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The Implementation of A-TooLips, A Learning Mobile Application for Deaf Children to Produce Words

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Graphical abstract
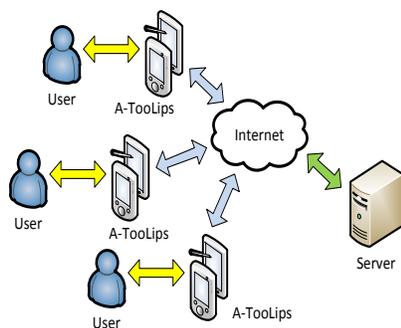
Abstract

The deaf have a very fundamental problem, which is the ability to communicate and interact, so that it makes their very complicated. In the process of learning in basic education, the problem root faced by children with hearing impairment is the limitation in identifying and producing words. The learning process is limited to only rely on time at the school was an obstacle for them. Therefore, A-TooLips built as learning applications on mobile devices for the deaf children focusing on the ability to produce words. A-TooLips gives more time and places for hearing impaired children to learn, so that it helps their problem in communicating and interacting with others. It is explained in this paper that the A-TooLips has been successfully implemented and tested by some children with hearing impairment, and reached positive results.

Keywords: Deaf children, communication and interaction, producing words, mobile learning application, A-TooLips

1.0 INTRODUCTION

Deaf characteristics according to Somad and Hernawati (1995: 35-39) can be viewed in terms of: intelligence, language and speech, emotional, and social. Moreover, according to Leigh (1994; in Bunawan, 2004), the main problem of the deaf does not lie in not mastering the verbal communication, but the consequences on the development of language skills. The lack of language skills causes deaf children not or less able to understand the symbol and the rules of language [1]. More specifically, they do not know or understand the emblem/code or 'name' that is used to represent the environment objects, event activities, and feelings. Besides, they can hardly understand the language rules or grammar. This situation is mainly experienced by children with hearing impairment who experience deafness since birth or early childhood (pre-language deaf). The inhabitation of deaf children's ability in language implies their specific needs to develop language skills with a special method.

There are many learning media for deaf children that are already exist and used. They are like visual stimulation media, auditory stimulation media, and visual communication-based learning media. TooLips, which was the application of the results of previous studies, is one of the visual communication-based learning applications for children with hearing impairment to increase users' vocabulary and practice their comprehension toward sentence patterns.

TooLips application has been tested in several Special Schools (SLBs) in Bandung. According to the test results, it appeared that deaf children have problems in pronunciation and vocabulary treasury,

so they will find it difficult first before they must understand the pattern of the sentences. Therefore, the application TooLips is developed further in the present study focusing the learning on the production of words. Deaf children's ability in producing and recognizing vocabularies becomes the most important and fundamental parts for them to be able to communicate, learn, and interact with others.

2.0 LITERATURE REVIEW

Deaf is someone who experienced lack or lose the ability to hear, so he cannot use his ears in daily life and it has complex impacts on his life. Deafness can be divided into two categories, namely the deaf and hearing less (hard of hearing). Deaf is someone or a child whose hearing senses are damaged so that his ears are not functioning anymore. While the lack of hearing is a child whose hearing senses are damaged but can still serve to hear, either with or without the use of hearing aids.

The followings are characteristics of deaf children based on Permanarian Somad and Tati Hernawati, in terms of intelligence, language and speech, as well as emotional and social development [4].

1. Characteristics in terms of intelligence
Deaf children's intelligence is not different from normal children, consisting of three levels: high, average, and low. In general, deaf children have normal or average intelligence. However, their achievements are often lower than normal children's ones because it is influenced by the ability of deaf children in understanding the verbalized lessons. Some aspects based on verbal intelligence are often low, but the aspects of intelligence that comes from sight and motor will be developed quickly.

2. Characteristics in terms of language and speech
Basically, the abilities of deaf children in language and speech are different from normal children because those capabilities are closely linked with the ability to hear or listen. Since deaf children can hardly hear or understand the language, the deaf children have problems in communicating. The ability to talk to a deaf child will grow by itself, but requires continuous effort and training as well as professional guidance.

3. Characteristics in terms of emotional and social
Deafness can cause alienation to the environment. Alienation will cause some negative effects, such as: egocentrism that exceed normal children, fear of the wider environment, and dependency on others.

As for the problems experienced by children with hearing impairment can be classified as follows [5].
a. Communication problems. These are the most complex problem belonging to deaf children.

These problems happen as the result of malfunction of the hearing sense either partially or wholly that turned out to be fatal in deaf children's life.
b. *Personal problems*. These problems include issues related to personal conditions of deaf children, including distress, feelings of doubt, always suspicious and aggressive.
c. *Teaching problems or learning difficulties*. These are related to the difficulties during the learning process, such as difficulty grasping abstract words, so they will impact on all subjects.
d. *Skills and employment development problems*. Persons with disabilities are usually hampered in his career development because of limited skills and work experience. Besides, many jobs are disbelief with the ability and skill of disability communities.

Language, as communication tools and becomes the most fundamental issues for the deaf, requires special handling so that deaf children can learn effectively and efficiently. There are three main methods for deaf children in learning language, namely by reading the speech, by hearing, and by the manual communication. It can be by the combination of these three methods [7].

2.1 Previous Work

From the research that has been done in the first year, some outcomes are produced. They are the TooLips application, some published scientific papers, and product copyright of TooLips application. In addition, in the first year of the research, it has been established partnerships between researchers, SLBs, and some disability caring communities in Bandung.

TooLips is a mobile application to learn words and sentence patterns for deaf children. The application has been tested to some deaf children in some SLBs and yielded positive results. However, some features need to be added to increase the usefulness and ease of use of the application, including: the need for sign language video feature, recording the progress of student learning outcomes, and the implementation of Intelligent Tutoring System. Some of the needs of the application development carried out and described in this paper.

3.0 METHODOLOGY

3.1 Literature Study

The first stage is to find a reference that is used to support this research, namely programming on the Android platform, the database on the Android platform, and study about TooLips application. It would also require various references related to the characteristics of children with special needs (ABK)

especially deaf, in terms of language and vocabulary, how the implementation of the Total Communications (KOMTAL) in learning to ABK deaf, vocabulary, and sentence patterns that should be recognized by ABK deaf at basic school with grade 1 to 6. The literature sources can be from books, journals, proceedings, articles, and other reference sources.

In addition, other literature study methods are needed that are non-textual, such as consultations with psychologists and special education practitioners. Moreover, at this stage, a data collection is done to support the development of applications in this study. What is required in this stage are: Indonesian learning curriculum for special kindergarten and elementary schools, as well as learning materials for the application, including images, sounds, text, and videos, based on the learning curriculum. The video collection in this research is assisted by Gerkatin (Gerakan Tunarungu Indonesia), BILiC (Bandung Independent Living Center), and some SLBs in Bandung.

3.2 System Specification and Design

The aims at this stage are as follows.
1. Study and analyze the needs of users, which is deaf children, to obtain system and software requirements specification.
2. Pick and choose the programming tools that will be used to develop applications on the Android platform.
3. Create the application interface design based on the characteristics of deaf children, as well as assets, characters, and components to be used.
4. Create a system database design using Entity Relationship Diagram (ERD) as well as the flow of business processes and application model with Unified Modeling Language (UML).

3.3 System Implementation

At this stage, the implementation of the application development is carried out based on the design that was created earlier. The development of these applications uses Eclipse IDE with the Java programming language and MySQL database to SQLite and Android platform. In the development of this application, there are two main tasks: (1) building user interfaces, assets, and application components; and (2) coding functionalities of the application.

3.4 Testing and Analysis

The established application entitled Advanced TooLips (A-TooLips) is installed in some smartphones and PC tablets. At this stage, alpha testing of the installed A-TooLips is done by using black box testing method. Besides, user testing is performed by some deaf students at the elementary school with grade 1 to 5. Analysis of the testing results is done to fix bugs that may be discovered during the testing and

reevaluate the application features that have been built associated with the software requirements specification has been defined at the beginning

4.0 RESULTS AND DISCUSSION

4.1 Current Situation

School for Disabilities (SLB) is a place to provide educational services for the crew, including children with hearing impairment. To execute learning process, SLB provides special facilities to every single student. It is different to ordinary school that each student is considered to have a relatively equal ability to capture the learning materials. In SLB, each child has different abilities in capturing the learning material, so that the learning process cannot be standardized and should be adapted to each child's needs.

In addition to schools, the parents' role is also very important in the learning process of children at home. However, most of children do not repeat the material they have learned at the school due to various conditions. One of them is that their parents who are really busy to work and have no time to guide their children in learning. In fact, deaf children should be trained continuously to improve their capabilities and insights, especially in this case is the vocabulary, as the most basic things needed in the communication. Based on the field surveys have been conducted on an SLB in Bandung, deaf children often have difficulties in expressing their desire with a sentence because of a very low understanding of the language and vocabulary, so that it hampers them from communicating with others.

4.2 General View of the System

A-TooLips is a mobile learning application on the Android platform that is designed to help children with hearing impairment in studying the production of words. In the material delivery, A-TooLips uses specific teaching methods for deaf children, namely:Learning vocabulary through pronunciation video and sign language video
1. Learning vocabulary by hearing the voice or audio file
2. Questions to evaluate what has been learned so far by the user

There are four main components in the A-TooLips system environment, namely (1) the user of the application, (2) the application A-TooLips already installed in mobile devices, (3) the Internet as a medium for communication and access between applications with the data, and (4) the server that stores the data to be accessed. Figure 1 shows the system architecture in general
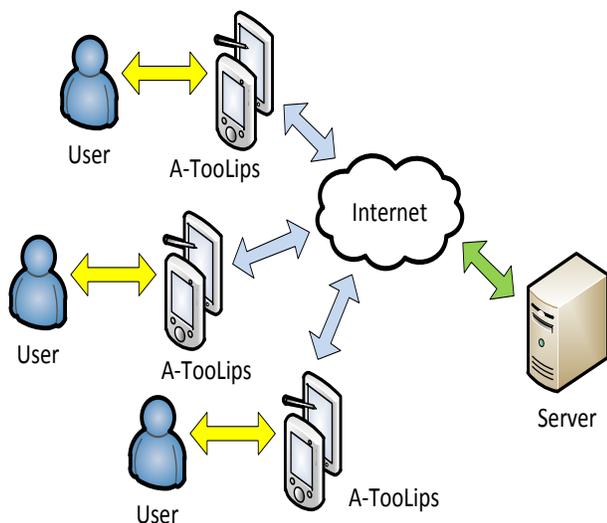
Figure 1 The system architecture in general

A-TooLips user targets are deaf children with the specifications as follow
1. The level of hearing problem : easy to severe level
2. The level of hearing loss : 27 - 90 dB
3. Range of age : 4 to 7 years old
4. Assumptions given :
   - Children do not have mental retardation
   - The child does not have a physical disability
   - The material taught is limited to items or objects commonly encountered everyday
   - The child can already read the letter alphabet, can read words, and simple commands

4.3 Implementation And Testing

i. Application Features

1. *Register an account*. In this feature, users will register an account. User will be prompted to input user data which includes name, class, username, and password.
2. *Login*. In this feature, the system will display the form consisting username and password. Users enter the username and password in accordance with the data that has been registered previously.
3. *Initial tests*. In this feature, system will display images, spelling words, the object's name, and the voice to text button. In this functionality, the user will be examined to answer some questions. This initial test is aimed to determine the type of material that will be given to the user (deaf children). There are two types, namely Bilabial Labio-Dental Vocal and Dental Palatal Velar. The application can automatically guide the users if they are supposed to be one of those types.
4. *Learning words*. In this feature, the system will display images, spelling words, the word name, voice that mentions the word, pronunciation video, and sign language video.

5. *Exercises*. This feature requires users to answer the name of the object or word based on the image shown in the display. A number of images will appeared and need to be answer correctly. After finishing this exercise, the user will get the score.
6. *Study Reports*. In this feature, the system will display the user study report time by time during he uses this application.

ii. Application Content

A-TooLips application consists of three main functionalities, namely learning, training, and reporting. Before accessing the A-TooLips, users are asked to create a personal account with the name, username, and password, used to access the A-TooLips applications. After that, the user is asked to choose a category of learning, as recommended by the guide or automatically through the initial test. This initial test aims to determine the appropriate category of pronunciation for the user, so that the learning process will be more effectively because it fits users' needs and characteristics. The material on the initial test refers to two categories of pronunciation of words that are commonly known, namely Bilabial Labio-Dental Vocal and Dental Palatal Velar.
- Bilabial Labio-Dental Vocal: –P-, -M-, -B-, -W-, -F-, -V-, -H- -A-, -I-, -U-, -E-, -O-
- Dental Palatal Velar: –T-, -D-, -N-, -I-, -R-, –C-, -J-, -NY-, -SY-, -Y-, -S-, -Z-, –K-, -G-, -KH-, -NG-

Results of preliminary tests will determine the category of the material to be learned by children with hearing impairment. The followings are procedures for assessing the initial test results.
1. If there is at least one incorrect answer among 5 questions in the material of Bilabial Labio-Dental Vocal, the user goes into the category of Bilabial Labio-Dental Vocal.
2. If all 5 questions about the Bilabial Labio Dental Vocal are correctly answered, then the user will be guided to category of Dental Palatal Velar.

After knowing the selected category, then there will be three main functionalities, namely learning, training, and reporting. On the learning functionality, based on the literatures and previous studies, there are 12 groups of words that are separated into three main categories, namely
a. *Letters and Syllables*.
b. *Nouns*, consisting of: Fruit, Animals, People Around, Limb, Clothing, Classroom, Objects Around, Place, and Transportation.
c. *Verbs*, which are adapted from a pictorial card-based learning medium in SLB in Bandung. Animated images are used and sorted in ascending from not-affixed words to affixed words.

On the functionality of training or exercise, there are 90 exercises with the distribution of 45 questions per category. Each category has 5 levels and each level consists of 9 stages (questions). While in the report functionality, A-TooLips display the log of user's

learning time by time so that the counselors or parents can monitor children's learning development.

iii. A-TooLips Screenshot

The following shows screenshots of implementation results of A-TooLips. Figure 2 shows the login page, Figure 3 shows the after login screen, Figure 4 demonstrates the Initial test, Figure 5 shows the input voice, Figure 6 visualizes the true answer screen and Figure 7 shows the wrong answer screen.

On the other hand, Figure 8 shows the option category, Figure 9 shows the studying word, Figure 10 demonstrates the leveling available and last but not least Figure 11 visualizes the sub-level available.

Figure 6 True Answer   **Figure 7** Wrong Answer

Figure 2 Login Page   **Figure 3** After Login

Figure 8 Choosing Category   **Figure 9** Studying Word

Figure 4 Initial Test   **Figure 5** Input Voice

Figure 10 Leveling   **Figure 11** Sub-Level

4.4. Application Testing

Until this stage, the tests performed is alpha testing using black box method and user testing done by some deaf children who meet the application user profile requirements. Table 1 shows the scenarios and results of the alpha testing stage.

Table 1 Testing scenario and result

1	Test poin	Testing the Login feature
	Goal	Checking whether the Login can successfully using the username and password that have been registered and in accordance
	Initial state	• Already connected to the internet • User is aided by companion
	Scenario	1. Activate internet service of the smartphone 2. Open the A-TooLips 3. Input the username and password 4. Press button "Masuk"
	Result	OK. Successfully done without problem.
2	Test poin	Testing the Register feature
	Goal	Checking whether the list can be managed by entering user data.
	Initial state	• Already connected to the internet • User is aided by companion
	Scenario	1. In the page of Login, press button "Daftar" 2. Fill in the name field, username, password, repeated password 3. Press button "Daftar"
	Result	OK. Successfully done without problem.
3	Test poin	Test the Initial Test feature
	Goal	Check whether the results of the initial test in accordance with the category of materials
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in
	Scenario	1. In the page of choosing material category, press button "Tes Awal" 2. Fill the answer of picture question in the provided column 3. Press button "Pelafalan" if user wants to fill the answer using Speech To Text feature 4. Press button "Cek"
	Result	OK. Successfully done without problem.
4	Test poin	Test the "Anjuran" feature
	Goal	Check whether the results of the initial test in accordance with the category of materials.
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in
	Scenario	1. In the page of choosing category, press button "Anjuran" 2. Press button "Bilabial Labio-Dental Vocal" if user want to choose it guided by the companion 3. Press button "Dental Palatal Velar" if user want to choose it guided by the companion
	Result	OK. Successfully done without problem.

5	Test poin	Test Learning feature
	Goal	Check whether the functionality of Learning can display the entire category of words and can play all video
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in • User is already done the initial test or chosen the category
	Scenario	1. Press button "Belajar" 2. Choose one Learning Category, i.e. Buah 3. Choose one object in Learning Category of "Buah", i.e. Apel 4. Press button articulation to see articulation video 5. Press button sign language to see sign language video
	Result	OK. Successfully done without problem.
6	Test poin	Test Exercise feature
	Goal	Check whether the functionality level and stage Exercise can run well and appropriate user training history
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in • User is already done the initial test or chosen the category
	Scenario	1. Press button "Latihan" 2. Press button "Level" that is already opened 3. Press button stage that is already opened 4. In the page of Exercise, fill the answer of the picture question in the provided column 5. Press button "Pelafalan" if user wants to fill the answer using Speech To Text feature 6. Press button "Cek"
	Result	OK. Successfully done without problem.
7	Test poin	Test Report feature
	Goal	Check whether the data displayed on the Report feature in accordance with the results of the user study
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in • User is already done the initial test or chosen the category • User already learn words
	Scenario	1. Press button "Laporan"
	Result	OK. Successfully done without problem.
8	Test poin	Test Setup feature
	Goal	Checking whether each button on the Setup is running well
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in
	Scenario	1. Press icon button "Pengaturan" 2. Press button "Akun", change the data, press button "Simpan" 3. Press button "Tentang" 4. Press button "Logout"
	Result	OK. Successfully done without problem.
9	Test poin	Test "Petunjuk" feature
	Goal	Check whether the "Petunjuk" can

		display all the images hint
	Initial state	• Already connected to the internet • User is aided by companion • User is already logged in
	Scenario	1. Press icon button "petunjuk" 2. Slider screen
	Result	OK. Successfully done without problem.

After the alpha testing and evaluation are done, A-TooLips is tested by some deaf children to see the interactions that occur between application and real users. There are two business functions that is tested by the users, namely (1) displaying of learning material, choosing the category of learning, selecting instructional videos, and running the video; (2) displaying a page of exercise, choosing the level of exercise, choosing the exercise stage, and answering questions. The results are briefly shown here.

1. Name: Bomantara D. P.
   Age / class: 11 year / 5 grade of primary school
   The level of hearing loss: severe / ±90 dB
   Result:
   a. Business function-1: 4 of 4 (good, easy, understand, like)
   b. Business function-2: 4 of 4 (good, easy, understand, like)
2. Name: Ani Nuraeni
   Age / class: 14 year / 6 grade of primary school
   The level of hearing loss: severe / ±90 dB
   Result:
   a. Business function-1: 4 of 4 (good, easy, understand, like)
   b. Business function-2: 4 of 4 (good, easy, understand, like)
3. Name: Dhimas F. N.
   Age / class: 11 year / 3 grade of primary school
   The level of hearing loss: severe / ±90 dB
   Result:
   a. Business function-1: 4 of 4 (good, easy, understand, like)
   b. Business function-2: 4 of 4 (good, easy, understand, like)

5.0 CONCLUSION

From the research that has been conducted so far, the following conclusions can be taken.
1. A-TooLips is a mobile learning application built for deaf children to train the capability of producing words.

2. A-TooLips is built by applying particular learning principles for deaf children through the medium of drawing image, text, audio, and video.
3. Based on the results of alpha testing, A-TooLips has been able to run all the main functions well. As for the user testing results by three deaf children, A-TooLips is acceptable and not difficult to use for users who have a severe hearing loss.

Acknowledgement

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