

TeleMe Speech Booster: Web-Based Speech Therapy and Training Program for Children with Articulation Disorders

C. Treerattanaphan, P. Boonpramuk, P. Singla

Abstract—Frequent, continuous speech training has proven to be a necessary part of a successful speech therapy process, but constraints of traveling time and employment dispensation become key obstacles especially for individuals living in remote areas or for dependent children who have working parents. In order to ameliorate speech difficulties with ample guidance from speech therapists, a website has been developed that supports speech therapy and training for people with articulation disorders in the standard Thai language. This web-based program has the ability to record speech training exercises for each speech trainee. The records will be stored in a database for the speech therapist to investigate, evaluate, compare and keep track of all trainees' progress in detail. Speech trainees can request live discussions via video conference call when needed. Communication through this web-based program facilitates and reduces training time in comparison to walk-in training or appointments. This type of training also allows people with articulation disorders to practice speech lessons whenever or wherever is convenient for them, which can lead to a more regular training processes.

Keywords—Web-Based Remote Training Program, Thai Speech Therapy, Articulation Disorders.

I. INTRODUCTION

OWING to the limited resources of speech therapy experts and a lack of supporting equipment in Thailand, people with speech disabilities at this moment do not have appropriate access to speech therapy training. To improve speech articulation, regular and repetitive speech training is proven to be effective. Due to lack of speech therapists in remote areas in Thailand, patients who live in the country need to invest a considerable amount of time and to support expenses for speech therapist's visits. Particularly for working parents, they find that it is inconvenient to reshuffle their daily life routine and job responsibilities. To encourage speech articulation training for the patients with these difficulties, a remote access to speech therapists seems viable. A speech articulation therapeutic website for Thai language excepting all Thai dialects has been established in order to lessen the problems of traveling time and expenses.

The project mainly supports speech therapists and children aged 3 to 9 years old who have articulation disorders. This

research will exclude people with language disorders caused by speech related physical impairments and psychiatric disorders. Patients in these groups may require medical treatment and exclusive training.

With regard to existing speech therapy applications currently on the market regardless of language [1]-[6], three main types are available, including applications with digital speech training tutorials; applications with automatic sound quality evaluation; and applications that enable teleconference speech therapy sessions. Advantages and disadvantages of these categories of speech therapy applications are presented as follows. Digital speech training tutorial applications support regular and daily speech practice, but they do not provide suggestions and evaluations that are specific to each patient. Auto sound quality evaluation applications give immediate responses following the patient's articulation. This feature helps patients to make adjustments depending on the system's auto evaluations; however, these applications do not provide sufficiently accurate intelligibility evaluations, and the recommendations and suggestions for Thai speech improvement are not satisfactory due to the subtleness of Thai language consonants and tones. Teleconference speech therapy session applications allow therapists to have real-time interaction with the patients and to instruct through gestures, images or sounds. On the other hand, these applications require therapist availability and they do not provide other self-practice functionalities.

In order to identify key functions and to discern new applications apart from existing speech therapy applications on the market in both Thai and English languages, all functionalities and features are plotted out and compared in Fig. 1.

As illustrated in Fig. 1, key functions, that is, functions that already exist in current speech therapy applications include: the capability to provide flexible training times, real-time interaction and training sessions between therapists and patients, direct training comments from personal therapists, tailor-made word sets, and expandable account systems.

The ability to store patient training history and records is one feature that is still missing from these applications. Therapists affirmed during interviews that this option would help them to plan training ahead of time and to review the patient's progress and improvement.

C. T. is with the King Mongkut's University of Technology Thonburi, Bangkok, Thailand (phone: 66(0)86-978-8539; fax: 66(0)2-452-3792; e-mail: chujit.jea@kmutt.ac.th).

P. B. and P. S. are with the King Mongkut's University of Technology Thonburi, Bangkok, Thailand (phone: 66(0)2-470-9096; fax: 66(0)2-470-9100; e-mail: panuthat.boo@kmutt.ac.th, phumin.sin@kmutt.ac.th).

	TeleMe	Speech Viewer	TSA	Dr. Speech	TinyEye	Voco Vision	Articulate It!	Pronunciation Coach	Sight'n Sound	Speech Trainer	TigaTalk
1 Thai Language Support											
Thai Language Practice and Word Sets	/	/	/	/	X	X	X	X	X	X	X
2 Saving Time & Money											
2.1 Alternative Training Methods											
Online Self Training	/	X	X	X	X	X	X	X	X	X	X
Online Conference Call with Speech Therapist	/	X	X	X	/	/	/	X	X	X	X
Offline Self Training	X	/	/	/	X	X	X	/	/	/	/
2.2 Training Accuracy											
Practice with Speech Therapist	/	X	X	X	/	/	/	X	X	X	X
Training Evaluation by Speech Therapist	/	X	X	X	/	/	/	X	X	X	X
Conference Call Appointment	/	X	X	X	X	X	X	X	X	X	X
Online Assignment	/	X	X	X	X	X	/	X	X	X	X
2.3 Speech Training Guidance											
Pronunciation Guide	/T,V,S	/S	/S	/S	X	X	/S	/V,S	/S	/V,S	/V,S
Phonic Tutorial	/T,V,S	X	X	X	X	X	/S	/V,S	/S	/V,S	/V,S
Supported Correction Input (T=Text, V=Video, S=Sound)	/T,V,S	X	X	X	/	/	/	X	X	X	X
3 Self Sustainable System											
3.1 Practice and Progress Review											
Sound Recording Function	/	/	/	/	X	X	/	/	/	X	X
Practice History	/	/	/	/	/	X	/	/	/	X	/
Personal Past Sound Records	/	/	/	/	X	X	X	/	/	X	X
3.2 Tailor-made Lesson											
Add Lesson by Speech Therapist	/	X	X	X	X	X	X	X	/	X	X
Customize Lesson	/	X	X	X	/	/	/	/	/	X	X
3.3 Expandable/Editable Accounts											
Add/Edit Therapists and Patients	/	X	X	X	/	/	/	X	X	X	X
4 Future Function and Features											
4.1 Motivation											
Game-based Practice	X	/	X	/	/	/	/	X	X	X	/
4.2 Auto Detection											
Sound Quality Detection	X	/	/	/	X	X	X	X	X	X	/
Correct Pronunciation Detection	X	X	X	X	X	X	X	X	X	X	X
4.3 Speech Therapist Compensation System											
	X	X	X	X	X	X	X	X	X	X	X

Fig. 1 Existing Application Comparison

II. SYSTEM REQUIREMENTS: FUNCTIONALITIES AND ENHANCEMENTS

In this research, web-based technology run on a windows server was used as the web services system. A real time communication system called Web RTC was integrated with the Google Chrome web browser, which operates on most platforms, including mobile devices, and is convenient for remote interaction between therapists and patients.

The system was designed to support three groups of users including patients, speech therapists, and administrators. To serve this group of young children, the features for the patient end were designed to be friendly and clear with less complex operations. In contrast, the speech therapist end required extra controls and customization. The user interface and media were comparatively more advanced, with more options and settings, though ease of use was still prioritized.

Gathering needs and insights from the field by conducting research with all three stakeholder groups led to the definition of application functionalities.

A. Web Based Remote Communication

Due to the capabilities of web-based applications, people with articulation disorders can receive speech training lessons

from speech therapists remotely as long as they have access to an internet connection.

The web-based application instantaneously provides general feedback and evaluations for speech trainees. Speech therapists can respond to a particular training exercise at any time once the exercise has been completed and delivered. After the website has been established, patients appreciate the value of on-line accessibility comparing to walk-in training. Having training through personal computer, the patients are able to practice their speech articulation more consistently. In addition, the web-based program system also provides live-video conference consultation functionality when the patients need a direct conversation with a speech therapist.

The web-based application consists of sound samples, still images, and animations that display correct ways of sounding to assist speech trainees during training sessions. Speech trainees will be provided with real-time feedback from the web-based application and results will be sent to the speech therapist through an established network.

In each web-based training session, the patients can record their own voice throughout the speech exercises. Using record archives, a speech therapist can retrieve and listen to all records for investigating, evaluating, comparing and monitoring the progress of each patient.

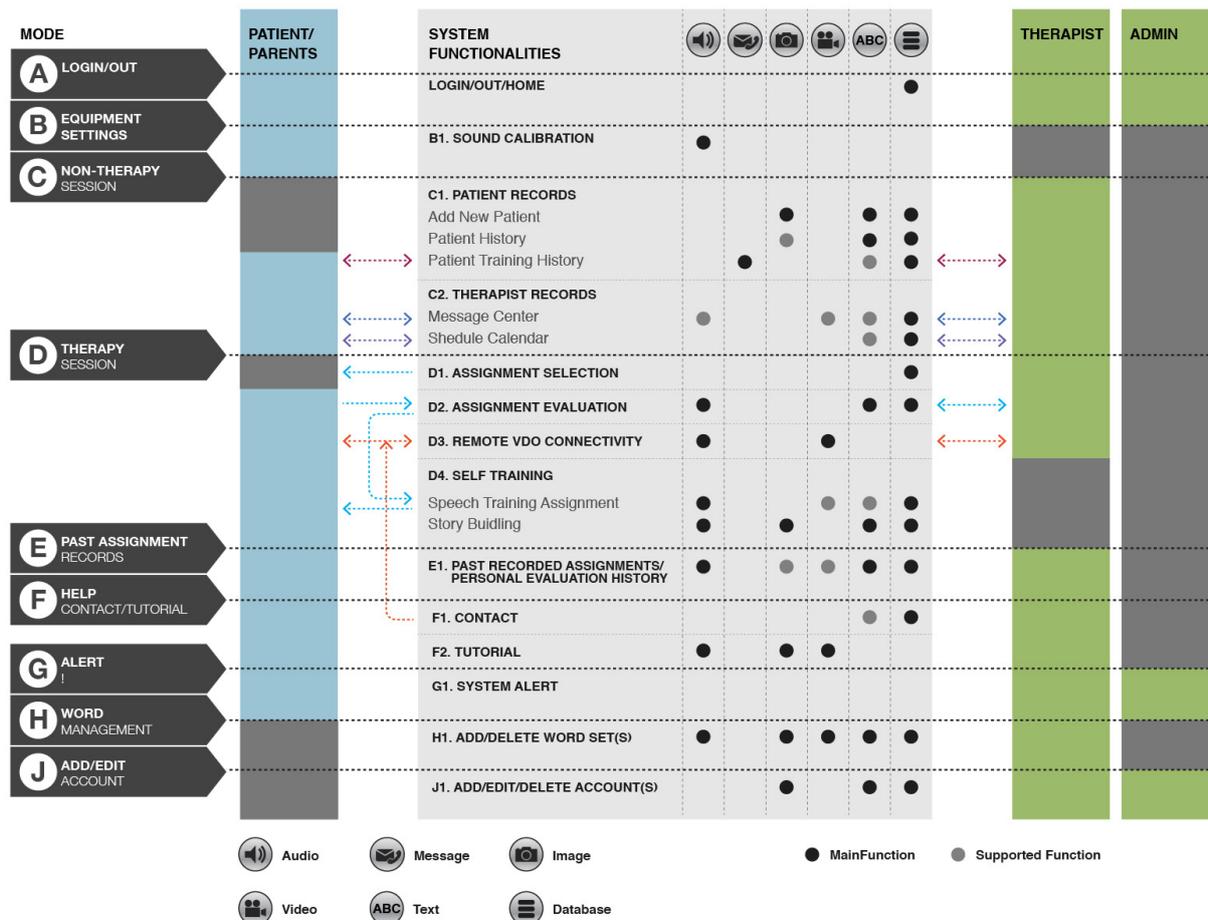


Fig. 2 System Functionalities and Enhancements

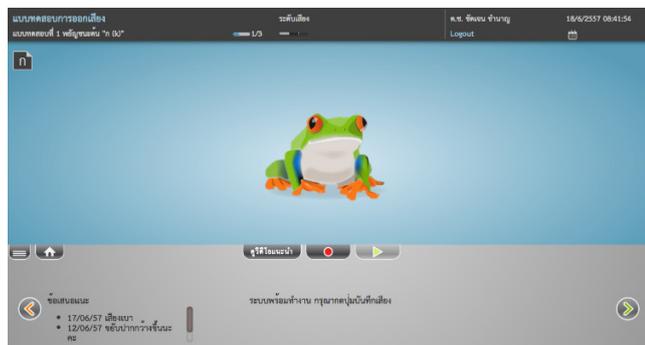


Fig. 3 Record Speech Training Exercises

B. Guidance (Sound, Video, Image, Animation, text)

TeleMe Speech Booster is a rich medium application for speech therapy. Sound is a key factor of the TeleMe application. The sound recording functionality is utilized when patients are practicing pronunciation exercises. Sound recordings made by patients can be archived, retrieved and replayed when needed by therapists for evaluation, and they can be accessed by patients who wish to keep track of personal development and progress. Video is used to demonstrate quick guides for lip positions and movements. Illustrative images and animations are integrated to show tongue positions. Due to the illiteracy of most young patients, images are provided

within the speech exercise sections, and are interchangeable with text. Nevertheless, text input is still important for communication between therapists and patients. Therapists can input text comments for each word to their patients. Upon initiating a tele-conference call, all media can be used simultaneously.

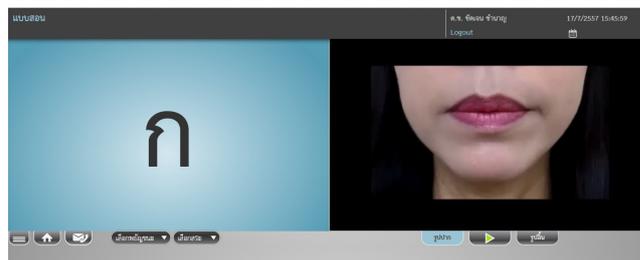


Fig. 4 Video and Audio Guidance

C. Preset VS Expandable

Due to the ability to edit word sets by adding and deleting, therapists can expand their own word lists. This allows word list databases to grow to an infinite number. To add a new word set, the therapist can type the word in a text format with options to upload images and lip position suggestion videos.



Fig. 5 Add New Word Set

D. Sharing (Exercise Database)

The development of TeleMe as an on-line application allows newly generated word sets to be stored on a central server. Therefore, pre-set and newly created word sets can be shared among therapists within a department or organization.

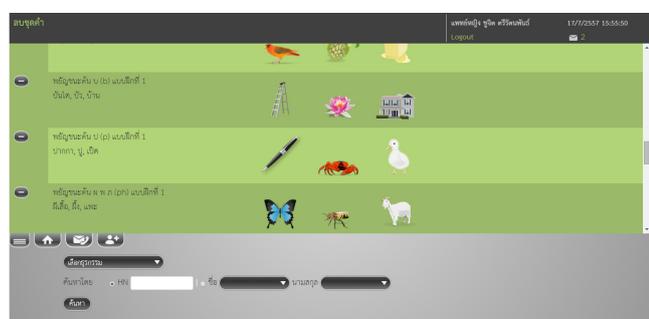


Fig. 6 Word Set Sharing Database



Fig. 7 Tele-conference Call with Patient History

E. Tele-Conference on Demand

Whenever the patient requires therapist consultation during the practicing process, the patient can request and schedule a tele-conference call with his or her own therapist. This feature is a crucial benefit, especially for children in rural areas, as it reduces travelling time and closely approximates the experience of meeting with the therapist in person.

F. Customization

Each patient has distinct challenges related to speech articulation. TeleMe allows therapists to arrange and select suitable exercises for each patient with varying levels of pronunciation difficulty.



Fig. 8 Custom Assignments

III. FEEDBACK FROM PATIENTS AND SPEECH THERAPISTS

Clinical trials and testing involved six Thai speech therapists and nine speech articulation patients with age range of three to nine years old. Speech therapists took the role of assigning speech exercises, commenting exercises, adding new word sets, and receiving tele-conference calls initiated by patients. Patients were responsible for practicing speech assignments and initiating tele-conference calls.

As determined through clinical testing on the patient end, caretakers play a crucial role in facilitating the use of the TeleMe application rather than the patients themselves, particularly in arranging appointments and encouraging training at home. The term caretaker refers to mothers, fathers, or guardians of children with speech articulation disorders.

There are essentially three types of caretakers, including “Disadvantage Hurdlers”, “Try-out Believers”, and “Therapist Dependents”. Identifying the typology of caretakers not only helps to illustrate the differences in users’ behaviors and needs, but also helps to leverage benefits of functionalities within TeleMe application for each typology.

Disadvantage Hurdlers include users facing various disadvantages, including location in remote areas, limited financial resources, and tightly scheduled lifestyles. As a result of these factors, individuals in this category are not likely to visit a therapist. This group of caretakers values the Tele-therapy session feature. This feature primarily helps to resolve travelling time issues and to reduce expenses. At the same time, the patients still have direct access to therapists even though they are not located in the same place.

Concern: Time, Expense

Try-out Believers embrace and enjoy being exposed to all sorts of training possibilities. They are willing to try new methods that could possibly enhance patient articulation. This group of caretakers sees the value of articulation guidelines and they are able to follow guidelines or instructions that accompany the application. Some can become in-home self-training advisors.

Concern: Guidelines

Therapist Dependents believe in direct therapy sessions. Caretakers in this group are busy professionals or run their own businesses. They have no financial constraints, but rather time constraints. They value a fully automated system that

supports full automatic guidance for daily home training. An application with automatic articulation detection and self-explanatory suggestions is desirable.

Concern: Time, Automatic Guidance

Patients/users are aged from three to nine years old. Patients are divided into two groups: those who have full exposure to digital interactive technologies, and those who are inexperienced with regard to digital interactive technologies. Patients with full technological exposure seek more exciting interactions rather than linear training exercises. On the other hand, inexperienced patients feel that the TeleMe application is pleasant.

Concern: Fun

Most **therapists** appreciate the function of adding and deleting word sets due to the diversity of personal speech training styles. They foresee that TeleMe can be used for different kinds of speech patients, not only for children, because of the flexibility of word set features.

Concern: Customization

1. Benefits of Expandable Custom Word List

Due to the different therapeutic approaches of each therapist, the process of building word lists varies. Therapists emphasized that adding a word list capability was a crucial function. This feature could serve a wide variety of patients with diverse ages and speech disorders.

2. Support Multiple Languages

Due to the word list-building feature, the application can easily be updated to support different languages. A therapist can add words instantly in different languages with the assistance of the therapist evaluation tool rather than an automated machine evaluation. Therefore, collecting sound samples in different languages is not required to produce a sound database for automated suggestions or evaluations.

3. Articulation Improvement VS Fun

TeleMe Speech Booster currently focuses on basic speech articulation improvement of the patient by improving not only sound quality but the physical quality of tongue and lip positions as well. Younger users express limited motivate to use the application. Therefore, a games section needs to be integrated to the application as a future development.

IV. CONCLUSION

Based on the therapists' feedback, most key functions were confirmed to be beneficial to both therapists and patients' caretakers. The application reduces travel time for patients, especially for remote populations who live in Thailand's rural areas. In addition, working hours for speech therapists in government-funded hospitals are limited to regular working hours (8:00-16:00). Most young students must attend school during that window of time. Therapists have expressed that they see the benefit of the application with regard to the ability to extend their instruction time outside of working hours at the hospital by engaging in direct consulting sessions with patients via the teleconference system.

Most therapists mentioned that existing Thai speech therapy applications are not effective enough to use, due to a lack of accuracy in guidance and suggestions based on particular patient weaknesses. Because each speech therapist has personal training techniques, word sets are crucial for their therapy sessions, but existing digital speech therapy applications do not provide tailor-made word sets.

Therapists also affirmed that TeleMe has the advantage of allowing patients to practice on a regular basis anywhere and anytime, with the added flexibility of evaluations or comments directly from therapists. To respond to the needs of therapists, custom word sets are now available with the capability of adding and deleting word sets and phrases.

Moreover, TeleMe supports therapists in assigning appropriate word training sets based on a level of difficulty that is suitable for each patient. By adding words or phrases to the database, all therapists within a department would be able to share and build up extensive speech training exercises.

V. FURTHER DEVELOPMENT

This project has been initiated for personal computer use only. To respond to the fast growing use of personal handheld devices, TeleMe will be expanded to run on Multi-platform devices as well.

In order to get patients more involved with the therapy process, the application developers plan to include a section devoted to generating stories. Patients will be able to select images from existing word lists and make up their own stories. Parents or caretakers can take part and share quality time in assisting and monitoring the child's practice.

ACKNOWLEDGMENT

This work was supported by a grant from the Cluster and Program Management Office (CPMO), National Science and Technology Development Agency, Thailand. The authors would like to thank Asst. Prof. Dr. Sriwimon Manochiopinig for valuable advice and support. Special thanks to Mr. Watcharapong Treerattanaphan for expert guidance in developing this interface design application.

REFERENCES

- [1] Rose Medical Solutions Ltd. (n.d.). Speech Therapy Software. Retrieved 04 09, 2012, from Rose Medical: Speech and Therapy Software: <http://www.rose-medical.com/>
- [2] Speech Tutor. (n.d.). Retrieved 04 09, 2012, from Speech Tutor: <http://pocketslp.com/our-apps/speech-tutor/>
- [3] Tiger DRS, Inc. (n.d.). Retrieved 04 09, 2012, from Dr.Speech: <http://www.drspeech.com/index.html>
- [4] TinyEYE Therapy Services. (n.d.). Retrieved 0811, 2013, from TinyEYE: <http://www.tinyeye.com/>
- [5] VocoVision: A telepracticecompany. (n.d.). Retrieved 05 09, 2013, from VocoVision: <http://www.vocovision.com/>
- [6] Tiga Talk Speech Therapy Games. (n.d.). Retrieved 05 09, 2013, from Tiga Talk: <http://tigatalk.com/app/>

C. Treerattanaphan, PhD. is an assistant professor in the Industrial Design Program at the School of Architecture and Design, King Mongkut's University of Technology Thonburi (KMUTT), Thailand. Her research expertise is in

user-centered design, design psychology, communication design, interaction design, and service design. She is also committed to undertaking design research for the elderly, the disabled, communities, and business development. She has been involved in research projects on consumer perception, product and service development strategies, space planning, and living trends with leading companies and organizations. Chujit received her BA in Industrial Design from King Mongkut's Institute of Technology Ladkrabang, her MFA in Industrial Design from Rochester Institute of Technology (RIT), and her Ph.D. in Human-Centered Communication Design from the Institute of Design, Illinois Institute of Technology (IIT).