1
ES_3	1.5	1	2	4.5	Least	Level 1
ES_4	1.5	1	4	6.5	Medium	Level 2
ES_5	1.5	2	2	5.5	Medium	Level 2

ES_6	1	2	2	5	Medium	Level 2
ES_7	1.5	1	6	8.5	Most	Level 3
ES_8	1	1	6	8	Most	Level 3
ES_9	1	1	6	8	Most	Level 3

Note- PE: Personal Environment; OW: Office or Workplace; HS: Hospital Settings; SS: Social Settings; HO: Hotels and Outings; PT: Public Transportation; EC: Exhausted Conditions; ES: Educational Settings

The situations and the number of scenarios presented under each difficulty level in the CST module-Kannada is depicted in Table 3.3. The participants could choose six most difficult situations in which they wish to be trained.

Table 3.3

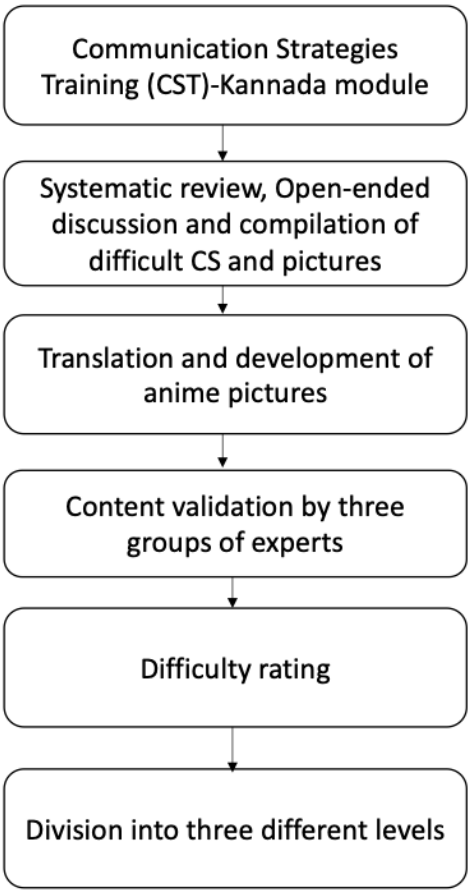
Situations and number of scenarios in each levels of training in CST-Kannada module

Place / Situation	**Training difficulty**			**TOTAL**
	Level 1	**Level 2**	**Level 3**	
Office or Workplace	6	6	6	18
Hospital Settings	3	3	3	9
Educational Settings	3	3	3	9
Hotels and Outings	3	3	3	9
Social Settings	3	3	3	9
Personal Environment	5	5	5	15
Public Transportation	3	3	3	9
Exhausted Conditions	3	3	3	9
TOTAL	29	29	29	87

The process of material development, content validation and assigning the scenarios into levels is depicted in the flow-chart (Figure 3.1).

Figure 3.1

Flow-chart of the development, content-validation and assigning the materials into different levels.



Phase 2: The development of a web-based Communication Strategies Training (CST) module- Kannada [tele-rehabilitation mode]

3.3 Development of web-based product

A web-based CST module-Kannada was developed for the training of Communication Strategies in Kannada for adults with hearing impairment. The web-based product was prepared in collaboration with the Digimarkstudio, Mysore. The materials of web-based CST-

Kannada module mirrored the conventional face-to-face CST module. Hence, after completing the validation process and finalizing the content and illustrations, the entire CST-Kannada module was systematically documented and prepared for handover to a professional software developer for development of the web-based CST-Kannada module. This stage involved compiling all validated scenarios, images, difficulty level classifications, and meta-data into structured digital assets. A detailed briefing was created, specifying the goals, learning objectives, and user flow for the module. This included outlining user roles (audiologists, adults with hearing impairment, and communication partners), navigation paths for selecting and practicing scenarios based on difficulty levels, and feedback mechanisms for reinforcing learning. The functional requirements document given to the developer defined key features such as scenario selection screens, animated illustration displays, prompts, instructions for each test and scenario, structured questioning interfaces, scoring or tracking of completed scenarios, and data security or privacy considerations. Meetings were held between the research audiologists and the developer to discuss the design specifications, user interface (UI) guidelines emphasizing cultural appropriateness and accessibility, and integration of assistive features (e.g., adjustable font sizes, high-contrast modes, module visuals, etc). The developer was also briefed on the need for cross-platform compatibility to ensure the module would be accessible via Android, iOS, and web browsers, thereby maximizing its reach among the users. In addition, plans were discussed to incorporate user analytics capabilities for future research on usage patterns and intervention effectiveness, with appropriate ethical safeguards for data handling. A phased development schedule was agreed upon, including wireframing, prototyping, iterative testing with sample users, bug fixing, and final web deployment. By handing over the validated and structured content to the software developer with these comprehensive specifications, the study aimed to ensure that the CST-Kannada module would be delivered as an interactive, user-friendly, and clinically meaningful digital tool.

3.4 Design and Working of the Web-based CST-Kannada module

The salient features and the working of the web-based CST-Kannada module is explained below-

1. As soon as the participant clicked on the link of the web-based product, a welcome window of the web-based CST-Kannada module appeared. Figure 3.2 and 3.3 are the screen shots of the link and the welcome window.

Figure 3.2

Screenshot of the link of the web-based CST-Kannada module

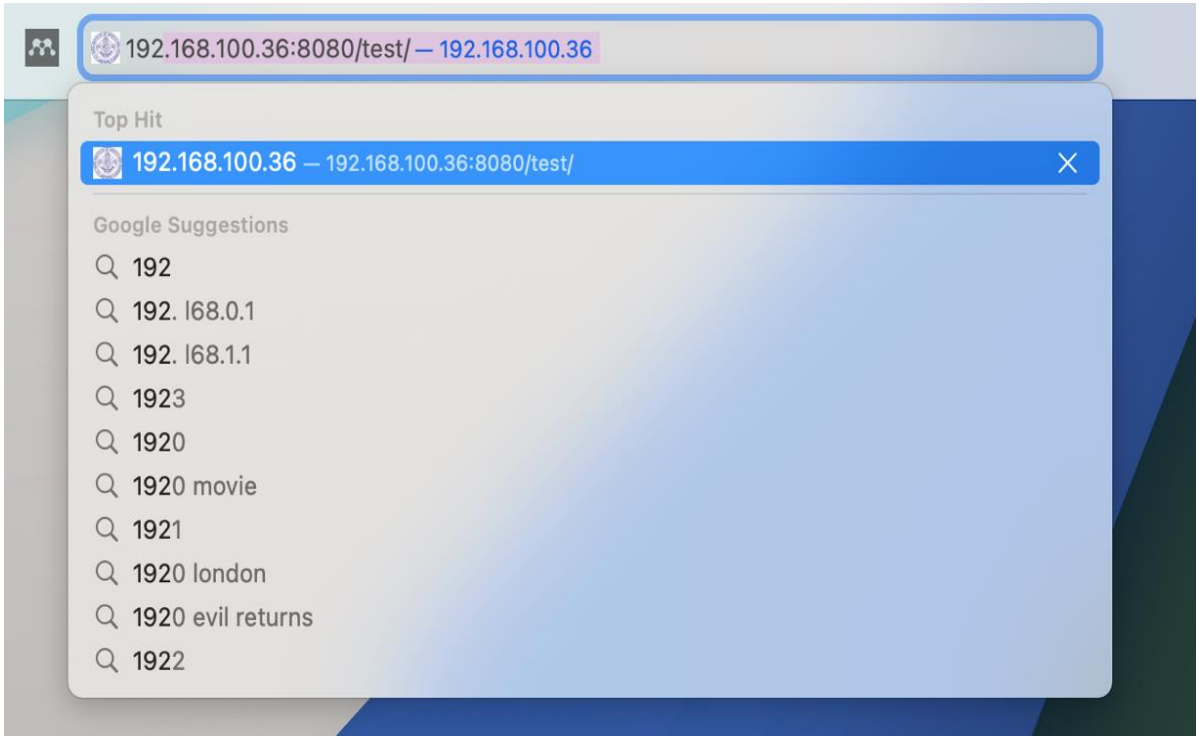
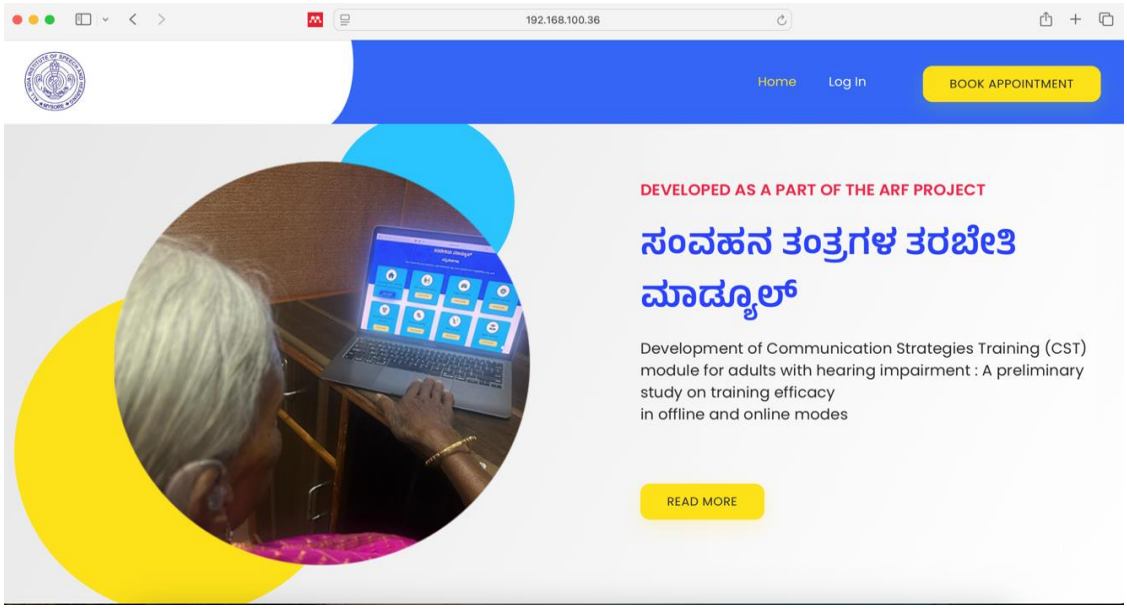


Figure 3.3

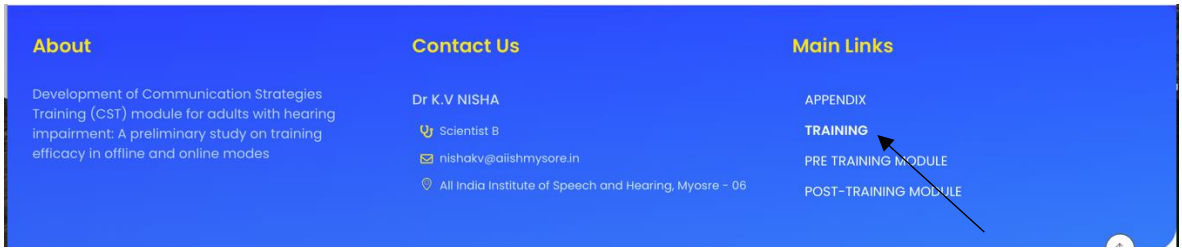
Screenshot of the welcome window of web-based CST-Kannada module



2. On the welcome window, all the options available in the web-based CST-Kannada module were displayed, which is shown in Figure 3.4.

Figure 3.4

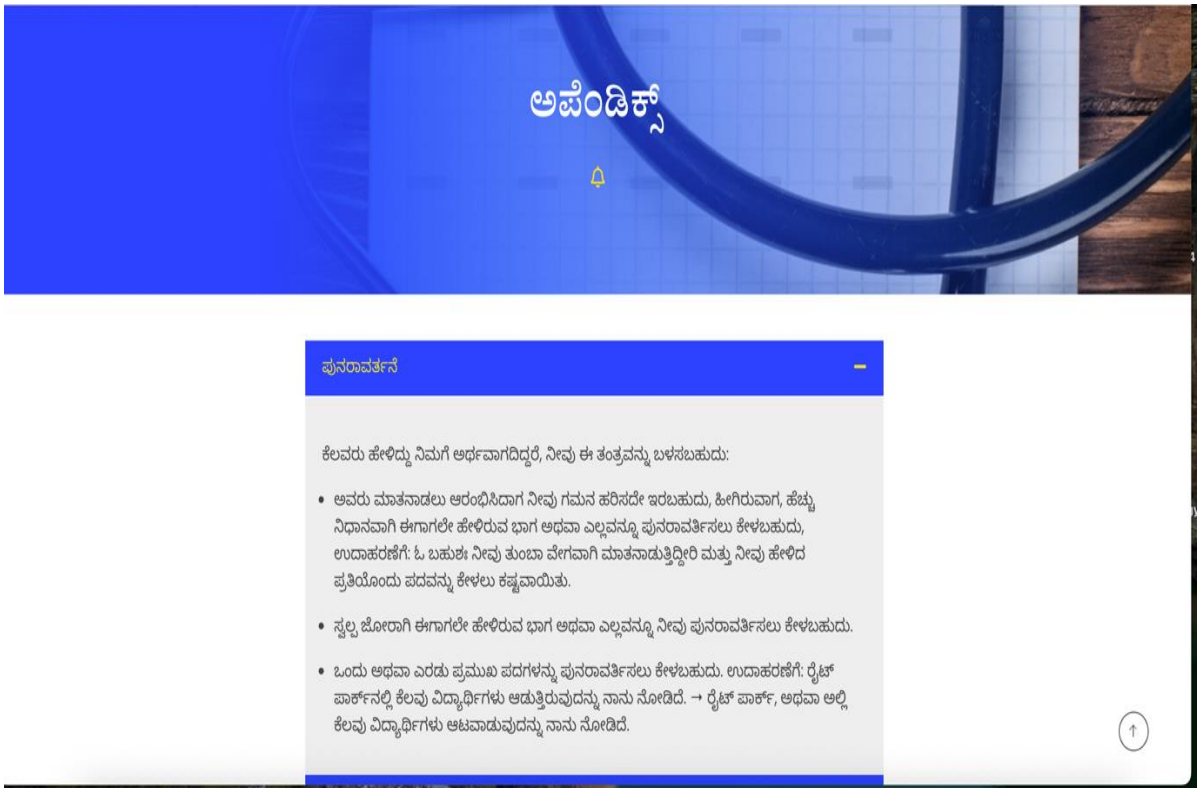
Screenshot of the options available in the web-based CST-Kannada module



3. The participant was asked to choose the appendix, which gives the comprehensive reading material about various CS prior to actual CST. Figure 3.5 is the screen shot of the appendix window.

Figure 3.5

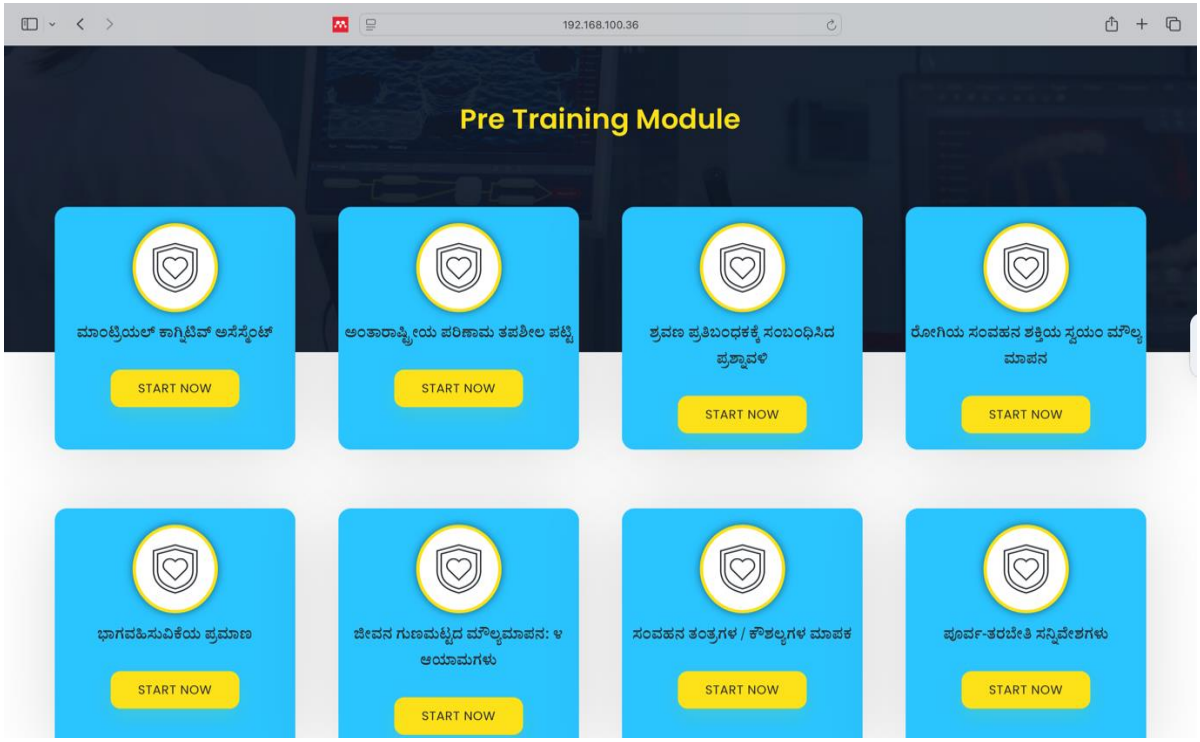
Screenshot of the appendix window



4. Once, the participant was done reading the materials, they had to go back to home page to choose the pre-training option which navigated them to the web-based CST-Kannada pre-training assessments which is depicted in Figure 3.6.

Figure 3.6

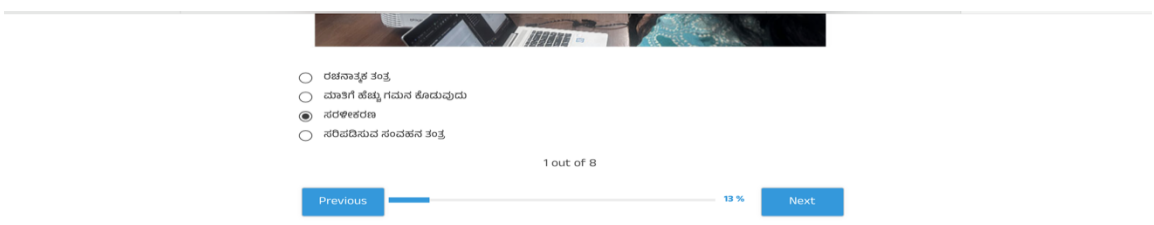
Screenshot of the pre-training window in the web-based CST-Kannada module



5. Once, the participant completed the six pre-training tests, they were asked to choose the pre-training CS scenarios questionnaire which provides no feedback on giving a response. It is depicted in Figure 3.7.

Figure 3.7

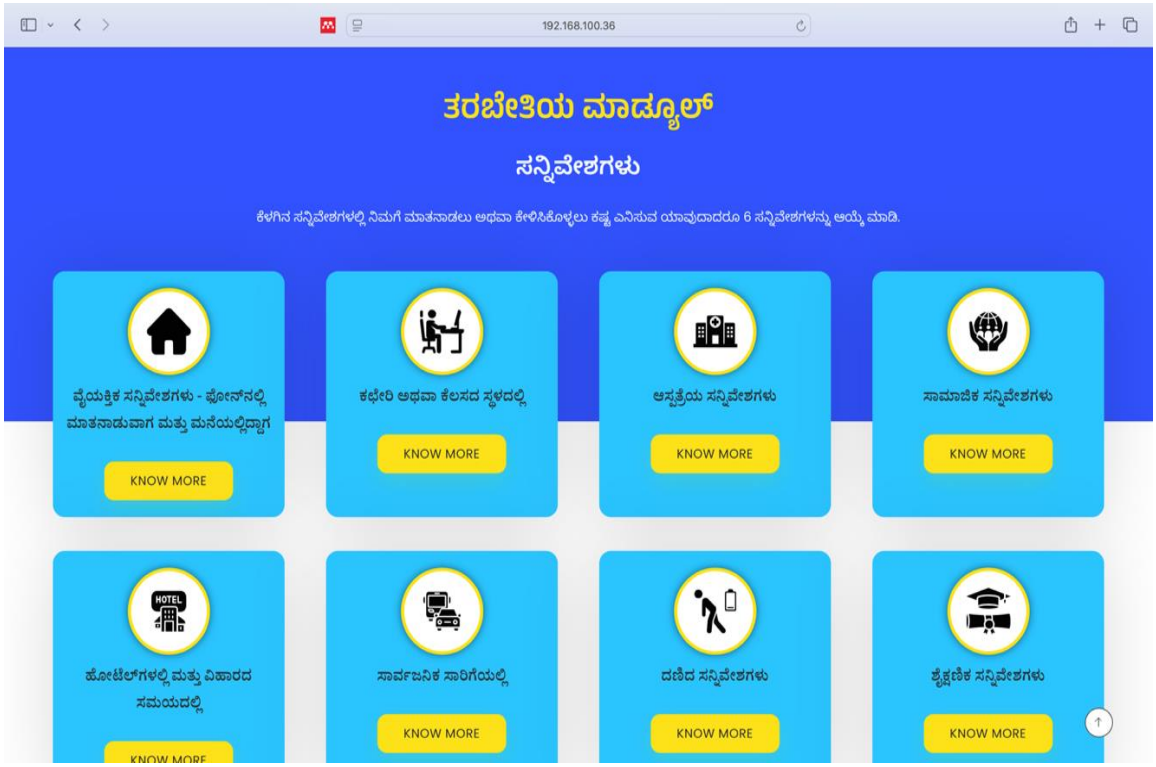
Screenshot of the pre-training CS scenario response not receiving any feedback



6. The participant then had to choose the training module on the home page, navigating them to the eight different CS scenarios, out of which they could choose six scenarios they wished to be trained one after the other. The screen shot depicts the same (Figure 3.8).

Figure 3.8

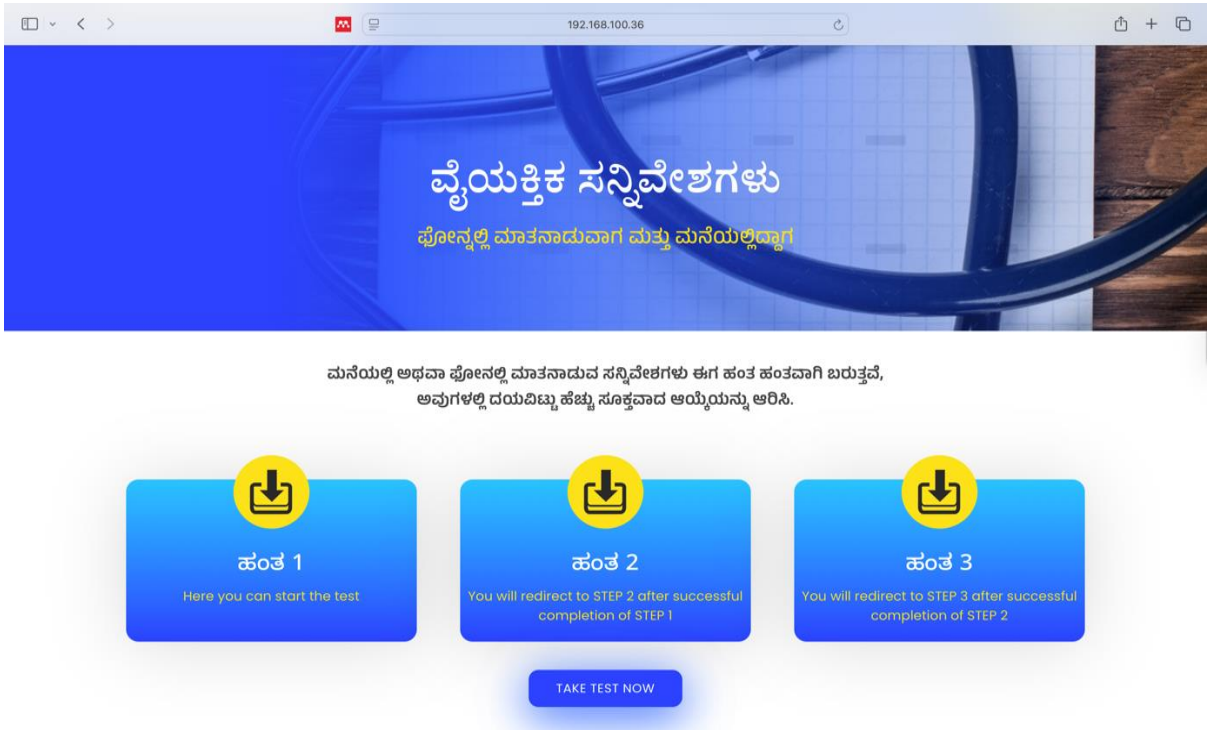
Screenshot of the training window in the web-based CST-Kannada module



7. Once the scenario is chosen by the participants, they can see the three different levels to begin the training. This is depicted in Figure 3.9.

Figure 3.9

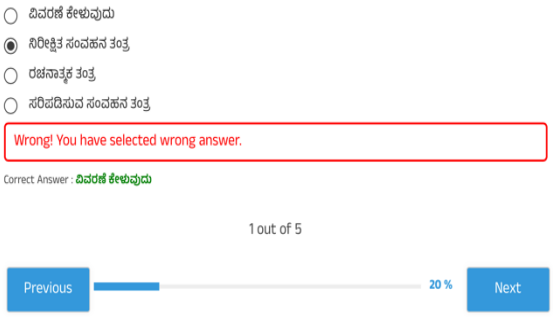
Screenshot of levels of training in web-based CST-Kannada module



8. Feedback was provided to participants in the training module upon choosing the response, which is depicted in Figure 3.10.

Figure 3.10

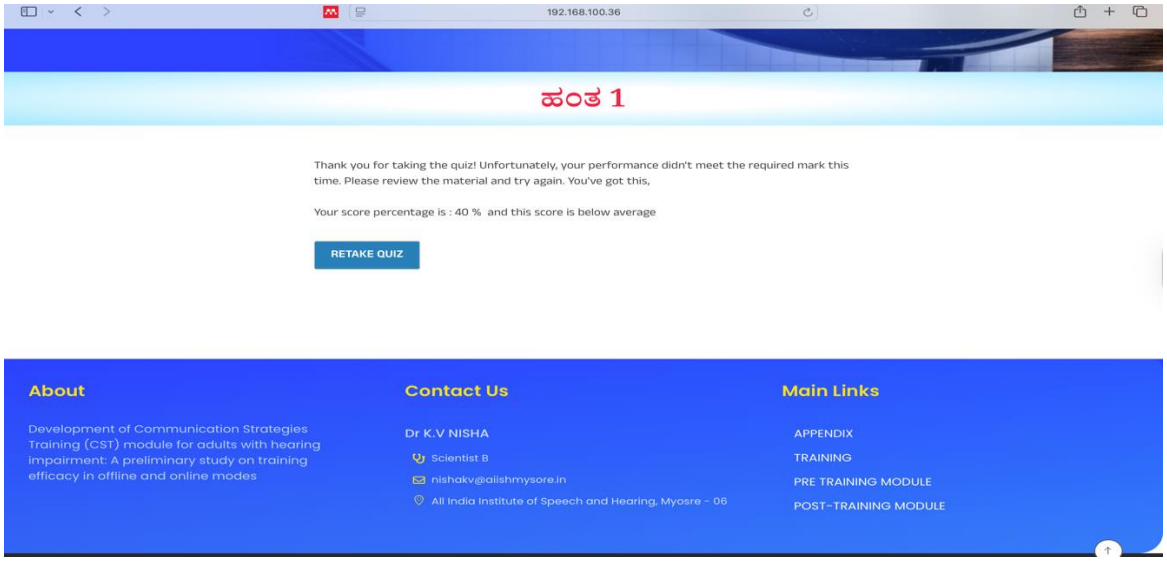
Screenshot of the feedback received in web-based CST



9. A minimum score of 70% was required for the participants to move on to the next level, otherwise, the web-based link navigates back to the same level and three attempts are given to complete each level. This is depicted in Figure 3.11.

Figure 3.11

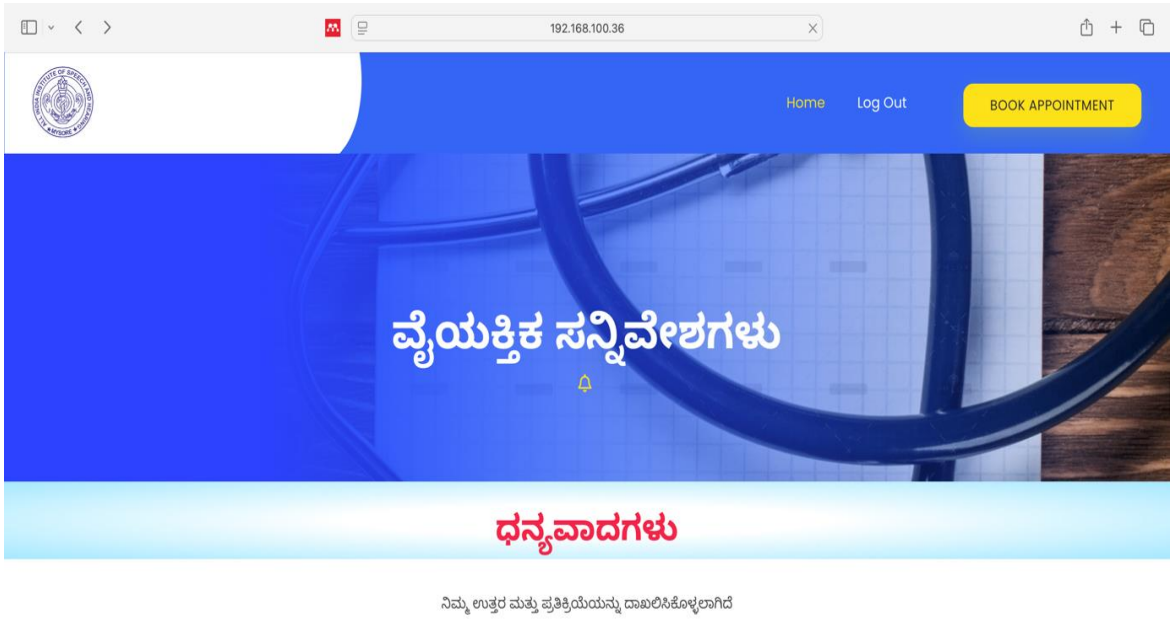
Screenshot of scoring in a level of web-based CST-Kannada module



10. Upon completion of all the three levels, a window showing a “Thank you” response would pop-up indicating completing the training of that chosen scenario, depicted in Figure 3.12.

Figure 3.12

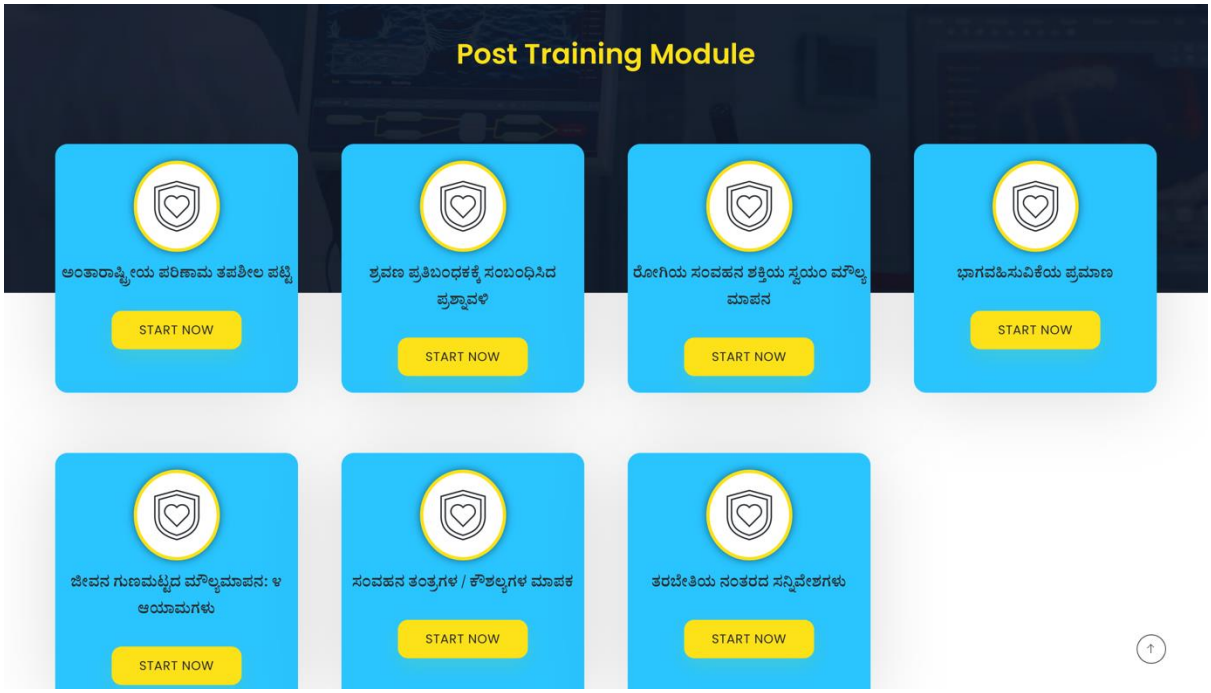
Screenshot of the training completion window of the web-based CST-Kannada module



11. Once all the six scenarios were completed and the core-CST is completed, the participants then had to choose the post-training option which navigates them to the web-based CST-Kannada post-training assessments which is depicted in Figure 3.13. It is mirrored exactly like the pre-training assessment. This stage of training was done twice, that is one, immediately after training (post-training 1) and the other at 1 month-follow up after training (post-training 2).

Figure 3.13

Screenshot of the post-training window in web-based CST-Kannada module



Phase 3: Administration of the CST module-Kannada in conventional face-to-face and tele-rehabilitation mode

The CST-Kannada module, both in conventional face-to-face and tele-rehabilitation mode followed a structured three-phase approach designed to assess baseline competency, deliver targeted training and evaluate outcomes. The complete training program required approximately 6-10 hours of total engagement time distributed across multiple sessions over a 2–3-week period. The participants could choose the mode of training and in it the six most difficult situations in which they wish to be trained out of eight situations from the module.

3.5 Participants

A total of 40 participants aged between 25-70 years, with an acquired sensorineural hearing loss ranging from mild to severe degree of loss using binaural or monoaural hearing aids and had Kannada as their native language were included in the study. They were divided

into two groups of 20 individuals each based on their choice and the knowledge and exposure to electronic devices. Group I were assigned to conventional face-to-face CST and Group II were assigned to web-based CST. All the participants had normal cognitive functioning (score of ≥ 26/30) as revealed by Montreal cognitive assessment test (MOCA) in Kannada language (Kaul et al., 2022). The demographic details of the participants including age, gender, MOCA scores, and audiological characteristics (pure-tone average, degree of hearing loss, the onset of the hearing loss, speech identification scores) were noted. In addition, hearing aid usage related data (unilateral/bilateral, hours of usage per day, and duration of usage in years) along with socio-educational status (occupation, and education category) of the participants were also noted. The participants hearing aid characteristics were matched in terms of the number of channels, period of usage, hours of usage, using NAL-NL2 fitting rationale, prior experience with hearing aid, and other signal processing features (digital noise suppression, feedback suppression). In addition, all the participants had a minimum educational qualification of 5^{th} grade, with Kannada as their primary language.

3.6 Initial set-up and preparation

3.6.1 For conventional face-to-face CST module

Prior to beginning the training sequence in conventional face-to-face mode, the participant was made to be seated in a well ventilated, low-noise exposure room on a chair comfortably and the purpose and nature of the study was explained to each participant and written informed consent was obtained. The study adhered to the 'Ethical guidelines for bio-behavioral research involving human subjects' (Venkatesan, 2009) and Institutional ethical committee approval (Ref: SH/AEC/ARF-6/2023-2024 dated 19.5.2023) was taken prior to the initiation of study. Participants then received a comprehensive reading material in the form of a booklet, that provided detailed explanations of various communication strategies along with

practical examples (Appendix I). This preparatory material served as the foundation for all subsequent training activities.

3.6.2 For tele-CST module

Prior to begining the use of web-based CST-Kannada module, the participants were made to be seated in a well-ventilated and low-noise exposure room on a chair comfortably and the purpose and nature of the study was explained to each participant and written informed consent was obtained. Then, the laptop (Dell Inspiron 13 7000 2-in-1) with AnyDesk (version 9.0) access was given to each of the participant and the instructions on the use of the web-based product was briefed. Mock-sessions were provided on demand from the participant prior to actual training. Once, the participant was ready, the web-based CST program began using the web-based link (www.192.168.100.36:8080/test/). In this mode of training, the assistance of the audiologist was provided remotely, with the audiologist available on the other end of the participant training room. Audiologist assistance was offered as and when required by the participant during the tele-CST sessions.

3.7 Pre-Training Assessment Session

The initial assessment phase presented participants with the six questionnaires in Kannada version (Thammaiah et al., 2016) that assessed three aspects of hearing disability: hearing handicapped [International Outcome Inventory for Hearing Aids (IOI-HA), Hearing Handicap Questionnaire (HHQ) and Self-Assessment of Communication (SAC)], participation and overall quality of life [Participation Questionnaire (PQ) and Assessment of Quality of Life in 4 Dimensions (AQoL-4D)] and the utilization of CS [Communication Strategy Scale (CSS), and communication scenarios (CS) questionnaire]. After completion of each questionnaire, a rest of five minutes was given. A standardized scoring procedure concerning each questionnaire was followed. The details of the test-materials used in the study is given in Table 3.4.

Table 3.4

Details of the questionnaires used as outcome measure in the study

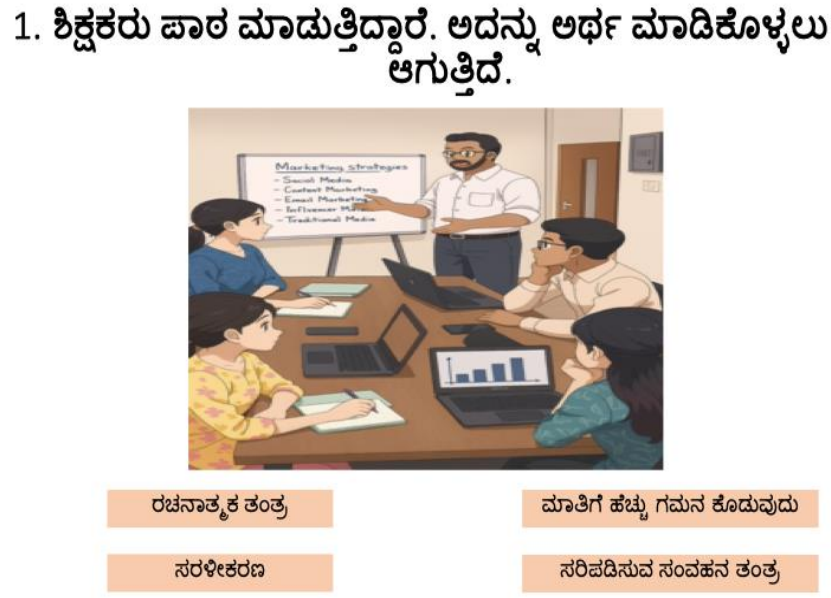
SL.no.	Test Material	Author and year (English version)	Author and year (Kannada version)	Domains assessed	Scoring
1	International Outcome Inventory for Hearing Aids (IOI-HA)	(Cox & Alexander, 2002)	(Thammaiah et al., 2016)	Seven different outcome domains related to hearing aid use: i) usage; ii) benefit; iii) residual activity limitations; iv) satisfaction; v) residual participation restrictions; vi) impact on others; and vii) quality of life	5-point scale ranging from "never=1" to "almost always=5" Maximum score=35, indicating maximum HA benefit Minimum score=7, indicating minimum HA benefit
2	Hearing handicap questionnaire	(Gatehouse & Noble, 2004)	(Thammaiah et al., 2016)	Three domains: i) emotional distress and discomfort; ii) social withdrawal, and iii) participation restrictions	5-point scale ranging from "never=1" to "almost always=5" Maximum score=60, indicating maximum handicap Minimum score=12, indicating minimum handicap
3	Self-Assessment of Communication (SAC)	(Schow & Nerbonne, 1982)	(Thammaiah et al., 2016)	The first five questions focus on assessing disability, while the remaining address participation restrictions.	5-point scale ranging from "never=1" to "always=5" Maximum score=50, indicating least awareness to difficulties

					Minimum score=10, indicating maximum awareness to difficulties
4	Participant Questionnaire (PQ)	(Van Brakel et al., 2006)	(Thammaiah et al., 2016)	Assesses the severity of participation restrictions; evaluate the need for rehabilitation and the effectiveness of interventions in reducing participation limitations.	4-point scale ranging from "Yes=3" to "No=0" Maximum score=54, indicating least restrictions in participation Minimum score=0, indicating highest restrictions in participation
5	Acquired Quality of Life- 4 dimensions (AQol-4D)	(Hawthorne et al., 1999)	(Thammaiah et al., 2016)	Five dimensions: i) illness; ii) independent living; iii) social relationships; iv) physical senses and v) psychological wellbeing.	4-point rating scale in multiple choice options with score ranging from 1 to 4 Maximum score=48, indicating fair to poor overall quality of life Minimum score=12, indicating good overall quality of life
6	Communication Strategies Scale (CSS)	(Demorest & Erdman, 1986)	(Pinto, 2025)	Three domains: i)Maladaptive behaviours, Total questions-8, Maximum score=1.6, Minimum score=0 ii)Verbal strategies, Total questions- 8 Maximum score=1.6, Minimum score=0 iii)Non-verbal strategies Total questions- 9 Maximum score=1.8, Minimum score=0	5-point rating scale ranging from "never=5" and "always=1" for Maladaptive behaviours and "never=1" to "always=5" for Verbal and Non-verbal strategies Maximum score=5, indicating maximum use of CS Minimum score=0, indicating minimum use of CS

For CS Questionnaire (CSQ), 16 scenarios; two from each of the eight situations, which do not fall into any difficulty level from the developed and validated material were chosen for assessment of the CS use at pre-training session (8 scenarios) and post-training evaluations (8 scenarios). For this, participants were instructed to identify and select the most appropriate CS (among the 4 given options) that can help overcome communication breakdown from the test booklet. An example of a question from CSQ is depicted in Figure 3.14. Responses were scored using a binary system where correct answers received one point and incorrect answers received zero points with no feedback on response. The maximum points allocated was 8.

Figure 3.14

Example of a question from the CS questionnaire



This baseline assessment served multiple purposes: it established each participant's current competency level, identified areas requiring focused attention and provided a benchmark for measuring training effectiveness. The pre-training session typically required

approximately 60 minutes and could be completed in a single sitting with adequate breaks given to the participants.

3.8 Core CST-Kannada Training Program

Following the baseline assessment, participants engaged in the primary training program. This phase required participants to complete 3-4 sessions under audiologist supervision. Sessions were conducted at the institute or audiology clinic, with home visits available when needed to accommodate individual circumstances. While CST is ultimately designed for independent self-monitoring and training of the patients, audiologist supervision was maintained as this is a preliminary study and to ensure proper efficacy testing protocols.

The training began with participants being seated comfortably, reviewing all eight communication situations in the test booklet and selecting the six situations they find most challenging or problematic in their daily communication experiences in the face-to-face mode. While in the tele-CST mode, the web-based CST link was given to select the six situations they find most challenging or problematic in their daily communication experiences. Training then proceeded systematically through each selected situation using a progressive three-level structure. Feedback of visualizing the correct CS was provided in the test booklet and the tele-CST training window upon choosing the incorrect CS. Each scenario training followed a consistent pattern: participants must achieve a 70% success rate at Level 1 (typically 2 correct responses out of 3 scenarios) before advancing to Level 2, and subsequently to Level 3. Complete mastery of a single scenario required achieving an overall score of 70% or higher across all three levels (generally 7 correct responses out of 9 total scenarios). This structured approach ensured adequate training while maintaining flexibility to accommodate individual learning paces, practice effects and scheduling their communication requirements.

The module is designed to allow three attempts at each level within each situation, ensuring participants to have adequate opportunity to demonstrate competency while maintaining training standards. Individual training sessions were limited to one hour duration with appropriate rest periods, and the complete training program typically spanned 6-10 total hours distributed across multiple sessions. The number of participants who attempted the situation is shown in Table 3.5.

Table 3.5

Participant attempt data of each situation in both the groups (n=20 in each group)

Place / Situation	**No. of patients attempted in Group I**	**No. of patients attempted in Group II**
Personal Environment	20	20
Office or Workplace	12	12
Hospital Settings	20	20
Social Settings	20	20
Hotels and Outings	18	19
Public Transportation	20	09
Exhausted Conditions	09	14
Educational Settings	01	06

3.9 Post-Training Evaluations

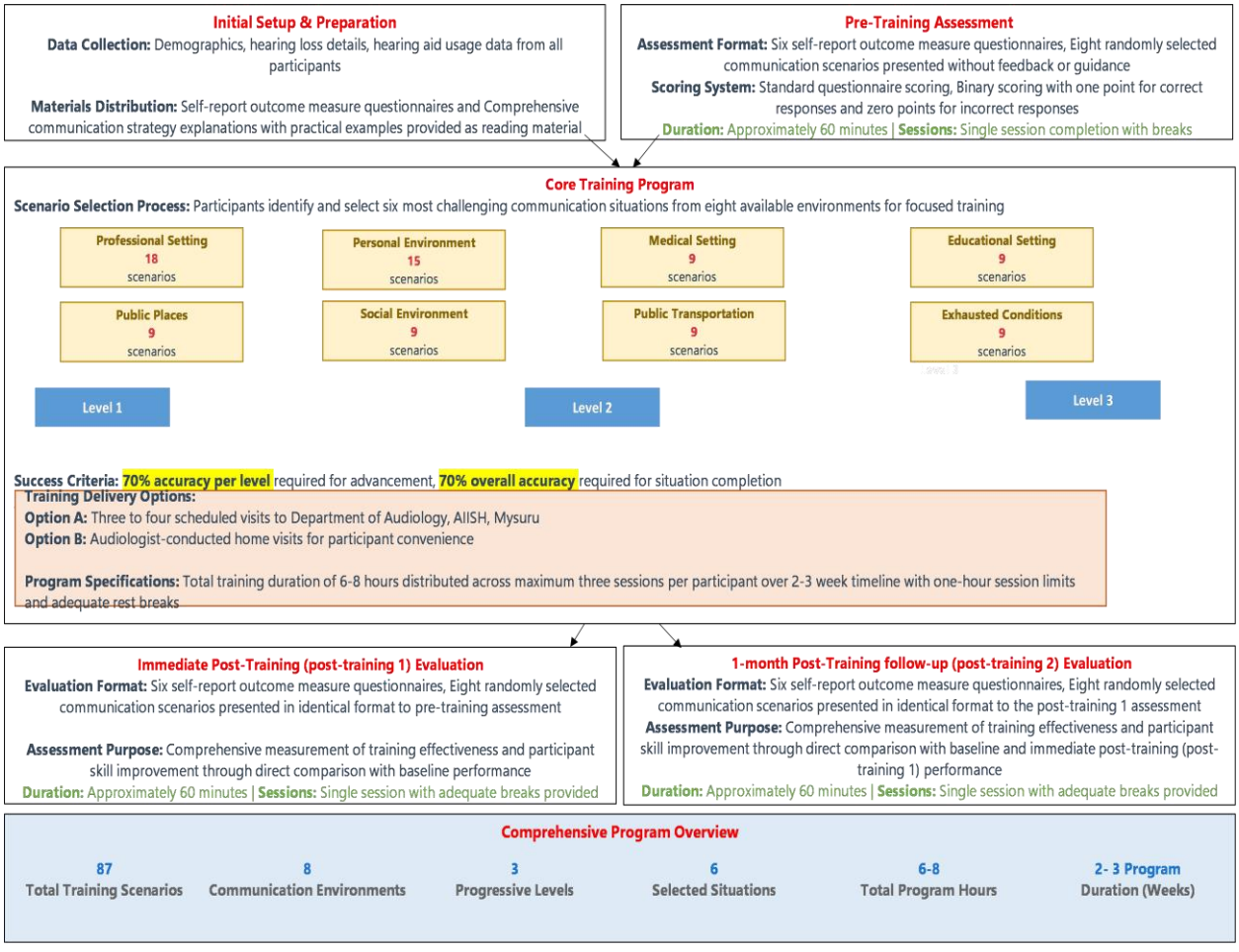
The final phase mirrored the initial assessment, presenting participants with the six questionnaires that were used in pre-training assessment and CS questionnaire in which the scenarios differed from the ones used in pre-training evaluation. A similar scoring procedure

concerning each questionnaire and, the same binary system scoring without feedback as used in pre-training evaluation was incorporated.

The post-training assessment was done immediately after completing the CST (post-training 1) and at 1 month follow-up after CST (post-training 2). These served as the primary outcome measures for determining training effectiveness soon after training. Also, 1 month follow up evaluation ensured evaluation of participants' performance after adequate practice of the CST. The evaluation session required approximately 60 minutes and could be completed in a single session with adequate breaks given to the participants. The CST-Kannada module administration process is explained briefly through a flow-chart detailed in Figure 3.15.

Figure 3.15

Flow-chart of the administration process of CST



3.10 Storing of responses

All the responses of the conventional face-to-face module (recorded by the Audiologist during the CST) and tele-CST module (stored in the back-end in the form of an Email) of the pre-training evaluations, core CST program and the post-training evaluations of all the participants were manually entered into a scoring sheet which was then entered to the Microsoft Excel sheet by the research Audiologist, which would be used for further analysis.

3.11 Statistical Analysis

The data was formally analyzed using the SPSS software (version 29.0) (IBM, 2023). Kappa coefficient (K) was calculated to test the reliability and validity of the developed module. The data was also tested for normality using the Shapiro-Wilk test with Lilliefors significance correction. Because of non-normality ($p < 0.05$), non-parametric statistical tests were administered. Mann-Whitney U-test was administered between two groups of the study to assess the similarities amongst the two. The effectiveness of CST was studied using graphical representation. For this, the CST attempt data was cumulated into a bar graph according to the total number of attempts each participant took in each level of the scenarios they attempted to complete the CST. Also, Mann-Whitney U test was administered between two groups of the study to assess the total percent score similarities to prove the similar effectiveness of CST among the two groups. Furthermore, Friedman's two-way analysis of variance test was administered to assess the benefits and retention effects of CST on self-outcome measures.

CHAPTER 4

RESULTS

Using the developed materials and the design, a conventional face-to-face module and a web-based software was developed for training of communication strategies (CST). Using the conventional face-to-face module and the web-based software, 20 individuals each with hearing impairment were trained for CS use in eight different difficult to communicate situations in two different modes that is face-to-face CST mode and tele-CST mode. The self-outcome measures pertaining to hearing handicapped (IOI-HA, HHQ and SAC), participation and overall quality of life (PQ and AQol-4D) and utilization of CS (CSS and CSQ) were administered at 3 intervals during the CST including the pre-training, immediate post-training (post-training 1) and at 1-month post follow-up (post-training 2) to measure the efficacy of CST. The results of the study are explained below based on the objectives of the study.

4.1 The development of a CST module in Kannada language in tele and conventional face-to face mode for individuals with hearing impairment (HI)-

The study resulted in the development of the CST-Kannada module in both tele and conventional face-to-face mode. The scenarios where communication breakdown is experienced by the hearing-impaired individuals were designed across eight different situations to facilitate the use of CS. Each scenario was related and generalized to daily activities of the individuals with HI and appropriate pictures were clicked and anime pictures were generated using a web-based image generator. The module was validated by three expert groups (AUDs, CPs and Adults with HI). Table 4.1 summarizes the I-CVI and Kappa values for each of the five validation parameters for eight situations.

Table 4.1

Content validation measures of the 18 parameters by three expert groups for scenarios incorporated in the CST-Kannada module

Parameter	**Expert Group (n=5 each)**	**A**	**I-CVI**	**Pc**	**K**
Simplicity	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Familiarity	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Size of the picture	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Colour and Appearance	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Arrangement	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Presentation	AUDs	5	1	0.031	1.0

	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Volume	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Relevancy	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Difficulty	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Iconicity	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Accessibility	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Flexibility	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Trainability	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Stimulability	AUDs	5	1	0.031	1.0

	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Feasibility	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Generalization	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Scope of practice	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0
Scoring pattern	AUDs	5	1	0.031	1.0
	CP	5	1	0.031	1.0
	Adults with HI	5	1	0.031	1.0

Note- A=Experts in agreement; I-CVI=Item level content validation index; Pc=Probability of chance agreement; K=Kappa coefficient

Each situation was analysed individually based on I-CVI and Kappa Statistics. According to the recommendations by Wynd et al. (2003), the cut-off criteria recommendations for I-CVI is 1 (for three subject experts). For Kappa Statistics, it is >0.75, indicating excellent strength of agreement. The content validity analysis in our study revealed that I-CVI values and Kappa Statistics values ranged from 0 to 1. All the situations achieved perfect I-CVI scores (Mean = 1.00) and K values (Mean = 1.00) across all 18 parameters indicating excellent strength of agreement as depicted in Table 4.1. Thus, the CST-Kannda module was rated excellent for all the rating parameters, with positive Kappa values (K=1) indicating high agreement beyond chance. The same developed material was used in the web-based tele-CST

module and five individuals had a test run to yield the similar content validation results indicating high agreement beyond chance.

4.2 Comparison of the efficacy of CST between groups, trained using conventional face-to-face mode and tele-intervention mode-

Results of the efficacy of the CST is explained through the descriptive data including median and the interquartile range of both the groups as shown in Table 4.2 and the graphical representations (Figure 4.1 and Figure 4.2). The bar graph is plotted using the choice of scenarios (Table 3.6) and the total number of attempts each participant took at each level of each scenario to complete the CST.

With that, most of the participants chose almost all of the scenarios equally, with the educational settings (Figure 4.1H), exhausted conditions (Figure 4.1G) and office settings (Figure 4.1B) being the least chosen and personal environments (Figure 4.1A), social settings (Figure 4.1D) and hospital settings (Figure 4.1C) being the most chosen for CS training in conventional face-to-face mode. Also, the participants finished each scenario in almost one attempt, but a few of them took two and sometimes three attempts in scenarios like the personal environment, office settings, at restaurants (Figure 4.1E) and public transportation (Figure 4.1F) to finish the CS training in face-to-face mode.

While in the tele-CST mode, most participants chose scenarios equally, with educational settings (Figure 4.2H), and public transportation settings (Figure 4.2F) to be least chosen, while personal environments (Figure 4.2A), office environments (Figure 4.2B), social settings (Figure 4.2D), and hospital settings (Figure 4.2C) were most chosen for CS training. Participants finished each scenario in almost one attempt, though some required two or three attempts in scenarios like personal environment, office settings, restaurants (Figure 4.2E), and public transportation.

Table 4.2

Descriptive data including the median and inter-quartile range of the total attempts of each scenario for both the groups

Situation	Total attempts taken in each level (L)	Group I		Group II	
		Median	IQR	Median	IQR
Personal Environments	L1	1.00	1	1.00	0
	L2	1.00	0	1.00	1
	L3	1.00	2	1.00	1
Office or Workplace	L1	1.00	1	1.00	1
	L2	1.00	1	1.00	1
	L3	2.00	1	1.00	1
Hospital Settings	L1	1.00	0	1.00	0
	L2	1.00	0	1.00	0
	L3	1.00	0	1.00	0
Social Settings	L1	1.00	0	1.00	0
	L2	1.00	0	1.00	0
	L3	1.00	0	1.00	0
Hotels and Outings	L1	1.00	1	1.00	0
	L2	1.00	0	1.00	0
	L3	1.00	1	1.00	1
Public Transportation	L1	1.00	0	1.00	0
	L2	1.00	0	1.00	0

	L3	1.00	0	1.00	0
Exhausted Conditions	L1	1.00	0	1.00	0
	L2	1.00	0	1.00	0
	L3	1.00	1	1.00	0
Educational Settings	L1	1.00	0	1.00	1
	L2	1.00	0	1.00	1
	L2	1.00	0	1.00	0

Note- L1: Level 1; L2: Level 2; L3: Level 3

Figure 4.1

Total attempt data of each scenario in conventional face-to-face CST mode

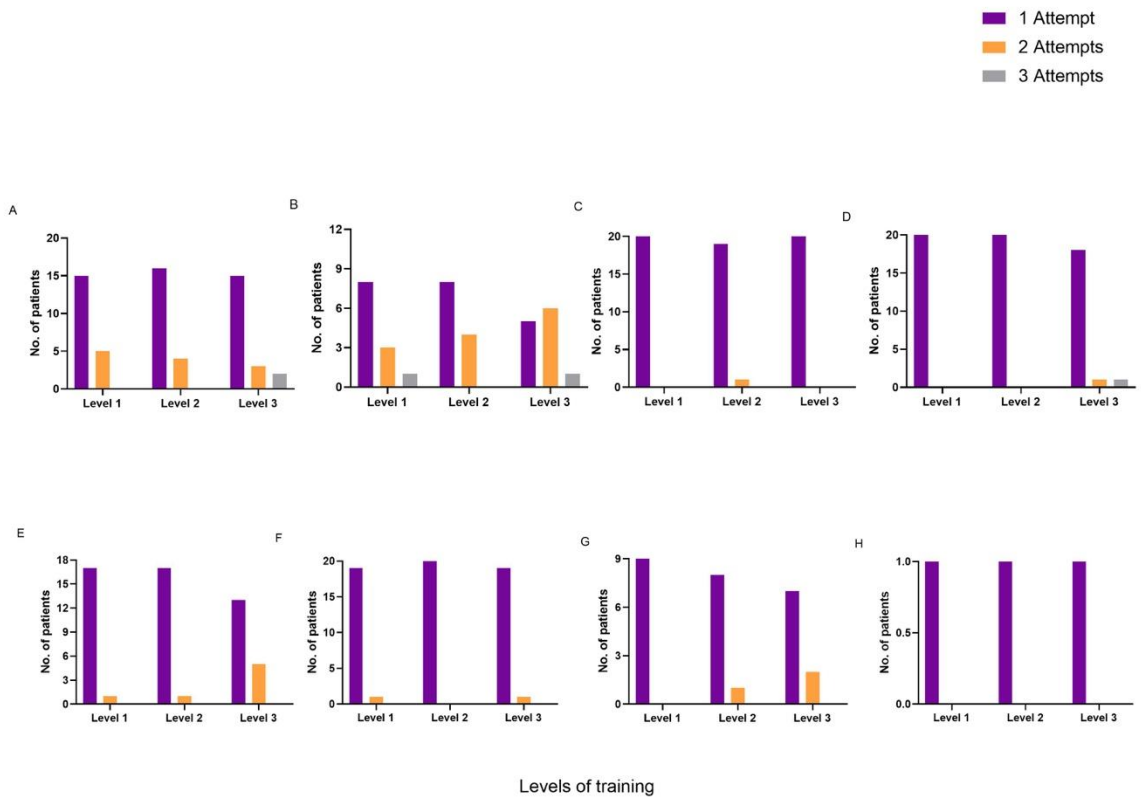
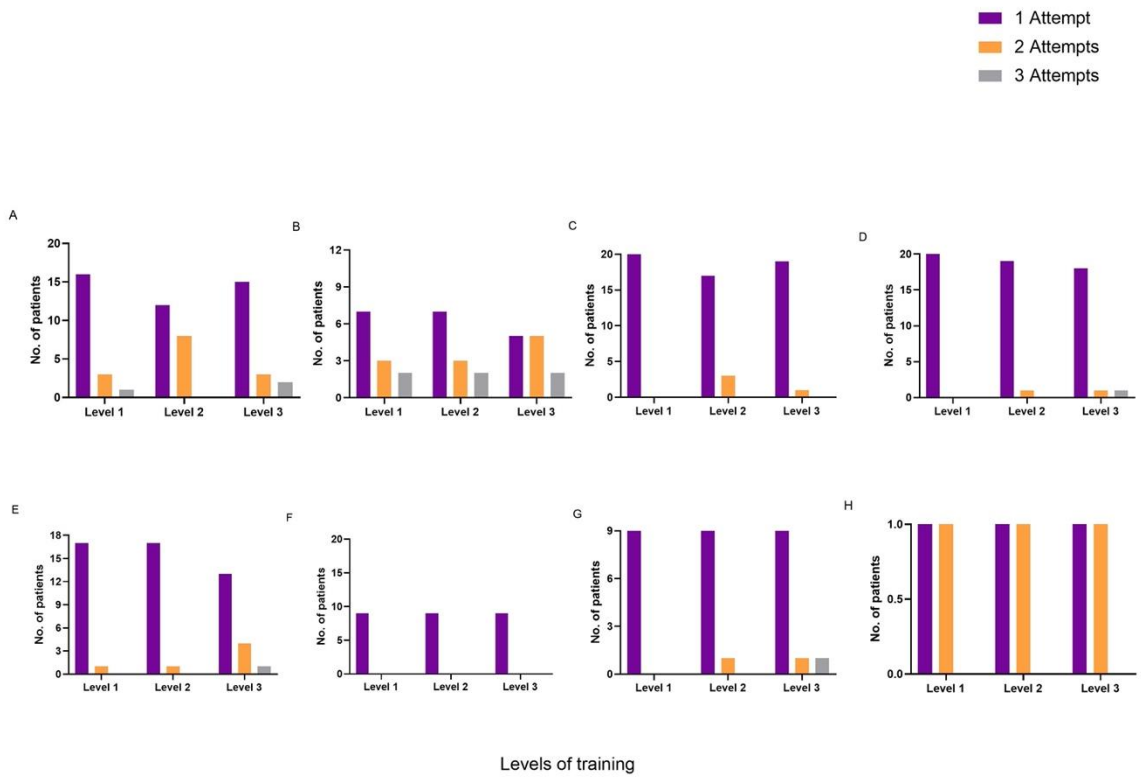


Figure 4.2

Total attempt data of each scenario in tele-CST mode



Also, descriptive statistics containing median, along with the interquartile range of all the percent correct (Pcorrect) scores of each of the three attempts in a level are provided in Table 4.3 for both the groups. From the table it can be inferred that participants in both the groups obtained similar percent correct scores during the CST for most of the scenarios. This was supported by the inferential statistics results using the Mann-Whitney U test between the two groups that showed similar performance in both the groups for CST, irrespective of the mode of delivery.

Table 4.3

Percent correct scores of each attempt of each level of scenarios in CST for both the groups

Situation	Levels (L)/ Attempts (A) Percent Correct	Group I		Group II		Mann-Whitney U test statistics
		Median	IQR	Median	IQR	
Personal Environments	A1_L1	80.00	20	80.00	15	z= 0.22; *p*= 0.82
	A2_L1	80.00	0	90.00	35	z= 0.73; *p*= 0.46
	A3_L1	NA	NA	80.00	0	NA
	A1_L2	80.00	20	80.00	20	z= 0.25; *p*= 0.80
	A2_L2	80.00	0	80.00	15	z= 1.28; *p*= 0.20
	A3_L2	NA	NA	NA	NA	-
	A1_L3	80.00	35	80.00	20	z= 0.23; *p*= 0.81
	A2_L3	60.00	20	80.00	20	z= 0.20; *p*= 0.80
	A3_L3	80.00	10	90.00	0	z= 0.22; *p*= 0.82
Office or Workplace	A1_L1	75.17	16.67	75.00	16.67	z= 0.22; *p*= 0.82

	A2_L1	83.00	0	83.33	25	z= 0.16; *p*= 0.87
	A3_L1	100.00	0	83.33	0	z= 1.41; *p*= 0.16
	A1_L2	66.67	33.33	83.33	33.33	z= 0.16; *p*= 0.87
	A2_L2	83.00	0.25	83.33	8.33	z= 0.15; *p*= 0.88
	A3_L2	100.00	0	91.67	0	z= 1.41; *p*= 0.16
	A1_L3	50.00	33.33	61.11	33.33	z= 0.16; *p*= 0.88
	A2_L3	83.00	0	83.33	12.50	z= 0.15; *p*= 0.88
	A3_L3	100.00	0	83.33	0	z= 1.42; *p*= 0.17
Hospital Settings	A1_L1	100.00	0	100.00	0	z= 0.00; *p*= 1.00
	A2_L1	NA	NA	NA	NA	-
	A3_L1	NA	NA	NA	NA	-
	A1_L2	100.00	25	100.00	33.33	z= 1.00; *p*= 0.31
	A2_L2	66.67	0	100.00	0	z= 1.58; *p*= 0.11
	A3_L2	NA	NA	NA	NA	-

	A1_L3	83.33	33.33	66.67	33.33	z= 0.31; *p*= 0.76
	A2_L3	NA	NA	100.00	0	-
	A3_L3	NA	NA	NA	NA	-
Social Settings	A1_L1	100.00	33.33	100.00	33.33	z= 0.00; *p*= 1.00
	A2_L1	NA	NA	NA	NA	-
	A3_L1	NA	NA	NA	NA	-
	A1_L2	66.67	0	66.67	33.33	z= 1.16; *p*= 0.25
	A2_L2	NA	NA	66.67	0	-
	A3_L2	NA	NA	NA	NA	-
	A1_L3	66.67	0	66.67	25	z= 1.06; *p*= 0.29
	A2_L3	66.67	0	66.67	0	z= 0.00; *p*= 1.00
	A3_L3	100.00	0	100.00	0	z= 0.00; *p*= 1.00
Hotels and Outings	A1_L1	66.67	33.33	66.67	33.33	z= 0.61; *p*= 0.54
	A2_L1	67.00	0	66.67	0	z= 1.00; *p*= 0.32
	A3_L1	NA	NA	NA	NA	-

	A1_L2	66.67	8.33	66.67	33.33	z= 0.34; *p*= 0.73
	A2_L2	67.00	0	66.67	0	z= 1.00; *p*= 0.32
	A3_L2	NA	NA	NA	NA	-
	A1_L3	66.67	33.33	66.67	33.33	z= 0.61; *p*= 0.54
	A2_L3	66.67	0.33	66.67	50	z= 0.61; *p*= 0.54
	A3_L3	NA	NA	100.00	0	-
Public Transportation	A1_L1	100.00	0	100.00	16.67	z= 0.00; *p*= 1.00
	A2_L1	100.00	0	NA	NA	-
	A3_L1	NA	NA	NA	NA	-
	A1_L2	66.67	33.33	66.67	33.33	z= 0.17; *p*= 0.86
	A2_L2	NA	NA	NA	NA	-
	A3_L2	NA	NA	NA	NA	-
	A1_L3	66.67	0	66.67	16.67	z= 0.47; *p*= 0.64
	A2_L3	100.00	0	100.00	0	z= 0.00; *p*= 1.00
	A3_L3	NA	NA	NA	NA	-

Exhausted Conditions	A1_L1	100.00	0	100.00	8.33	z= 0.62; *p*= 0.53
	A2_L1	NA	NA	NA	NA	-
	A3_L1	NA	NA	NA	NA	-
	A1_L2	100.00	16.67	100.00	33.33	z= 0.20; *p*= 0.83
	A2_L2	67.00	0	66.67	0	z= 1.00; *p*= 0.32
	A3_L2	NA	NA	NA	NA	-
	A1_L3	100.00	50	100.00	33.33	z= 0.28; *p*= 0.80
	A2_L3	66.83	0	66.67	0	z= 0.47; *p*= 0.64
	A3_L3	100.00	0	100.00	0	z= 0.00; *p*= 1.00
Educational Settings	A1_L1	67.00	0	100.00	0	z= 1.25; *p*= 0.21
	A2_L1	NA	NA	100.00	0	-
	A3_L1	NA	NA	NA	NA	-
	A1_L2	33.00	0	100.00	33.33	z= 1.67; *p*= 0.09
	A2_L2	67.00	0	100.00	0	z= 1.00; *p*= 0.32
	A3_L2	NA	NA	NA	NA	-

	A1_L3	33.00	0	83.33	33.33	z= 1.62; *p*= 0.11
	A2_L3	33.00	0	100.00	0	z= 1.62; *p*= 0.11
	A3_L3	100.00	0	NA	NA	-

Note- NA: Not Attempted; A1_L1: Attempt 1_Level 1; A2_L2: Attempt 2_Level 2; A3_L3: Attempt 3_Level 3

4.3 The effect of CST on hearing handicap, participation and overall quality of life and use of CS immediately after the CS training in conventional face-to-face vs -tele-mode

Descriptive statistics containing median, along with the interquartile range of all the participants' demographic details are provided in Table 4.4. From the table it can be inferred that both the groups of the study are similar with respect to the demographic details. This was supported by the inferential statistics results using Mann-Whitney U test between the two groups that showed no significant difference for all the demographics in both the groups, which is also provided in Table 4.4.

Table 4.4

Descriptive and Inferential statistic results of the demographics of both the groups

Demographics	**Group I (n=20)**				**Group II (n=20)**				**Mann-Whitney U-test**
Stat Measure	**Mean ± SD**	**Median ± IQR**	**Min**	**Max**	**Mean ± SD**	**Median ± IQR**	**Min**	**Max**	
Age (in years)	62.11 ± 9.61	64.00 ± 11	36	70	51.95 ± 10.63	52.00 ± 19	35	69	z=1.76; *p*=0.08

Onset of HL (in years)	4.16 ± 1.21	4.00 ± 2	2	6	4.05 ± 3.66	3.00 ± 4	1	15	z=1.70; *p*=0.24
R PTA	58.36 ± 8.00	58.75 ± 6.50	40	68.50	55.39 ± 9.14	56.38 ± 3.75	35	68.50	z=1.78; *p*=0.76
L PTA	58.83 ± 10.07	58.75 ± 10.00	40	74.50	54.66 ± 12.88	55.38 ± 18.56	35	74.50	z=1.40; *p*=0.16
R SRT	57.63 ± 7.34	60.00 ± 10	45	70	54.50 ± 8.23	52.50 ± 10	40	70	z=1.48; *p*=0.14
L SRT	57.90 ± 8.89	60.00 ± 15	40	70	54.50 ± 10.75	50.00 ± 15	40	70	z=0.82; *p*=0.41
R SIS	77.47 ± 11.92	76.00 ± 12	52	100	82.10 ± 8.93	80.00 ± 12	66	100	z=1.18; *p*=0.24
L SIS	74.84 ± 13.94	80.00 ± 22	52	100	84.20 ± 12.94	88.00 ± 23	62	100	z=1.29; *p*=0.20
R Period of HA use (months)	18.32 ± 10.72	17.00 ± 5	6	48	17.05 ± 9.12	12.00± 10	7	36	z=0.70; *p*=0.48
R Hours of HA	6.63 ± 1.01	6.00 ± 1	5	9	7.10 ± 1.12	7.00 ± 2	6	9	z=1.28; *p*=0.20

use (hours/ day)								
L Period of HA use (months)	18.32 ± 10.72	17.00 ± 6 5	48	17.05 ± 9.12	12.00± 10	7	36	z=0.70; *p*=0.48
L Hours of HA use (hours/ day)	6.63 ± 1.01	6.00 ± 1 5	9	7.10 ± 1.12	7.00 ± 2	6	9	z=1.28; *p*=0.20

Note- HL: Hearing Loss; PTA: Pure Tone Average; SRT: Speech Recognition Threshold; SIS: Speech Identification Scores; HA: Hearing Aid; R- Right ear; L: Left ear

Also, descriptive statistics containing median, along with the interquartile range of all the self-reported questionnaires and subscales of CSS (CSS_MA, CSS_Verbal and CSS_NV) in pre-training, post-training 1 and post-training 2 conditions are provided in Figure 4.3 and Figure 4.4 (A-C) for conventional face-to-face CST-trained group, while similar representation of the tele-CST trained group is given in Figure 4.5 and Figure 4.6 (A-C). It can be inferred from the figures 4.3, 4.4, 4.5 and 4.6 that participants in both the groups obtained similar scores during the pre-training, immediate post-training (post-training 1) and at 1-month post follow-up (post-training 2) for most of the questionnaires. This was supported by the inferential

statistics results using Friedman's test that showed significant difference for three questionnaires in both the groups, provided in Table 4.5.

Table 4.5

Effect of CST at pre-training, post-training 1 and post-training 2 for both the groups

Self-outcome measure	**Group I**	**Group II**
Statistic measures	**Friedman test statistic** χ^2 (2)=	**Friedman test statistic** χ^2 (2) =
IOI-HA	0.35; p=0.73	1.18; p=0.24
HHQ	0.98; p=0.24	0.75; p=0.45
SAC	2.18; p = 0.03	2.44; p = 0.01
PQ	0.16; p=0.88	0.71; p=0.64
AQoL-4D	0.65; p=0.52	0.47; p=1.00
CSS (Total)	0.27; p=0.79	0.0; p=1.00
CSS_MA	0.46; p=0.65	1.54; p=0.12
CSS_Verbal	2.67; p=0.008	1.99; p=0.047
CSS_NV	1.42; p=0.14	0.87; p=0.38
CSQ	3.75; $p < 0.001$	3.38; $p < 0.001$

Note- IOI-HA: International Outcome Inventory for Hearing Aids; HHQ: Hearing Handicap Questionnaire; SAC: Self-Assessment of Communication; PQ: Participation Questionnaire; AQoL-4D: Assessment of Quality of Life in 4 Dimensions; CSS (Total): Communication Strategy Scale; CSS_MA: Subscale of Communication Strategy Scale (Maladaptive behaviours); CSS_Verbal: Subscale of Communication Strategy Scale (Verbal behaviours);

CSS_NV: Subscale of Communication Strategy Scale (Non-Verbal behaviours); CSQ: Communication Strategies Questionnaire

A significant difference was noted between three assessments in SAC, Verbal subscale of CSS and in the CS questionnaire in both the groups. Post-hoc pairwise comparisons revealed no immediate benefit in SAC and the verbal subscale of the CSS, as there was no significant difference between pre-training and immediate post-training (post-training 1) scores. However, significant improvement was observed between pre-training and 1-month post-training (post-training 2) scores ($p < 0.05$), indicating long-term benefits of CST, likely attributable to the time provided for practice and real-life adaptation of the use of CS. While, the CS questionnaire showed immediate, short-term as well as sustained benefits. Both pre-training scores and immediate post-training (post-training 1) scores were significantly different from the 1-month post-training (post-training 2) scores in both modes of CST, highlighting early and continued impact of the training on self-reported use of CS.

Figure 4.3

Descriptive statistics (median , IQR) of the Group I for six self-reported outcome measures and CS questionnaire scores in pre-training, post-training 1 and post-training 2 conditions [Panel A shows scores of IOI-HA, HHQ, and SAC; Panel B shows scores of PQ and AQoL-4D; Panel C shows scores of CSS (Total) and CSQ]

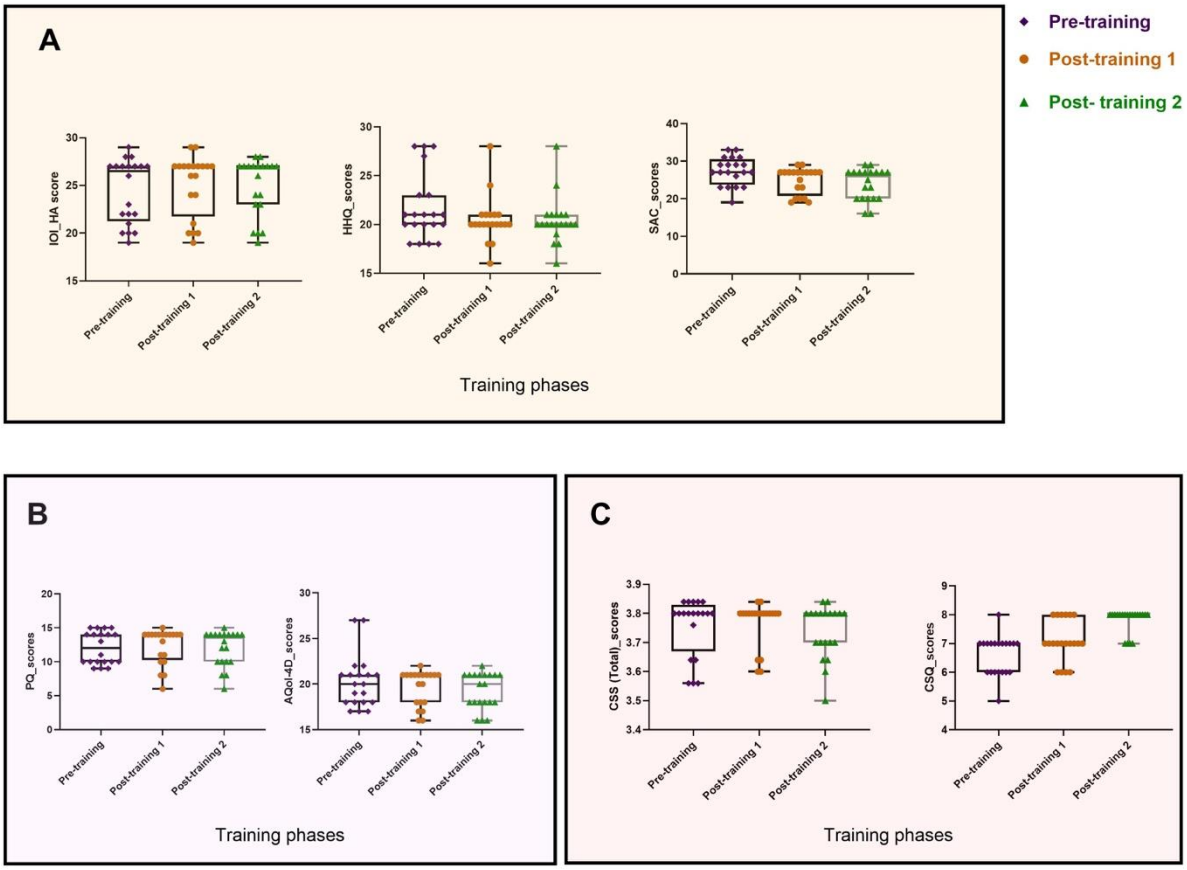


Figure 4.4

Descriptive statistics (median , IQR) of the Group I for sub-scales of CSS scores in pre-training, post-training 1 and post-training 2 conditions.

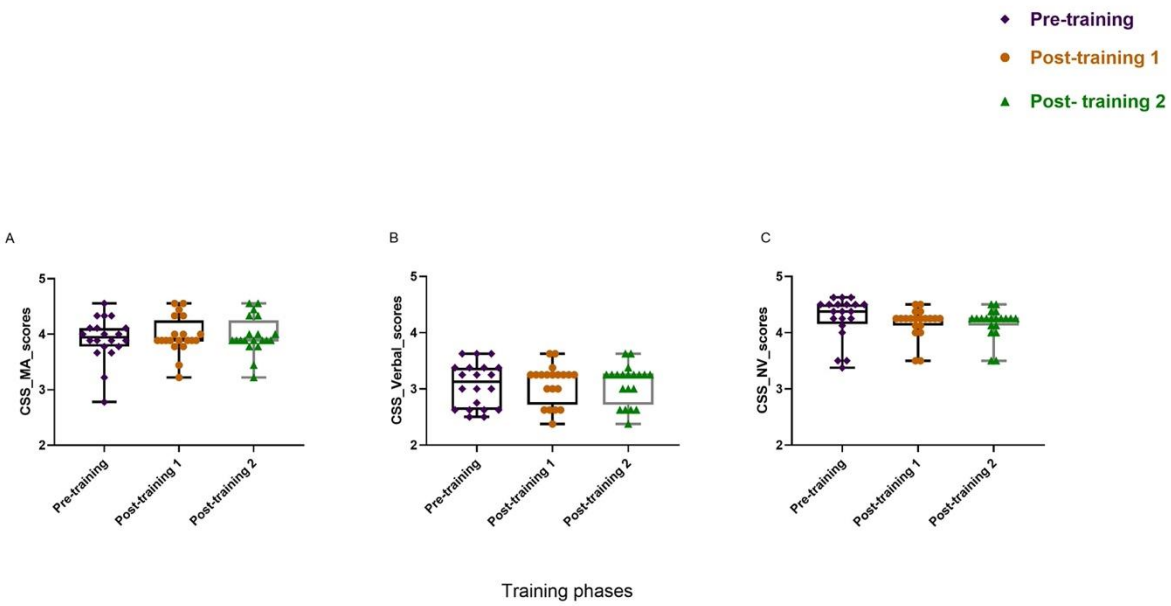


Figure 4.5

Descriptive statistics (median, IQR) of the Group II for six self-reported outcome measures and CS questionnaire scores in pre-training, post-training 1 and post-training 2 conditions [Panel A shows scores of IOI-HA, HHQ, and SAC; Panel B shows scores of PQ and AQoL-4D; Panel C shows scores of CSS (Total) and CSQ]

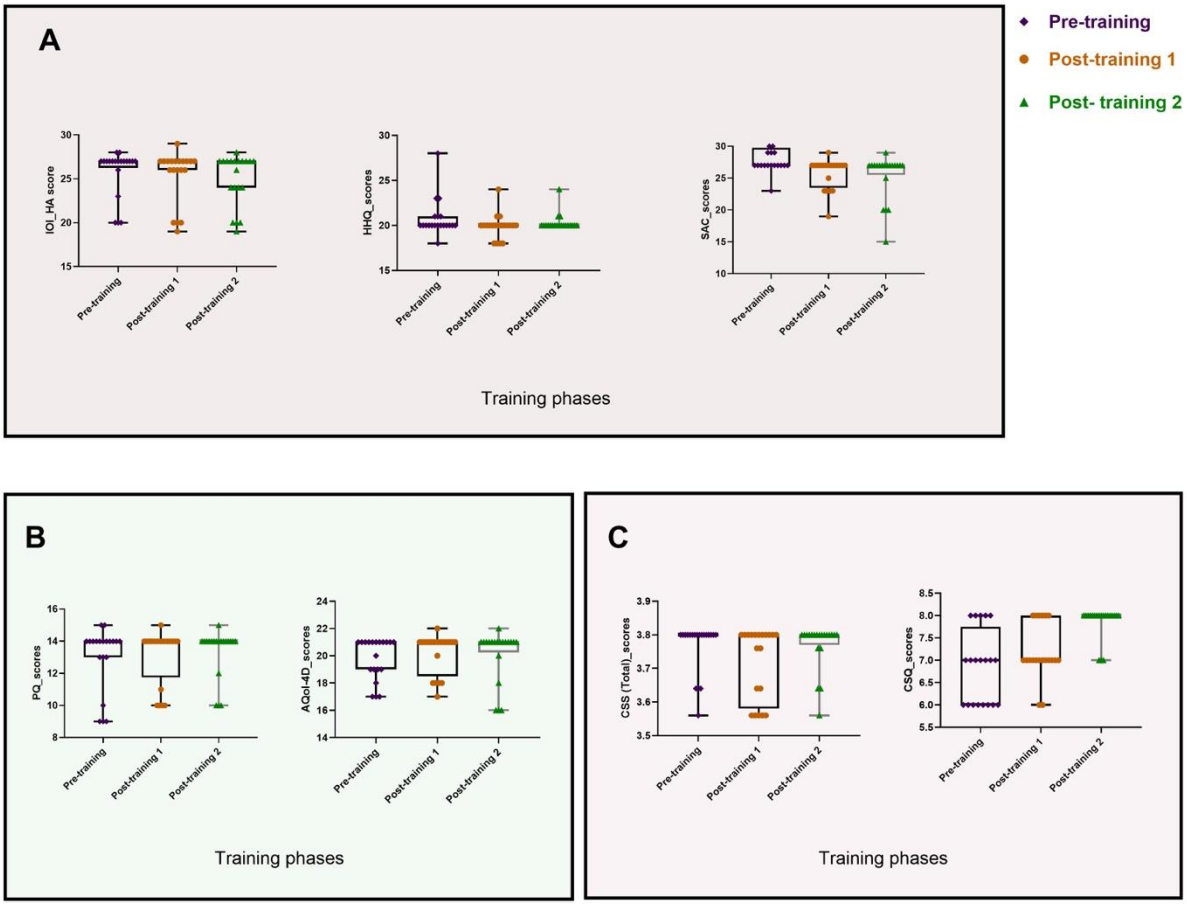
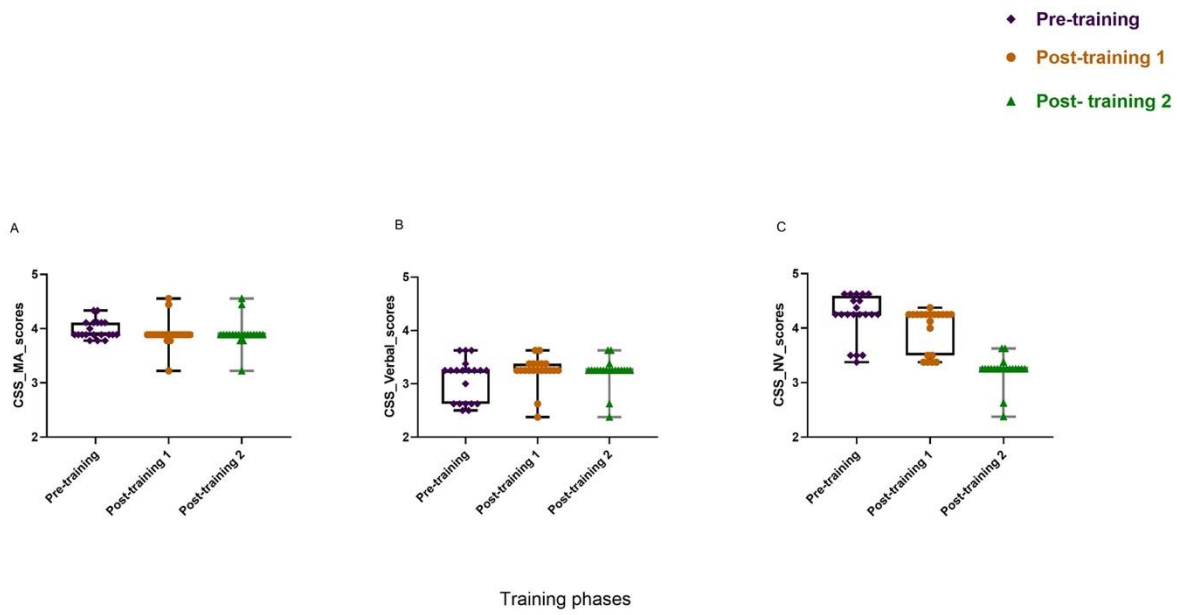


Figure 4.6

Descriptive statistics (median , IQR) of the Group II for sub-scales of CSS scores in pre-training, post-training 1 and post-training 2 conditions.



4.4 The retention effects of CST on self-reported outcome measures at one-month post-training in tele vs conventional face-to-face mode-

The retention effects of CST in both modes was measured by comparing the scores of outcome measures at immediate post-training (post-training 1) and at 1 month post follow-up (post-training 2). The results of the Wilcoxon-signed rank test comparing the scores of immediate (post training 1) and one month post training (post training 2) and the scores of self-reported outcome measures are reported for the two groups in Table 4.6. Significant decrease in the communication difficulties in SAC and Verbal subscale of CSS was noted in the post-training 2 compared to post-training 1 (Figure 4.3 and 4.4 – conventional face-to-face CST, 4.5 and 4.6 – tele CST). Similarly, in CS test, scores in one month post-training (post-training 2) evaluation was found to be significantly higher than immediate evaluation (post-training 1), indicative of long term benefits of CST in these measures for both the groups..

Table 4.6

Results of the retention effects of CST between the two groups

Self-outcome measure	**Group I**	**Group II**
Statistic measures	**Wilcoxon signed rank test statistic**	**Wilcoxon signed rank test statistic**
IOI-HA	z= 0.74; *p*= 0.46	z=0.74; *p*=0.43
HHQ	z= 1.00; *p*= 0.31	z=0.74; *p*=0.46
SAC	z= 1.89; *p*= 0.04	z=1.83; *p*=0.04
PQ	z= 0.74; *p*= 0.46	z=0.45; *p*=0.65
AQoL-4D	z= 0.74; *p*= 0.46	z=0.43; *p*=0.67
CSS (Total)	z= 1.00; *p*= 1.00	z=1.00; *p*=1.00
CSS_MA	z= 1.00; *p*= 1.00	z=1.00; *p*=1.00
CSS_Verbal	z= 2.00; *p*= 0.05	z=2.00; *p*=0.05
CSS_NV	z= 1.00; *p*= 1.00	z=1.00; *p*=1.00
CSQ	z= 3.23; *p*= 0.001	z=3.36; *p*=0.001

Note- IOI-HA: International Outcome Inventory for Hearing Aids; HHQ: Hearing Handicap Questionnaire; SAC: Self-Assessment of Communication; PQ: Participation Questionnaire; AQoL-4D: Assessment of Quality of Life in 4 Dimensions; CSS (Total): Communication Strategy Scale; CSS_MA: Subscale of Communication Strategy Scale (Maladaptive behaviours); CSS_Verbal: Subscale of Communication Strategy Scale (Verbal behaviours); CSS_NV: Subscale of Communication Strategy Scale (Non-Verbal behaviours); CSQ: Communication Strategies Questionnaire

The above test results showed that SAC and verbal subscale of CSS measured at pre- and 1-month post-training was significantly different ($p<0.05$) in both groups, suggesting a good retention effect of CST at 1 month post-follow-up (post-training 2), more due to the time given between assessments to practice or adapt to the use of CS irrespective of the mode of delivery of CS training.

CHAPTER 5

DISCUSSION

The main aim of the study was to develop a language specific communication strategies training module in Kannada which aids in the auditory rehabilitation of individuals with hearing impairment in conventional face-to-face mode and tele-rehabilitation mode. The CST developed on both modes were administered on 20 participants each to understand the efficacy and feasibility of each mode.

5.1. Validity of the CST module

In, line with this, the content validity findings of the present study, wherein the CST-Kannada module achieved perfect I-CVI and Kappa values (Mean = 1.00), suggest that the tool demonstrated strong agreement among experts and high representational accuracy of intended constructs. These results are consistent with previous research that highlights the value of high I-CVI and Kappa values in establishing strong content relevance and clarity for clinical and rehabilitation tools (Polit et al., 2007). The excellent agreement observed (Kappa = 1) reflects perfect inter-rater reliability, which indicates that the expert groups had a shared understanding of the constructs and rating parameters. According to Wynd et al. (2003), I-CVI values of 0.78 or higher are considered acceptable when there are more than five experts, while a value of 1.00 denotes unanimous agreement and strong content representation. This unanimous agreement may signify that the CST-Kannada module was systematically and rigorously developed, possibly with clear operational definitions and comprehensive literature guidance, ensuring its relevance to the communication challenges faced by native Kannada-speaking individuals with hearing impairment. The replication of similar content validity findings in the web-based tele-CST module further strengthens the claim of robustness and generalizability. The high agreement beyond chance suggests consistency in experts' interpretation even when delivered through a tele-health platform.

However, several scholars caution against over-interpreting perfect I-CVI and Kappa values. Polit et al. (2007) argue that while high values suggest excellent agreement, they may also reflect limited diversity in experts' opinion or potential bias due to similar training backgrounds. In addition, the use of small expert panels may inflate the I-CVI and Kappa values due to lower statistical variability (Romero Jeldres et al., 2023). This issue is especially pertinent in culturally specific modules, where regional nuances or dialectical variations might not be fully captured if the panel lacks demographic heterogeneity. Moreover, critics such as Rubio et al. (2003) point out that while content validity is crucial, it is only one dimension of overall validity. Modules with high content validity may still require evidence of construct validity, ecological validity and predictive validity, particularly when used in diverse real-world clinical environments. This is especially relevant to the CST-Kannada module's application in tele-rehabilitation, where user interface, digital accessibility and technological literacy can affect outcomes. Hence, the current findings support the strong content validity of the CST-Kannada module across delivery modes. Yet, researchers must interpret perfect agreement cautiously and triangulate these findings with user feedback and performance-based validity indices.

5.2. Comparison of CST between conventional face-to-face mode and tele-intervention mode-

The present study also aimed to explore the preferences and completion patterns of participants undergoing CST across two different modes, that is conventional face-to-face and tele-CST mode. Specifically, it examined the types of real-life scenarios selected by participants and the number of attempts taken to complete each, which offers insights into both the relevance and perceived difficulty of various communication environments. The findings point toward similarities and differences across modes and scenarios, shedding light on user engagement and training efficacy in scenario-driven CS rehabilitation.

In both CST modes, participants generally engaged with most scenarios equally. However, there were distinctive preferences in terms of most and least selected settings. In the face-to-face mode, personal environments (e.g., home settings), social settings (e.g., gatherings), and hospital settings emerged as the most preferred. Conversely, educational settings (e.g., schools), exhausted conditions and office environments were least chosen. These preferences possibly reflect the participants' immediate communication needs or the perceived frequency and familiarity of specific environments in their daily lives. Notably, the predominance of personal and social settings is supported by prior research, which has shown that communication difficulties are most noticeable and thus more urgently addressed in these everyday environments (Hickson & Worrall, 2003). Ferguson et al. (2014) emphasized the importance of training that focuses on real-life social scenarios to enhance generalizability and use of trained skills. These settings offer a natural platform to practice CS use such as repair strategies, turn-taking cues and environmental management, which are core components of CST.

The importance of accurate and assertive communication in health care has been well-documented in the literature, particularly in relation to supporting patient needs and improving intervention outcomes (Olson et al., 2013). In support to this, the preference for hospital settings is also significant in this study. Although less familiar than home or social contexts, hospital environments typically involve high-terminology communication, where misunderstandings can have serious consequences. It is plausible that participants recognized the criticality of this domain, prompting their active selection. In contrast, educational settings and exhausted conditions were among the least preferred in face-to-face CST. This may reflect limited relevance for certain participant demographics, e.g., older adults or individuals not currently engaged in formal learning. Preminger and Ziegler (2008) argued that educational environments are crucial for younger individuals with hearing impairment but may not be

prioritized by older adults in CST. Furthermore, simulating fatigue or exhaustion in a structured training session may be perceived as uncomfortable or unauthentic, leading to under-selection.

Interestingly, the tele-CST mode demonstrated some divergence in scenario preferences. While personal, social, hospital and office environments were again frequently chosen, educational and public transportation scenarios were least selected. The recurrence of personal and hospital environments across both modes points to their generalizability and relevance. However, the increased selection of office settings in tele-CST possibly reflects broader society shifts due to digital transformation and remote work adoption during and after the COVID-19 pandemic. Saunders et al. (2016) reported that remote communication tools have become normalized, altering perceptions of professional communication scenarios. Thus, participants may have viewed tele-CST as an appropriate space to train for digital office environments, aligning with contemporary communication demands.

Furthermore, after the choice of scenarios, the total attempts taken by each participant to complete each level and scenarios and the scores obtained were studied. Pertaining to this, across both training modes, participants completed most scenarios in a single attempt. However, a few scenarios such as personal environments, office settings, restaurants and public transportation occasionally required two or three attempts. These variations suggest differences in perceived complexity, cognitive load or comfort levels associated with specific scenarios. Scenarios like public transportation inherently involve external auditory and visual challenges, such as background noise, unpredictable conversations and rapidly changing environments. These characteristics make them cognitively demanding and thus more difficult to navigate, even with CS training. Wu and Bentler (2012) highlighted the detrimental effects of adverse listening conditions on speech perception, suggesting that communication breakdowns are more likely in such settings, which could account for repeated attempts. Restaurants similarly pose unique communication barriers, including noise, multi-talker conversations and relying

on non-verbal cues. Dai et al. (2018) reported that individuals with hearing loss often struggle to apply CS effectively in such dynamic, noisy environments, which demand high attentional control and social adaptability. Participants' repeated attempts may indicate efforts to internalize and refine appropriate CS such as selective attention, anticipatory, repair or strategic seating. Even personal environments, though familiar, occasionally required multiple attempts. This may seem counter-intuitive but could reflect the nuanced nature of home interactions, e.g., emotional weight, habitual communication patterns and relational dynamics that complicate CS implementation. According to Hickson and Worrall (2003), communication within intimate relationships often demands a delicate balance of assertiveness and empathy, making it more complex than initially assumed.

The tele-CST group exhibited a similar pattern, with the same set of scenarios necessitating more than one attempt. This consistency across modes underscores the inherent challenge posed by these scenarios, regardless of delivery mode. However, the virtual nature of tele-CST may provide participants with increased psychological safety, allowing them to take risks or repeat attempts without the pressure of face-to-face scrutiny.

The similarity in scenario selection and completion across both training modes supports the notion that participant engagement is primarily driven by scenario relevance and perceived communication difficulty, rather than by the delivery mode. This aligns with the findings of Regehr and Birze (2024), who observed that web-based simulations can elicit emotional and physiological responses equivalent to face-to-face ones, while participants often perceive the tele-mode as safer and less anxiety-provoking itself. Nonetheless, it supports the notion that the mode of delivery may affect emotional comfort and willingness to engage with emotionally vulnerable scenarios. Also, tele-CST may afford a more flexible and emotionally secure environment for simulating complex affective states. Chu et al. (2023) and Liang et al. (2024) emphasized the value of tele-health in facilitating self-paced, reflective learning, which might

be particularly beneficial when practicing CS in emotionally nuanced situations. The selection of office settings more frequently in tele-CST also implies shifting participant priorities or increased confidence in applying CS in virtual professional contexts. With more people adapting to hybrid or remote work arrangements, virtual meetings have become a dominant form of professional communication in younger adults. This contextual evolution is consistent with broader audiological trends emphasizing real-world applicability (Alqudah et al., 2021).

The general success in completing most scenarios in a single attempt suggests a high level of engagement and scenario feasibility. Participants likely found the simulations to be realistic and achievable, which is essential for effective learning. Ferguson et al. (2014) demonstrated that when participants perceive scenarios as reflective of their daily lives, they are more likely to internalize and apply the trained strategies. At the same time, the necessity for multiple attempts in a subset of scenarios underlines the importance of allowing repetition and individualized learning pace in CS training. The active process of trial and error may enhance learning by encouraging self-monitoring, feedback processing and problem-solving all critical components of social cognitive theory (Bandura, 1991).

Along with this, the present study also found that participants in both conventional face-to-face and tele-CST modes achieved comparable percent correct scores across most scenarios. This observation was statistically supported by the Mann–Whitney U test, which showed no significant differences between the two groups. These findings suggest that the mode of CST delivery; whether face-to-face or tele-CST, does not significantly influence immediate task performance during training sessions. This result aligns with a growing body of literature supporting the efficacy of tele-health in delivering communication-based rehabilitation. For instance, Regehr and Birze (2024) reviewed tele-audiology services and concluded that remote delivery methods are effective for adult hearing rehabilitation, provided the content is structured and user-friendly. These findings reinforce the notion that when training is

contextually relevant and participants are adequately supported, tele-CST can match the effectiveness of conventional face-to-face mode.

Furthermore, Ferguson et al. (2014) emphasized that the success of training lies primarily in its content, structure and real-world applicability, rather than the physical medium of instruction. Given that both CST modes in the current study used identical training content and scenarios, the similarity in performance is likely a result of standardized delivery rather than mode dependency. Additionally, Alqudah et al. (2021) highlighted that CST focusing on practical, scenario-based learning fosters generalization of CS across diverse communication scenarios, an effect that can be achieved equally well through digital or face-to-face platforms.

However, some researchers have raised concerns regarding tele-CST, particularly in terms of engagement and scenario generalization. Saunders et al. (2016) reported that while tele-health offers flexibility, it may lack the immediacy and non-verbal richness of face-to-face interactions, which are vital for CS training. These subtle interactional cues are often less perceptible in virtual formats, potentially affecting the depth of learning in more nuanced or emotionally laden scenarios. Moreover, Preminger and Yoo (2010) emphasized the importance of inter-personal rapport and real-time feedback in audiological rehabilitation. Face-to-face settings may offer a more naturalistic environment for developing such rapport, which in turn could influence CS acquisition, particularly for participants with lower digital literacy or social confidence. Nonetheless, the present study's findings indicate that, at least in terms of objective performance scores during CST scenarios, these potential disadvantages of tele-CST did not contribute to reduced effectiveness. The comparable performance across both CST modes underscores the viability of tele-health as an alternative or complementary mode of CS training. These results support the ongoing integration of tele-CST into audiological services, particularly in contexts requiring accessibility, flexibility, and resource optimization.

5.3 The effect of CST on hearing handicap, participation and overall quality of life and use of CS immediately after the CS training in conventional face-to-face vs -tele-mode

The present study also found that participants in both conventional and tele-CST groups performed similarly across pre-training, immediate post-training (post-training 1), and at 1-month follow-up (post-training 2) on most outcome measures used in the study. However, significant improvements were noted in three measures: the Self-Assessment of Communication (SAC), the verbal subscale of the CSS and the CS questionnaire (CSQ). However, post-hoc pairwise comparisons revealed a delayed benefit in SAC and the verbal subscale of CSS, with no significant difference between pre-training and immediate post-training scores. In contrast, significant improvements were evident between pre-training and one-month post-training scores, suggesting a delayed but meaningful impact. The CSQ, however, showed immediate and sustained benefits, with both pre-training and immediate post-training scores differing significantly from one-month post-training scores in both CST modes.

These findings suggest that the acquisition and internalization of CS may require a period of real-life application and practice before they translate into improved self-perception and strategic behaviour. The delayed improvement in SAC and verbal subscale of CSS outcomes highlights the importance of time and experience in adapting newly learnt CS to everyday contexts. This is supported by Ferguson et al. (2014), who emphasized that while training may introduce changes effectively, their real-world use and measurable impact often emerge gradually as individuals gain confidence and apply them in diverse situations. Similarly, Hickson et al. (2007) noted that psycho-social adjustments and self-awareness of communication challenges evolve over time and may not be immediately evident following brief interventions.

The significant, sustained improvements observed in the CSQ suggest that participants could quickly recognize and report their use of CS in structured situations, and these gains were

retained over time. Scenario-based tasks likely provided a more direct assessment of the behavioural application of CS introduced during CST. Realistic and context-rich training environments probably promote faster uptake and retention of CS. The CSQ's structure may have allowed participants to relate their learning directly to familiar interactional challenges, resulting in immediate and measurable benefits.

The difference in trajectory between the SAC and verbal subscale of CSS scores versus the CSQ underscores the distinction between cognitive awareness, behavioural application and self-efficacy. The SAC, which focuses on perceived communication difficulty, and the verbal subscale of the CSS, which evaluates strategy use frequency, both rely on internal reflection and self-perceived competence, factors likely influenced by consistent success in real-life application. In contrast, the CSQ assesses concrete behavioural actions in response to pre-defined scenarios, making it more sensitive to immediate change following CST. Barker et al. (2016) highlighted the need for follow-up support and real-world practice to reinforce CS internalization and self-efficacy benefits.

The present study's findings also support the growing evidence on the efficacy of tele-health delivery in audiological rehabilitation. Both delivery modes: face-to-face and tele-CST demonstrated comparable long-term outcomes, with no significant differences between groups. Saunders et al. (2016) observed that tele-audiology services could be equally effective in promoting hearing aid use and communication success as traditional in-person models, provided that training is structured and interactive. Furthermore, Beukes et al. (2021) demonstrated that remote CS training modules led to similar levels of adherence and satisfaction compared to face-to-face sessions, especially when supplemented with interactive tasks and follow-up reminders.

Nonetheless, some studies have raised concerns about the immediacy and depth of engagement in tele-health formats. Contrasting evidence also comes from studies where

immediate post-intervention gains were reported across both psycho-social and behavioural outcomes. For example, Preminger and Yoo (2010) observed immediate improvements in communication-related quality of life following a family-centred audiologic intervention. The presence of communication partners (CPs) and the social reinforcement during practice may have contributed to faster benefits. This suggests that the inclusion of significant others in CST could facilitate earlier improvements in measures such as SAC and verbal subscale of CSS by creating immediate opportunities for CS use and feedback.

Another support for the delayed benefits in the current study could be the cognitive load associated with learning and applying new CS. According to Gamble et al. (2024), older adults and those with cognitive challenges may require more time to consolidate and implement complex behavioural changes. The need for repeated exposure, consistent practice and feedback cycles might explain the timeline of improvements observed in the current study. The findings also puts attention to the need for extended monitoring and follow-up in CST programs. Short-term post-intervention assessments may not fully capture the depth of CS adoption or its impact on everyday communication. Nihara and Seethapathy (2022) suggested that longitudinal monitoring extending beyond one month can offer insights into the sustainability of tele-audiology and the emergence of broader quality-of-life improvements.

However, broader psycho-social and quality-of-life measures like the AQoL-4D, IOI-HA, and HHQ did not show significant short-term change. These tools assess long-term adjustment, social participation and overall well-being; areas that may require longer follow-up or supplementary support, such as group counselling or environmental modification, to reflect meaningful change (Hickson et al., 2007).

Importantly, the similar outcomes between tele- and face-to-face modes underscore the feasibility of remote service delivery. Tele-mode also improves accessibility, especially for individuals in rural or underserved areas (Liang et al., 2024). Furthermore, individual factors

such as cognitive status or prior experience may moderate training benefits. Gamble et al. (2024) emphasized that personalized support is crucial for older adults with cognitive difficulties during aural rehabilitation.

5.4 The retention effects of CST on self-reported outcome measures at one-month post-training in tele vs conventional face-to-face mode-

The present study hence investigated the retention effects of CST across conventional face-to-face and tele-CST modes by comparing immediate post-training (post-training 1) and one-month post-training (post-training 2) outcomes. The results indicated significant improvements in participants' self-perceived communication abilities and verbal CS use over time. Specifically, a notable decrease in communication difficulties was observed in both the SAC and the verbal subscale of the CSS between post-training 1 and post-training 2. Additionally, the CSQ showed a significant increase in performance, indicating enhanced practical application of CS over time. These findings were consistent across both conventional and tele-CST groups, suggesting that long-term retention and internalization of CS occurred irrespective of the delivery mode.

These results align with the research supporting the time-dependent benefits of training. Ferguson et al. (2014) emphasized that while training introduces changes effectively, it is long-term practice and real-world use that facilitate deeper learning and internalization. The improvement observed between post-training 1 and post-training 2 in the current study may reflect this natural trajectory of behaviour change, where individuals require time to experiment, adapt and integrate newly acquired CS into daily communication routines.

Similarly, Barker et al. (2016) noted that reinforcement and contextual exposure are critical for sustaining communication behaviour change. In their review, long-term training benefits were more consistently observed when participants had opportunities to apply strategies in realistic environments beyond the structured CST setting. This supports the current

study finding that participants continued to show benefits in SAC, verbal subscale of CSS and CSQ scores even after the formal training period ended, likely due to real-life adaptation and the continued application of the learnt skills.

The improvements in the verbal subscale of the CSS reflect participants' increased use of specific verbal strategies such as repeating, rephrasing, asking for clarification and confirming information. These strategies are central to CST and are often emphasized through modelling and practice. The delayed yet significant change in this subscale supports the idea that participants became more comfortable and consistent in applying such techniques over time (Boothroyd, 2007). Similarly, the SAC, which measures self-perceived communication difficulty, also improved over time, indicating growing self-awareness and confidence in managing communication breakdowns, a goal often targeted in rehabilitation.

The CSQ provided an additional perspective, capturing the application of strategies in context-specific challenges. The significantly higher scores at post-training 2 compared to post-training 1 suggest that scenario-based learning in CST may have facilitated not only initial acquisition but also delayed mastery of communication management skills. This finding is consistent with Kiessling et al. (2009), who emphasized that scenario-based interventions bridge the gap between theoretical understanding and functional use, promoting long-term generalization.

While the current study demonstrated retention benefits over a one-month period, longer-term follow-up would be necessary to confirm sustained behaviour change. This is especially important in light of Wu and Bentler's (2012) observation that communication habits are influenced by environmental complexity and without continuous feedback, learnt strategies may diminish in use or be abandoned altogether. Additionally, the cognitive demands associated with CST should be considered. Gamble et al. (2024) emphasized that older adults or individuals with mild cognitive impairment might require extended learning periods or

additional support to retain and apply the learnt CS. The consistent benefits across both modes in the current study suggest that the CST module was well-structured for hearing impaired adult users.

An important contribution of the current study findings lies in the equivalent retention outcomes across face-to-face and tele-CST modes, suggesting that delivery method does not compromise the effectiveness of CST when content and structure are preserved. Recent evidence supports this equivalence. For instance, Saunders et al. (2016) demonstrated that tele-health CST can result in meaningful behavioural changes and is well-received by participants, particularly when supported with visual aids, examples and interactive discussions.

However, some concerns about tele-CST remain. In a study by Liang et al. (2024), participants expressed that rapport-building and personalized interaction might be limited in virtual formats. Although the current study did not find performance disparities between the modes, future research may benefit from including participant satisfaction or therapeutic alliance measures to better understand the nuances of tele-delivered interventions. The delayed improvement seen in post-training 2 also offers clinical insight. While immediate benefits are often expected after structured training, the findings from the present study emphasize the importance of follow-up assessments to capture late-emerging effects.

Another factor to consider is the role of self-monitoring and meta-cognition in sustained CS use. The delayed improvements in SAC and verbal subscale of CSS suggest that participants became more adept at evaluating their own communication behaviours over time, which may be tied to increased confidence and awareness. According to Hickson et al. (2007), enhancing self-monitoring capacity is essential for long-term training benefits, as it allows individuals to independently recognize communication breakdowns and apply the learnt strategies appropriately.

CHAPTER 6

SUMMARY AND CONCLUSION

The main aim of the study was to develop and validate a communication strategies training (CST) module in Kannada for adults with hearing impairment. It was designed to facilitate auditory rehabilitation and was implemented among 40 hearing-impaired individuals through both traditional face-to-face and tele-rehabilitation (tele-CST) modes. Recognizing the need for culturally and linguistically relevant training materials, the module incorporated communication scenarios reflecting the real-life communication challenges commonly encountered by individuals with hearing difficulties. The web-based CST module was developed in collaboration with the Digimarkstudio, Mysore. The study evaluated the module's content validity, usability, participant performance, outcome measures and training effectiveness across both modes.

A part of the development of the module was the content validation of the CST-Kannada module. Utilizing a panel of experts, the study reported perfect Item-Content Validity Index (I-CVI) and Kappa values (Mean = 1.00), indicating unanimous agreement on the clarity and relevance of the training content. This high level of expert agreement confirmed the module's cultural and linguistic appropriateness. Furthermore, the structural consistency and replicability of results across both delivery formats highlighted the generalizability of the module. Nonetheless, the study acknowledged the need for future validation efforts to include demographically diverse panels and incorporate user-centric insights through qualitative feedback and performance-based evaluations.

Participants' interactions with the training scenarios provided further insights into the module's design and its implementation in real-life. Most scenarios were successfully completed in a single attempt in both delivery modes, suggesting high content feasibility and

participant engagement. The findings underscore the cognitive and emotional demands of certain real-life communication situations and highlight the importance of including such complexity in CST modules to improve preparedness and adaptability in actual communication settings. But participant preferences in scenario selection showed slight variations between the face-to-face and tele-CST groups. This shift may reflect evolving communication habits and societal changes in how individuals interact across environments. The performance parity indicates that psychological factors, such as comfort with remote interaction, reduced social pressure or increased autonomy may contribute to the effectiveness of tele-CST as much as traditional methods. These insights point toward a broader acceptance and effectiveness of remote interventions in audiological rehabilitation.

Furthermore, the study also investigated the efficacy of the CST module by analyzing participant performance across three time points: pre-training, immediate post-training, and one-month follow-up. The self-outcome measures captured different dimensions of CS adaptation. SAC measured cognitive awareness, CSS-verbal reflected behaviour frequency and CSQ assessed scenario-specific CS application. The distinct yet complementary nature of these measures highlighted the layered process involved in learning and applying CS. Moreover, the retention of improvements at one-month follow-up emphasizes the importance of sustained exposure, reinforcement and daily application of learnt CS for long-term benefits.

One of the most notable outcomes of the study was the equivalency of results between the face-to-face and tele-CST groups. This supports a growing body of evidence suggesting that tele-rehabilitation can be as effective as traditional face-to-face interventions. However, future research should go deeper into qualitative dimensions such as rapport, satisfaction, and perceived support to fully understand the emotional and relational dynamics of CST. Along with this, the study also evaluated the sensitivity of the three selected outcome measures in

detecting change over time, suggesting that clinicians can flexibly choose any of them based on the clinical context, time constraints or patient preferences without compromising the assessment of progress in CST.

Overall, the CST-Kannada module is a contribution to language-specific auditory rehabilitation, aligning with modern demands for accessibility, flexibility and personalized care in CS training. Through continued refinement and broader implementation, such modules can significantly enhance the communication and quality of life of individuals with hearing impairment.

Limitations of the study

Despite its strengths, the current study has some limitations: (a) Limited follow-up duration - the retention effects were assessed only up to one-month post-training. While this provides short-term insight, it does not capture long-term sustainability or regression of communication strategies use, (b) Self-Report bias - the outcome measures used were primarily self-reported tools, which may be subject to social desirability or subjective misinterpretation. While effective for capturing perception and application, these tools may not fully reflect real-world behaviour or ecological validity, (c) Absence of booster sessions: Sustained reinforcement through follow-up or refresher sessions was not included. The use of booster training to maintain communication strategies benefits over time.

Future implications of the study

Based on the findings and limitations, the following future directions are recommended:

a. Long-Term Follow-Up Studies. Future research should include assessments at 3, 6, and 12 months post-intervention to examine long-term retention and real-world impact

of CST. This will help determine if early benefits translate into sustained behaviour change.

b. Booster and support modules. Future CST programs could explore the benefits of scheduled reinforcement sessions or group-based reflections to support sustained use of CS.

c. Qualitative insights. Incorporating user feedback, interviews or satisfaction surveys can provide deeper understanding of participant experience, emotional engagement and barriers to CST adherence, especially in tele-health settings.

d. Stratified analyses. Analysing CST outcomes based on variables like age, hearing loss severity, digital literacy, or cognitive ability can help tailor interventions more precisely for different subgroups.

e. Family/partner involvement. Including communication partners in the training process can enhance ecological validity, reinforce learning and accelerate improvements in psychosocial domains.

f. Cross-linguistic and Cross-cultural validation. The successful development and validation of the CST-Kannada module opens avenues for similar efforts in other regional languages and cultural contexts, promoting inclusive and scalable rehabilitation strategies.

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APPENDIX - I

Examples of the scenarios used in the module for CST

(The module is copyrighted with the acknowledgement number- LD-27625/2025-CO to the Director, AIISH, Mysore)

ಕುಟುಂಬದವರು ಜೀವನದ ಒಂದು ಮುಖ್ಯವಾದ ಘಟನೆಯ ಬಗ್ಗೆ ಮಾತನಾಡುತ್ತಿದ್ದಾರೆ. ಅದು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಅಸ್ಪಷ್ಟವಾಗಿದೆ.

ವಿವರಣೆ ಕೇಳುವುದು

ನಿರೀಕ್ಷಿತ ಸಂವಹನ ತಂತ್ರ

ರಚನಾತ್ಮಕ ತಂತ್ರ

ಸರಿಪಡಿಸುವ ಸಂವಹನ ತಂತ್ರ

ಶಿಕ್ಷಕರು ಹೊಸ ಪಾಠವನ್ನು ಸಾರಾಂಶವಾಗಿ ಹೇಳುತಿದ್ದಾರೆ. ಅದನ್ನು ಅರ್ಥ ಮಾಡಿಕೊಳ್ಳಲು ಕಷ್ಟ ಆಗುತ್ತಿದೆ.

ರಚನಾತ್ಮಕ ತಂತ್ರ

ಸರಿಪಡಿಸುವ ಸಂವಹನ ತಂತ್ರ

ಮಾತಿಗೆ ಹೆಚ್ಚು ಗಮನ ಕೊಡುವುದು

ವಿವರಣೆ ಕೇಳುವುದು

ಟ್ಯಾಕ್ಸಿ/ಕ್ಯಾಬ್ ಡ್ರೈವರ್ ತಾನು ಹೋಗಬೇಕಾದ ಜಾಗದ ಬಗ್ಗೆ ಕೇಳುತ್ತಿದ್ದಾರೆ. ಸುತ್ತಮುತ್ತ ತುಂಬ ಗಲಾಟೆ ಇರುವುದರಿಂದ ಕೇಳಲು ಕಷ್ಟ ಆಗುತ್ತಿದೆ.

ನಿರೀಕ್ಷಿತ ಸಂವಹನ ತಂತ್ರ

ಪುನರಾವರ್ತನೆ

ಮಾತಿಗೆ ಹೆಚ್ಚು ಗಮನ ಕೊಡುವುದು

ಮಾತನ್ನು ಅರ್ಥ ಮಾಡಿಕೊಳ್ಳಲು ಸಹಾಯಕರಿಗೆ ವ್ಯವಸ್ಥೆ

ಹೋಟೆಲ್ ನಲ್ಲಿ ಸಾಕಷ್ಟು ಗಲಾಟೆಯೊಂದಿಗೆ ಮಾತು ಕೇಳುವುದು ಮತ್ತು ಅರ್ಥ ಮಾಡಿಕೊಳ್ಳುವುದು ತುಂಬಾ ಕಷ್ಟ ಆಗುತ್ತಿದೆ.

- ಪುನರಾವರ್ತನೆ
- ಮಾತಿಗೆ ಹೆಚ್ಚು ಗಮನ ಕೊಡುವುದು
- ರಚನಾತ್ಮಕ ತಂತ್ರ
- ನಿರೀಕ್ಷಿತ ಸಂವಹನ ತಂತ್ರ

ನೀವು ತೀರಾ ಭಾವನಾತ್ಮಕ ಪರಿಸ್ಥಿತಿಯಲ್ಲಿದ್ದೀರ. ಹೀಗಿರುವಾಗ ಮಾತನ್ನು ಮುಂದುವರಿಸಲು ಕಷ್ಟ ಆಗುತ್ತಿದೆ. ಆಗ ನೀವು ಯಾವ ತಂತ್ರವನ್ನು ಬಳಸುತ್ತೀರ?

- ಸಂದೇಶ- ಸರಳೀಕರಣ ತಂತ್ರ
- ಪುನರಾವರ್ತನೆ
- ನಿರೀಕ್ಷಿತ ಸಂವಹನ ತಂತ್ರ
- ರಚನಾತ್ಮಕ ತಂತ್ರ