

A CONCEPT AND IMPLEMENTATION OF INSTRUCTIONAL INTERACTIVE MULTIMEDIA FOR DEAF STUDENTS BASED ON INQUIRY-BASED LEARNING MODEL

LALA SEPTEM RIZA, DHEANA SUSANA FIRDAUS, ENJUN JUNAETI,
TOPIK HIDAYAT, ADE GAFAR ABDULLAH,
ASEP BAYU DANI NANDIYANTO, CEP UBAD ABDULLAH

Universitas Pendidikan Indonesia
Jl. Setiabudi No. 29 Bandung, Jawa Barat, Indonesia 40154
*Corresponding Author: lala.s.riza@upi.edu

Abstract

Everyone, including deaf children, is entitled to the right of education. Deaf children have difficulties in developing cognitive abilities, linguistic skills, and reading comprehension. Therefore, this study was aimed to develop a concept and implementation of instructional media for deaf children to be implemented in inquiry-based learning interactive multimedia. The design of this media took account of 24 characteristics of multimedia for deaf students. The experiment was carried out at the special school for disability students (i.e., Sekolah Luar Biasa (SLB) in Bahasa) Negeri Beringin Purwakarta, Indonesia, involving five fourth grade special students as the research subjects. The result of the experiment was then analyzed using a qualitative method. It was revealed that students' scores, perceptions of the media, feelings during and after the use of the media, and average attention spans were very good. Based on the results obtained during experiment, the developed media was proven to have positive impacts on the deaf children.

Keywords: Deaf children, Inquiry-based learning, Instructional media, Characteristics of multimedia for deaf students.

1. Introduction

Education is very critical for human beings to develop their potentials. Therefore, education should be made available to all including children with special needs, ones of which are deaf children. The hearing impairment they suffer affects their cognitive, the linguistic, learning, and reading development [1]. Basically, linguistic ability is fundamental and influential in the personal development

because it is a means of everyday communication. Moreover, one of the linguistic abilities is reading.

As things stand, an instructional media is needed to facilitate the learning of deaf children and to help them reduce their difficulties in everyday life. There have been many studies on media development. Ahmadi et al. [2] developed a multimedia software to identify deaf children's health priority needs in elementary schools. The developed software contained educational videos, sign language, picture guide, translation texts, and animation specifically designed to teach children with hearing impairment. Moreover, an analysis on the use of multimedia storybooks discussing the vocabulary acquisition has been done by Donne and Briley [3].

This research was aimed to develop a concept of instructional media for deaf children that considers characteristics of multimedia for deaf students, and then it was implemented in inquiry-based learning interactive multimedia. Having been implemented, the deaf children's opinions were analyzed to figure out if the developed media is relevant to their needs. Generally, the developed media could be used by children with hearing impairment at all stages. This study used following three methodologies. First, this study used the waterfall method to develop multimedia [4]. This method consists of: analysis, design, development/ implementation, and software testing. Second, the data were analyzed using a qualitative analysis technique [5]. This technique had three steps: data reduction, data representation, and conclusion. Third, the inquiry-based learning model was used to develop the instructional media for children with hearing impairment [6].

2. Related Works

Learning media for the hearing impaired is actually different from the media for normal children. This is because they use more visual sense. Proven by some related research. The following are studies related to learning media for the hearing impaired.

There are several researchers who develop applications for helping communications of deaf students, such as Darmayanti [7] designing mobile-based learning applications with the name "on chat" which can be accessed for free and only need to connect to the internet to be used. The purpose of this application to add vocabulary, can communicate with classmates or friends cyberspace, the results achieved from this application is a child with special needs deaf can retell the learning process experienced during "on chat" in the class orally. So, with mobile-based learning for children with special needs deaf using the application "on chat" to be effective, efficient and has appeal. Ohene-Djan et al. [8] developed two new communication-based learning systems namely Mak-Messenger and Finger-Chat. The application is similar to Microsoft Messenger and Yahoo Messenger specifically designed to help teach languages and the means of exchanging ideas, messages or information.

There are some researchers who develop e-learning such as Masitry et al. [9] developed multimedia for pre-school students with hearing problems, the developed multimedia is called e-MSL. e-MSL can be run on a computer or notebook and can not only be used in class, but also used anywhere. There are four modules developed by e-MSL that consist of alphabet, number, words and quiz

with colored text, animation, sound, video and picture using Malaysian Sign Language (MSL). The survey results show that 100% of respondents have agreed that using e-MSL successfully reduces student's learning time by more than 80%. Thus, the learning performance using e-MSL is better than traditional learning. Al-Osaimi et al. [10] built an e-learning interface designed specifically for hearing-impaired children to enhance the learning experience. The prototype of the e-learning program is used to get children's feedback on interface design. Furthermore, the guidelines proposed here are built on deaf children and their teacher input. This guide is suitable for designing e-learning programs for deaf children between the ages of seven and thirteen.

Ahmadi et al. [2] helped identify priority health needs of deaf students in elementary school and make it into the form of health education software. Multimedia software programs created including educational videos are enriched with sign language, guided images, and subtitles with simple phrases and special animations specially designed to suit the education of the Deaf. The software also helps teachers and student families to promote deaf students' health so they learn effectively. Kourbetis et al. [11] has presented an innovative interactive app for deaf and hard-hearing student education (D/HH). The contents of educational documents are given in Greek Sign Language (GSL). The multimedia electronic form of Hybrid books combines presentations from the original GSL textbooks, subtitled texts under GSL video, video with text navigation, as well as audio-recorded texts by native speakers. This app is free and accessible to everyone via the web. Shin et al. [12] developed a conceptual understanding of mathematical topics with virtual manipulation that is an interactive visual model that can be used as a tool for students while actively engaging in mathematics learning.

3. Research Methods

As briefly discussed earlier, the process of this study, as illustrated in Fig. 1, could be said to use several methods, including the concept of inquiry-based learning model, the waterfall method to implement the media, and a qualitative method to analyze the results of experiment. These modules will be explained below.

3.1. Inquiry-based learning for deaf children

The inquiry-based learning was adjusted to the instructional concept and psychological characteristics of deaf children. The instructional process was divided into three phases: situation and thinking, independent inquiry, and cooperation and independent evaluation. In each of these three phases, the teacher provide relevant guidance.

The phases of inquiry-based learning for deaf children are as follows [6]:

- 1) Creating situation: At this phase, the teacher stimulated students to concentrate, get ready for the lesson, and get ready to enter the learning environment. In addition, the teacher prepared the topic of the lesson at this stage.
- 2) Stimulating thinking: At this stage, the teacher introduced the problem to the students, and then the students analyzed them indirectly.
- 3) Independent inquiry: At this point, the teacher provided a visual aid to deliver the instructional material. The students received, analyzed, used, and assessed the information.

- 4) Collaborative exchange: At this phase, the teacher chaired the discussion among students as they share the results of their analyses.
- 5) Summarize to improve: At this point, the students did a self-evaluation, and the teacher summarized and corrected students' analysis results.

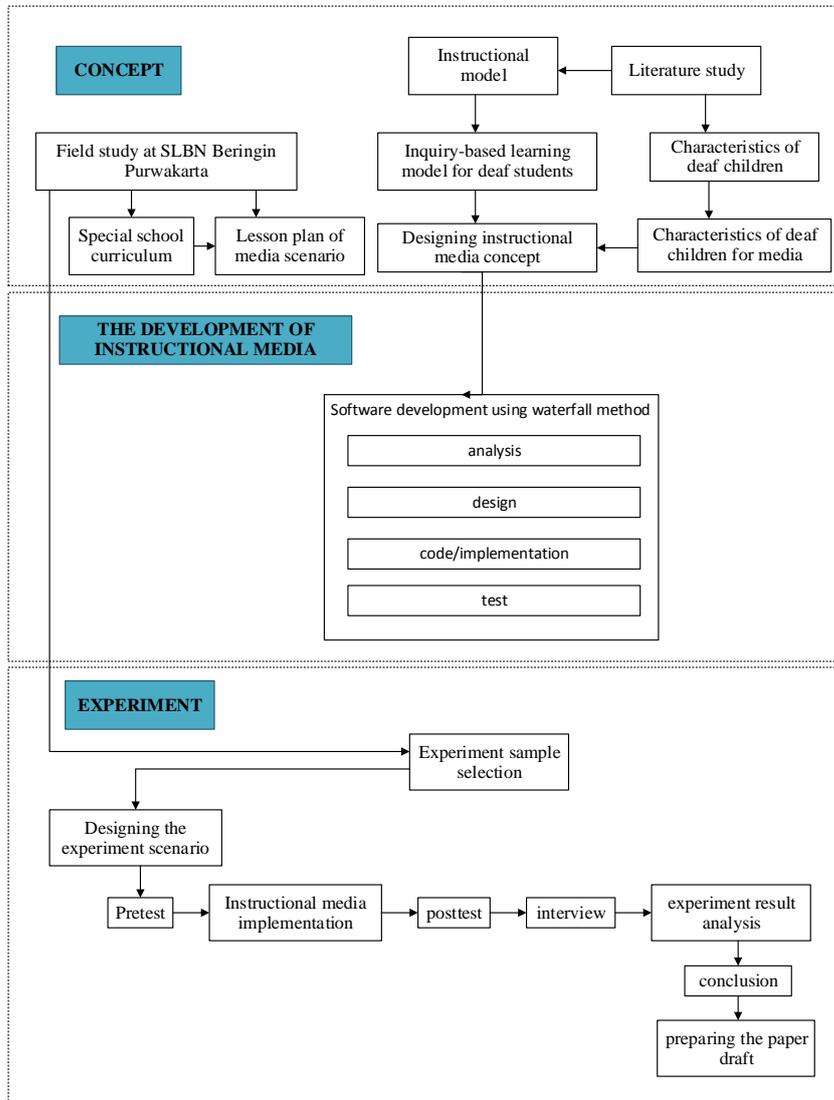


Fig. 1. Research process.

Basically, the instructional model for deaf children was the same as that for other children in general, but the teacher had three additional roles:

- 1) Into situation and think:

At this stage, the teacher created a situation and stimulated the thinking. The teacher played an additional role in improving deaf students' self-confidence using a student-friendly method and acted as a friend to the students.

2) An inquiry by themselves:

At the inquiry phase, the teacher played an additional role in providing counseling, providing picture guides, and improving cognitive abilities.

3) Cooperation and improve:

At the summarizing for evaluation phase, the teacher played an additional role in improving linguistic abilities, stimulating students' independent thinking, and improving IT literacy.

3.2. The waterfall method as a development model of instructional media for deaf children

The waterfall method [4] was used a reference for the development of instructional media that contains the following steps:

- 1) Analysis: analyses of the software and hardware that would be used to develop the instructional media with regard to the concept of the desired instructional media.
- 2) Design: consisted of flowcharts, storyboards, characteristics of instructional media for deaf children that would be used as a reference for the media development.
- 3) Development: the development of software in accordance with the flowcharts and storyboards developed and validated by experts.
- 4) Test: the testing was carried out using the blackbox approach to figure out if the functions worked properly. The test was also needed to improve the media.

3.3. Qualitative method to analyze experiment data

This study employed a qualitative approach [5, 13] to analyze the experiment results. The analysis was in the form of narrative description about the obtained results during the experiment.

The experiment was carried out by a class of fourth grade special students at SLB Negeri Beringin Purwakarta selected as the sample purposively. The sample was chosen by considering the number of class needed, suggestion from the special school curriculum developer, and class schedule.

The data were collected through observation, interviews, tests, and documentation. The collected data were then analyzed in three stages including data reduction to sort out irrelevant data, data presentation in the forms of tables, graphics, etc. to support the narrative explanation, and conclusion.

The result of data analysis was then validated using two credibility criteria including the observation accuracy in the sense that it was done thoroughly and detailedly to achieve the maximum results and triangulation to check and recheck through various trusted sources including the teacher, special education lecturers, and special students at SLB Negeri Beringin Purwakarta.

4. Designing the Concept of Instructional Media for Deaf Students

This chapter discusses the process of concept designing and the process of the development of instructional media for deaf students. The concept took account of

three important aspects: characteristics of multimedia for deaf students, the implementation of inquiry-based learning, and syllabus of the instructional media. What follows will describe the concept in question in detail.

4.1. Concept of instructional media based on the characteristics of multimedia for deaf children

Basically, the concept of instructional media that would be developed is designed with reference to 24 characteristics of multimedia for children with special needs. Thus, the instructional media would be suitable for use by the hearing impaired children. These characteristics were summarized from various literatures that there are several aspects to consider: text specification, video quality, color, image, animation, interpreter, and video of instructional media concept design. Below is a detailed explanation of what should be paid attention to when designing an instructional media for deaf children:

- 1) Use legible font types such as Arial and Helvetica; avoid the likes of Comic Sans and decorative serif fonts [14]. One of the fonts that can improve legibility is Tiresias Screen [15].
- 2) Use font sizes 14 to 20. Always use a space between words [16].
- 3) Use simple and short sentences to present the information [17]. Use simple vocabulary and well-structured sentences [18].
- 4) Use subtitles to facilitate deaf children's understanding and help the sign language interpreter [19].
- 5) Equip the animation with a description text [14].
- 6) For the deaf people, it is necessary that the details of motion can be reproduced so that fingers, eyes and mouths can be distinguished, even for signs consisting of both hands and arms moving with all the fingers. Unclear finger movements are acceptable, but clearly visible fingers are preferred. And finally, acceptable video submission time is an important point in order to make the use comfortable for deaf people [19].
- 7) Provide clear video images in such a way that the room lighting will enable sign language interpretation [18].
- 8) Increase the video size and quality so that deaf people can see better facial expressions and hand gestures [19].
- 9) Use color combinations that provide enough contrast between the foreground and the background. Use graphics and animations to illustrate abstract concepts or ideas without causing disruption to the materials. Background design should be made simple so as not to disturb the students' focus [16].
- 10) Deaf children often lose interests in educational programs very quickly. Colorful interface design is useful to elicit their interests [10].
- 11) Color contrast is also important, so the designer should make sure there is enough contrast between the foreground and the background colors [16].
- 12) Deaf students need visual images and sign language to facilitate their learning and to improve their comprehension [17].
- 13) Using story pictures can facilitate students' learning and instructional material understanding [17].

- 14) Use graphics and relevant texts to illustrate the concept and process of thinking [18].
- 15) Images should display aesthetic quality [17].
- 16) Icons should be of appropriate size so that children can easily click on them [17].
- 17) In order for the icons to be easily understood by deaf children, it is better to use linguistic symbols rather than the standard symbols commonly used in most software applications [10].
- 18) Illustration and animations are meant to elicit learning interests and help students understand the instructional material and their readings. Animations should be displayed slowly because deaf children have difficulties in reading and comprehending texts. A duration of six seconds is a widely accepted standard rule for subtitles because deaf children usually read slowly [15].
- 19) Use a user interface design suitable for children. The designer must use highly visual menus, icons, and images [17].
- 20) The best position of the sign language interpreter in a media is at the bottom right corner. According to the ethics, the sign language interpreter should wear formal, neat, and modest outfit without excessive accessories and makeup. The clothing should be dark-colored and plain. The interpreter must also be skillful in interpreting [20-22].
- 21) Use audio to improve interactive experience of partially hearing impaired children. The audio should be clear and the speech speed should be appropriate for them [10].
- 22) When an activity includes a sign language video, the children continued to play the video until they really know the sign. Most children agreed that they needed to replay the video at least three times to fully learn a new sign [10].
- 23) Although the sign language video is intended for deaf people, it can also be used by hard of hearing people who use hearing aids and know sign language. It is perfect to add voice or a spoken translation to a video clip, along with subtitles, that can be used by hard of hearing people wearing hearing aids who know sign language. The combination of audio, video and subtitles allows the users to choose which objects will receive higher attention [19, 23].
- 24) The developer used animated video equipped with voice and texts to facilitate deaf students' learning [24, 25].

4.2. Stages of inquiry-based learning model included in the instructional media

The concept of inquiry-based learning model was then used in the instructional media. Table 1 shows steps on inquiry-based learning model and design of their implementations on the media. Basically, we consider 5 stages of learning: creating a situation, concentration, independent inquiry, brainstorming, and summarization. Then, these steps are implemented into the instructional media as illustrated in the column of concept in media in Table 1. It should be noted that the additional roles were technically done in the classroom by the teachers themselves because deaf children should be given special treatment in accordance with their difficulties and limitations.

Table 1. The concept of inquiry-based learning model stages in the instructional media.

No	Model Stages	Concept in Media
1	Creating a situation. The teacher stimulated students to concentrate, get ready for the lesson, and get ready to enter the learning environment. In addition, the teacher prepared the topic of the lesson.	The media would display a video related to the instructional material.
2	Concentration. The teacher introduced the problem to the students, and then the students analysed them indirectly.	The media displayed questions or the topic of the lesson along with images to facilitate students' understanding.
3	Independent inquiry. The teacher provided a visual aid to deliver the instructional material. The students received, analysed, used, and assessed the information.	The media illustrated the material in the form of animations, images, sign language video along with texts that can be manually played and stopped.
4	Brainstorming. The teacher chaired the discussion between students as they share the results of their analyses.	Not included in the media. Students discussed and shared information in sign language about the previously learned materials in the classroom to improve their linguistic abilities.
5	Summarizing for evaluation. The students did a self-evaluation, and the teacher summarized and corrected students' analysis results.	The media provided questions and could show the answer key to the completed questions.

4.3. Syllabus on instructional media

This instruction is included in a learning material for Indonesian on the theme "Air", "Earth", and "Sun". The purpose of this lesson is to get students to know the text of the reports about the natural world, animals, and plants with the help of teachers or friends in oral and written Indonesian that can be filled with regional vocabulary to help understand reading.

The media consists of 6 modules, namely 2 modules of the "water" theme, 2 modules of the "earth" theme, and 2 modules of the "sun" theme. Each module consists of evaluation questions taken from question instruments made based on lattice and tested to children with special needs on class IV with 5 questions of each material. In the "water" theme, there are several topics, which are heat, rain, and water use. The "earth" theme contains earth relief, land, and ocean. Lastly, the "sun" theme consists of occurrence of day and night, sunrise, and sunset.

5. The Implementation of Instructional Multimedia Based on the Proposed Concept

The developed concept was implemented in the instructional multimedia for deaf students. Below is the illustration of the multimedia interface discussed in the previous chapter:

- 1) Creating a situation: Fig. 2 shows the "creating a situation" page. There is an apperception of subthemes to be studied along with a sign language interpreter. The high quality video is equipped with audio and positioned at the bottom

right corner as commonly seen on the TV screen. The video is equipped with texts, images, and voices to facilitate students' understanding. The "Memulai Materi" button is made highly visual, using the 20pt Arial font and a very bright color, in order for the students can easily click on it.



Fig. 2. The interface of creating a situation page of the instructional media for deaf children.

- 2) Concentration: Fig. 3 shows the interface of concentration stage page that displays the topic of the lesson. A text posing a question about the instructional material is displayed along with pictures to stimulate students' imagination. The "Penjelasan" button will navigate you to the answer key with explanation. At the bottom right corner is a high quality sign language interpreter video that can be played and paused. This video also has audio.



Fig. 3. The interface of concentration page of the instructional media for deaf children.

- 3) Independent Inquiry: Fig. 4 shows the interface of independent inquiry stage page that displays the instructional material illustrated by animations relevant to everyday life.

The animation transition is made slow. The text is provided to help students understand the material. The “Memulai” and “Berhenti” buttons were provided to enable students to replay the sign language interpreter video. The video is of high quality, equipped with audio, and placed at the bottom right corner as commonly seen on TV screen.

The subtitle text uses 18pt Arial font colored very distinctively from the background color. The text transition is made slow to conform to the ability of deaf children. The text on the buttons use 14pt Arial font and is bright-colored.

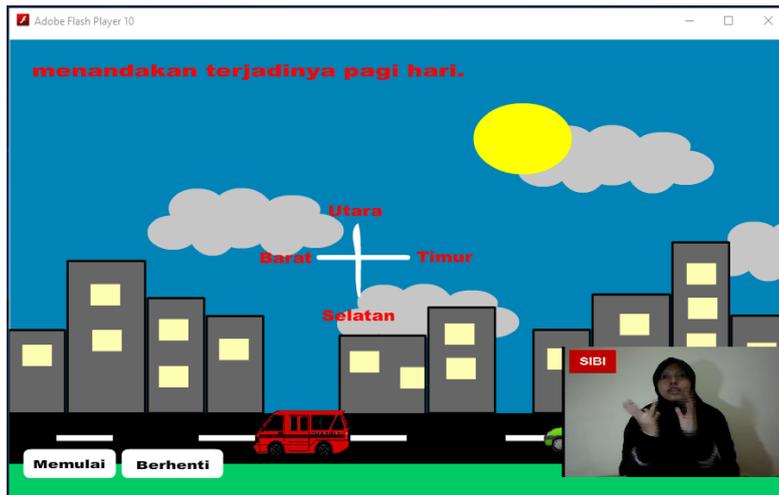


Fig. 4. The interface of independent inquiry page of the instructional media for deaf children.

- 4) Brainstorming: This stage was not included into the media. Deaf students were trained to make signs, talk, and memorize. Therefore, at this stage they were assigned to talk in front of the class.
- 5) Summarizing for evaluation: Fig. 5 shows the interface of summarizing for evaluation stage that provides the evaluation and summary of the instructional material.

As shown in Fig. 5, there are many things worth paying attention to, considering the characteristics of multimedia for deaf students. The interface provides questions related to the instructional material. Click “Ya” to answer the questions, and click “Tidak” to go back to the independent inquiry page. Click “Koreksi” to revise the answer or “Reset” to clear all answers. At the top right corner is “Kembali ke awal” button made highly visual so that students can easily click on it.

At the bottom right corner is a high-quality video of a sign language interpreter equipped with audio that can be played and paused. The questions are written using 14pt Arial font. The background color is white, making the black texts very legible.



Fig. 5. The interface of summarizing for evaluation of the instructional media for deaf children.

6. Design and Results of Experiments

6.1. Experimental design

This section discusses the experiment design. The experiment was necessary to be carried out in order for the developed concept and multimedia can be tested and analyzed.

Prior to the experiment, the researchers first gained a permit to access the research site. On the first day, the researchers were escorted to the classroom to observe the teaching and learning process and get to know the students. At this stage, the researchers interact directly with students through question and answer session guided by the teacher. The researchers were then taught how to interact with them and how to use sign language.

On the second day, the researchers conducted the experiment in the laboratory. The objects of the research were fourth grade students, but in practice for the fifth and the sixth grade of students also participated because there was only one teacher

who cannot be left behind. At the beginning of experiment, the students were given a pretest to measure their initial understanding. The pretest scores were used as the basis for grouping. The students were grouped homogeneously. Each group is provided with only one computer due to the inadequate facility.

Before the teaching and learning activities (TLAs), the students were introduced to the instructional media that would be used. During the TLAs, the students were enthusiastic and motivated to participate from the beginning to the end of lesson. In the interviews, they expressed their positive impression of the instructional media they used during the lesson.

After completion of learning, students are asked to fill in posttest questions in the media. The last stage, students are interviewed about the media that has been used and the implementation of teaching and learning activities that have been implemented. The results of the student's responses are then used as a reference for improvement in subsequent development, as a parameter of success that the learning media is effective and in accordance with the characteristics of learning children with special needs deaf.

Before teaching and learning processes, students are introduced to the media that will be used. At the time of doing the processes, students are very enthusiastic and focused in following from the beginning to the end of learning. All stages of the model in the media is done entirely from the start of the stage create situation up to stage summarize to improve.

Table 2 describes the implementation of media on learning that corresponds to the five stages of the inquiry-based learning model. There is a very important role of teacher at the time of learning deaf students using the media that teachers should always be friends and provide guidance in every stage of the model because students do not hear, language limitations, less able to operate the computer and especially on independent inquiry stage so that no concept mistake received by students and students is not left alone during the learning process. The additional role of the teacher is done technically in the lesson, not in the media.

Table 2. Activities of students related to the inquiry-based learning model.

No	Stages	Implementations with the media
1	<i>Create Situation</i>	Students are asked to view videos that have been provided by the media.
2	<i>Stimulate Thinking</i>	Students read the subject matter in the media and are asked to answer with a temporary answer.
3	<i>Independent Inquiry</i>	Students analyse and study the material presented in the media. Students can repeat continuously the material presented.
4	<i>Collaborative Exchange</i>	Students discuss and give each other information about the material that has been submitted in the media. Then each child is asked to speak and be classed in front of the class for showing the language progress.
5	<i>Summarize to Improve</i>	Students answer questions that have been provided in the media and correct the results of the answer analysis of the subject matter.

Based on the results of field notes that have been reduced, the main or important things are about the students' assessment in terms of attitude, skills and knowledge, the use of computer media, the average duration of student focus on media, media display design, sign language skills of students and emotional feelings when using the media. All data that has been obtained then presented into the form of tables and graphs to facilitate researchers in analyzing the results of research.

6.2. Results of experiments

After performing some experiments following the scenarios explained in the previous subsection, we obtained some useful data by doing some interviews with involved students (i.e., FDL, FTN, MTA, SM, and VPV). Basically, the question in the interview contains 5 important factors: (i) computer use, (ii) assessment of attitudes, knowledge, and skills, (iii) average Attention Span to the Media, (iv) media display design, (v) students' Ability in the Sign System of Indonesian Language, and (vi) students' emotional feelings while and after using the media. The explanations of these aspects are as follows:

- 1) Computer use: The data of computer use are presented in Table 3. Table 3 shows that three out of five students have and can operate laptops, two of them don't have one but can operate them, and one does not have one and cannot operate them.

Table 3. Computer use for learning.

No	Name	Question: Do you have your own computer at home and can you operate it as a learning media?
1	FDL	Yes, I have 2 laptops, and I can operate them
2	FTN	Yes, I have a laptop, and I can operate it
3	MTA	No, I don't and have never operated one.
4	SM	No, I don't but can operate one.
5	VPV	No, I don't but can operate one.

- 2) Assessment of attitudes, knowledge, and skills: The assessment data of attitudes, knowledge, and skills are presented in Tables 4, 5, and 6 respectively. The scores of attitude change are between 1 and 4. The score of 1 means the attitude change is not yet visible, whereas it has been entrenched if the score is 4. Table 4 shows that four out five students demonstrated good attitudes and one student is not really thoughtful and confident. Table 5 shows the assessment of students' knowledge after using the proposed media. It was obtained by calculating the gap between pre-test and post-test that are conducted by the students. It can be seen that two students managed to improve their score after using the media, and the scores of the other three were relatively stable from the beginning to the end. Moreover, after using the media students' skill can be measured from two components: ability to talk and its voice volume. Table 6 shows majority students obtained relatively good scores, except one student who can only be heard from the front of the class because the student in question was shy.

Table 4. Assessment of students' attitudes.

No	Name	Attitude Change											
		Thoughtful				Confident				Responsible			
		1	2	3	4	1	2	3	4	1	2	3	4
1	FDL			√				√					√
2	FTN			√				√					√
3	MTA	√				√							√
4	SM			√				√					√
5	VPV			√				√					√

Table 5. Assessment of students' knowledge.

No	Name	Pretest score	Posttest score
1	FDL	100	100
2	FTN	60	100
3	MTA	60	100
4	SM	80	100
5	VPV	100	100

Table 6. Assessment of students' skills.

No	Name	Score and criteria	
		Ability to talk	Voice volume
1	FDL	4	4
2	FTN	4	4
3	MTA	4	2
4	SM	3	3
5	VPV	4	4

- 3) Average Attention Span to the Media: When the students perform the proposed media, we also observe their activity, especially on duration of attention to the media as presented in Table 7. It can be seen at Table 7 that FDL, SM, and VPV participated in the lesson from the first to the last stage in the media, FTN was disrupted by the flu and had to go to the toilet a couple of times and was only focused for 32 minutes, and MTA was focused for 34 minutes since the student in question did not know how to operate a computer.

Table 7. Students' average attention span to the media.

No	Name	Average
1	FDL	35 mins
2	FTN	32 mins
		Note: disrupted by the flu and had to go to the toilet a couple of times.
3	MTA	34 mins
4	SM	35 mins
5	VPV	35 mins

- 4) Media display design: The interview data about students' perceptions of media are presented in Table 8. Table 8 presents students' perceptions about the media display design. They all expressed that the texts, animations, images, videos were very good, clear, and user-friendly. The students answered the questions in a brief manner.

Table 8. Students' perception of media display design.

No.	Name	Questions				
		Are the texts legible?	Are the colors any good?	Do you understand the animations?	Are the animations and images any good?	Are the videos visible?
1	FDL	Yes	Good	Yes	Good	Yes
2	FTN	Yes	Good	Yes	Good	Yes
3	MTA	Yes	Good	Yes	Good	Yes
4	SM	Yes	Good	Yes	Good	Yes
5	VPV	Yes	Good	Yes	Good	Yes

- 5) Students' Ability in the Sign System of Indonesian Language: According to the interview on students' ability in using the sign system of Indonesian language, it shows that all students needed a guidance in using and practicing the sign system of Indonesian language. When talking, they often forgot their previously learned signs so that sometimes the teacher had to remind them.
- 6) Students' emotional feelings while and after using the media: The interview data about students' feelings is presented in Table 8. Table 8 shows that all students felt happy to use the media. Moreover, their happiness could also be noticed during the lesson.

7. Discussion

From the results of field research, the implementation of the inquiry learning model is conducted in a guided manner and all the learning model stages at the time of the research are carried out completely. The teacher performed 3 additional roles, as follows:

7.1. Part I: Into situation and think

At the stage of creating situation and stimulate thinking, teachers have an additional role in improving students' self-confidence deaf, using learning methods that are easy to understand based on facts, and become friends. These include the characteristics of a child who is deaf because basically the child is more concerned with concrete or real objects, then they have greater fear. Thus, they should be given more guidance, encouragement, and motivation during the lesson. In all activities, children do feel greater confidence.

7.2. Part II: Inquiry by themselves

In the independent stages of inquiry the teacher has an additional role of providing guidance time, providing picture instruction, and improving cognitive abilities. The role is very useful because deaf children are difficult in processing, understanding, and remembering the information conveyed by the teacher. At the time of learning,

the teacher must provide guidance and instructions. Thus, when studying, the material is not the concept of mistakes received by students and students' cognitive abilities increased.

7.3. Part III: Cooperative and improve

In the collaborative exchange and summarize to improve sections teachers have an additional role to play in improving language skills, encouraging their own judgments to the right path, and enhancing information technology capabilities. This must be done because deaf children have low language skills, then from the results of the study also the ability of children using technology and its operations still lacking.

In addition, the use and implementation of learning media that has been developed is said to be suitable and provide a positive impact for learning for children with special needs deaf. It can be seen from several points, including:

1) Assessment of students

Students are given 20 minutes of problem-solving time, with the type of multiple choice questions as much as 10 questions and the problem is related to reading text comprehension. With simple text available, the student needs several reads to be able to understand the content of the text.

In general, the scores obtained from the five students in terms of attitude and skill are high, but there is a student who scores low due to lack of care when studying the material and when telling the story in front of the class the volume is so low that it is heard only in front of the class and the student looks not confident. However, in terms of knowledge of the test results, all students showed improved results and there is a stable because the quality of children in learning very well.

2) The average duration of focus

The core learning process is conducted for 70 minutes. In the first 35 minutes, students use the media from the stage create situation to stage independent inquiry. The stage creates a situation where students are asked to watch the apperception video related to the material that will be discussed. Thus, students are ready to learn. The stage of stimulate thinking of the students is given the subject matter that will be discussed. The independent inquiry phase students learn the material taught and analyze the material to seek answers from the subject problem. For the second 25 minutes, students perform the collaborative exchange stage which is done manually without media. At that stage, students discuss and share information about the material that they have learned before by telling stories in the classroom. Then, in the last 10 minutes, the summary to improve the students is given with problems as much as 5 questions. After answering, the answer will be corrected by the media, and the correction result is shown based on the subject matter question. This result matches with research conducted in other references [9, 18].

During the 35 minutes of process, the average duration of student focused using the media is very long. The students who do not focus on the time of learning to use the media were found. This is because of some conditions, such

as the condition of a child who was sick with the flu, the child back and forth to toilet, and a child who is less understood in using the computer. Student reactions during the use of the media look happy and focused. They follow the learning and practice of the sign language contained in the media.

3) Student's perception

Each student has the same perception of learning media. This can be seen from some of the student statements during the interview. This is revealed by the fact that the design of the display in terms of writing, video quality, color selection, readability, image quality and animation is very clear and easy to understand.

It is very helpful for students during the learning process due to the use of a strong student sense of deaf students, so that students deaf need visual or display with good media quality so that their vision process is not disturbed and the media can be used very well.

4) Emotional feelings

Emotional feelings of students are depicted at the time of the learning process takes place, students look very enthusiastic and the spirit of learning in following the learning. Likewise, after being reconfirmed after the learning process has been completed through the interview, all students say the same thing that they love to learn to use the media and are visible from the expression of the students at the time of the interview [26-28]. From the overall points that have been described above, in terms of media is good and suitable for learning children with special needs Deaf, and give a positive impact.

Moreover, after the comparison with the related works [27-29], there are differences and similarities between the present result and the literature. Media built by researchers have similarities in terms of media components and media types ie multimedia that combines all media such as text, video, audio, images, animations with additional interactivity and equally used in learning. It also considers the typeface, font size, transition speed, clarity (video, sound, image), and so on. The difference of the media that has been built are found, specifically in terms of the aided learning model and the content of the material discussed is assisted in the stages of inquiry learning model and material content is Bahasa Indonesia in reading comprehension ability.

8. Conclusion

The contributions of this study is that we have designed an instructional media that considers some characteristics of multimedia for deaf students and applies inquiry-based learning model. While these characteristics are obtained from various literature studies, the implementation of media was based on the waterfall method. After using the proposed media, three factors analyzed with the qualitative method are (i) assessment of attitudes, knowledge, and skills, (ii) the average duration of concentration, (iii) students' perception on media design, and (iv) emotional feelings of students. The developed instructional multimedia was proven to provide positive impacts. This was indicated by students' scores, average attention span, perceptions, and emotional feeling while and after using the instructional media.

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