



User Interface Design Analysis of Android-Based Sign Language Recognition Learning Media at Special Schools

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/ajess/2024/v50i71450>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/118384>

Original Research Article

Received: 05/04/2024

Accepted: 08/06/2024

Published: 10/06/2024

ABSTRACT

This research aims to conduct an in-depth analysis of the user interface (UI) design of Android-based sign language recognition learning media used in special schools. In the context of educational inclusion, sign language learning plays an important role in facilitating effective communication for individuals with hearing loss. The use of mobile technology, such as Android applications, has offered an attractive solution to enhance sign language learning by providing flexible and affordable access.

However, the UI design of sign language learning apps does not always adequately consider the special needs of users, especially students with hearing impairment. Therefore, this research aims to analyze the UI design of existing Android-based sign language learning apps, focusing on accessibility, intuitiveness, and effectiveness in delivering learning content.

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Cite as: Faisal, Yunus Tjandi, and Hendra Jaya. 2024. "User Interface Design Analysis of Android-Based Sign Language Recognition Learning Media at Special Schools". *Asian Journal of Education and Social Studies* 50 (7):125-35. <https://doi.org/10.9734/ajess/2024/v50i71450>.

This research uses the Research and Development (R&D) method with the Waterfall model approach. This research method involves analyzing various aspects of UI design, including layout, navigation, use of symbols, and interactivity. Data was collected through direct observation of student use of the application and interviews with educators in special schools. Data analysis was conducted using qualitative and quantitative approaches to identify strengths and weaknesses in the app's UI design.

The results showed that of the four instruments used in analyzing the UI design of this "AkuBisa" learning media application, using a Likert scale and a Guttman scale, the following results were obtained: needs analysis instrument with an average value of 3.45; media development storyboard instrument with an average value of 3.37; media display design instrument with an average value of 3.31; and Blackbox testing instrument with a percentage level of functionality reaching 100%. The results of testing and assessment of the four instruments show that the user interface design of android-based sign language recognition learning media is declared very valid in fulfilling the elements of accessibility, intuitiveness, and effectiveness as a learning media application and is very feasible to use as an alternative learning media for sign language recognition in special schools.

Keywords: User interface; learning media; sign language; android; hearing impaired students.

1. INTRODUCTION

Sign language learning is an important part of supporting inclusion and equal access to education for individuals with special needs, especially in special schools [1-4]. In the growing digital era, the use of technology-based learning media, such as mobile applications, has become increasingly common and effective in supporting the learning process. Previous research by Rofi'i [5], Gayatri [6] and Fatjriyatun [7] also emphasized the importance of technology-based learning media in improving student understanding. In this context, appropriate and effective *user interface* (UI) design is essential to improve *user experience* (UX) and learning effectiveness [8,9,10,11,12].

This research aims to analyze the *user interface* design of learning media for sign language recognition of SIBI (Indonesian Sign Language System) and BISINDO (Indonesian Sign Language) methods based on Android used in special schools. Research related to *user interface* design has also been conducted by Ridzky et al. [13] who designed a *user interface* model for SIBI sign language learning using the *User-Centered Design* method. Taking into account the special needs of users, including motor and sensory abilities, as well as user preferences in accessing and interacting with mobile applications, this research will investigate the factors that influence UX and learning effectiveness [14-18].

Through an in-depth analysis of existing app UI designs, this research aims to identify strengths and weaknesses in terms of accessibility,

intuitiveness, aesthetics, and effectiveness in supporting sign language learning. References from Parvez et al.'s [19] and Nathan et al.'s [20] research show the importance of the effectiveness and usability of a mobile app's *user interface*. The results of this study are expected to provide valuable insights for application developers and educators in designing and improving Android-based learning media to support sign language learning in special schools, so as to improve the quality and accessibility of education for individuals with special needs.

2. METHODS

This research uses the *Research and Development* (R&D) research type with the *Waterfall* development model. The goal is to develop an android-based sign language recognition learning media application in special schools, which focuses on in-depth analysis of the application's *user interface* design.

The research was conducted in three special schools, namely: SLB Negeri 1 Makassar, SLB Negeri 1 Somba Opu Gowa, and SLB Jenetallasa Gowa. The main subjects in this study were 25 people consisting of 20 material expert assessors who work as sign language teaching teachers as application users who will teach sign language introduction to their students at school, so they are competent in assessing the *usability* of these learning media applications, and 5 media expert assessors who work as lecturers and programmers with competence in the field of *mobile* programming and UI/UX. While the object of this research is the *user*

interface design of an android-based sign language recognition learning media application for special schools.

The research procedure adopts the *Waterfall* development model from Roger S. Pressman, which consists of 5 stages, namely: *requirement analysis*, *system design*, *implementation*, *integration and testing*, and *system deployment and maintenance*. *The user interface* design analysis of this learning media application uses qualitative data and quantitative data. Qualitative data was obtained through observations and interviews in three special schools as research locations. For quantitative data, it is collected using a research instrument in the form of a questionnaire distributed to deaf teachers and lecturers/programmers. The questionnaire sheet in this study used Likert scale and Guttman scale as the measurement scale. While data collection techniques are carried out through observation, interviews, distributing questionnaires / questionnaires and literature studies.

The data collection instruments used in analyzing the *user interface* design of this android-based learning media consist of observation sheets, interview sheets, and questionnaires. The instruments developed in this study consist of a series of structured instruments to measure various aspects of the *user interface* of android-based sign language recognition learning media. The instruments are divided into educational experts, media experts and material experts. There are four types of research instruments that represent the needs of *user interface* design analysis of this android-based learning media which include media needs analysis instruments, media design *storyboard* instruments, media display design instruments, and learning *media blackbox* testing instruments.

3. RESULTS AND DISCUSSION

3.1 Research Results

3.1.1 Learning media application development design

In the discussion of system design as an integral part of the implementation of the *Waterfall* model in the development of sign language learning applications, the main focus is to create a system that is not only effective in delivering learning materials but also easy to access and use by the target users, namely SLB teachers and deaf students. The system design is built on two main

pillars: a user-friendly user interface and a system architecture designed to maximize system efficiency and effectiveness.

The user interface design was designed to ensure high accessibility. It integrates universal design principles, ensuring that the app can be used by teachers and students of varying ability levels. This includes the selection of contrasting colors, easy-to-read fonts, and intuitive navigation. It also considered the use of icons and clear visuals to support the understanding of students who may have difficulty with text. Interactive features, such as replayable videos of sign language movements, are introduced to enrich the learning experience and ensure that students can learn at their own pace.

Through a combination of a well-designed user interface and efficient system architecture, this application aims to provide an innovative and accessible sign language learning platform for special school students, supporting them in developing vital communication skills in an engaging and interactive way.

This android-based sign language learning media application is named "AkuBisa", as an abbreviation of Application for Learning Sign Language. In addition, the name of the application "AkuBisa" means that users of this application can and are able to learn and recognize sign language, so that the purpose of this learning media application is expected to bridge communication between deaf people and other normal people.

The application interface is designed vertically with the selection of an application logo that represents the purpose of this learning media application. In addition, it considers the use of a contrasting green color, with *font* types and sizes that are clear enough, easy to read and proportionally displayed on a *smartphone* screen.

In compiling the main menu and sub menu, it emphasizes the purpose, main function and target users of the application, using short and clear menu names so that it only focuses on the four main menus, namely: SIBI menu, BISINDO menu, Quiz menu and About menu. The four main menus are arranged symmetrically so as to optimize the interface on the *smartphone* screen. *The SIBI* main menu and *BISINDO* main menu have the same three sub menus, namely the Alphabet, Number, and Word sub menus. The Alphabets and Numbers sub menu is arranged

horizontally with a very clear font size and numbers. Alphabets are arranged from A to Z alphabetically in capital letters, while numbers are arranged from 1 to 10 and added with several types of numbers representing tens, hundreds, thousands and millions. While the Word sub menu is made in the form of vertically arranged word groupings. The selection of word groupings is based on basic words that are commonly used daily and also added several other groupings such as: pronouns, adjectives, verbs, question words.

For sign language learning media with SIBI and BISINDO methods, using images and videos arranged vertically. Images and videos are stored in a *database* which will be displayed if the user presses the desired alphabet, number or word button.

For the Quiz main menu, the sub menu is also arranged vertically consisting of Quiz guess the picture, Quiz guess the video, and Quiz History. Quiz questions are made simpler and easier to understand, equipped with images or videos related to the question. While the quiz answers are made in the form of multiple choices with four concise and vertically arranged answer options, and can be answered by simply pressing one of the four multiple choice answers. If the selected answer is correct, the answer option will change to green color, while if the selected answer is wrong, the answer will change to red color. Furthermore, the answers that have been selected are converted in the form of points until all quiz questions have been answered. All quiz answers are stored in the database and can be traced back through the Quiz History *sub menu*.

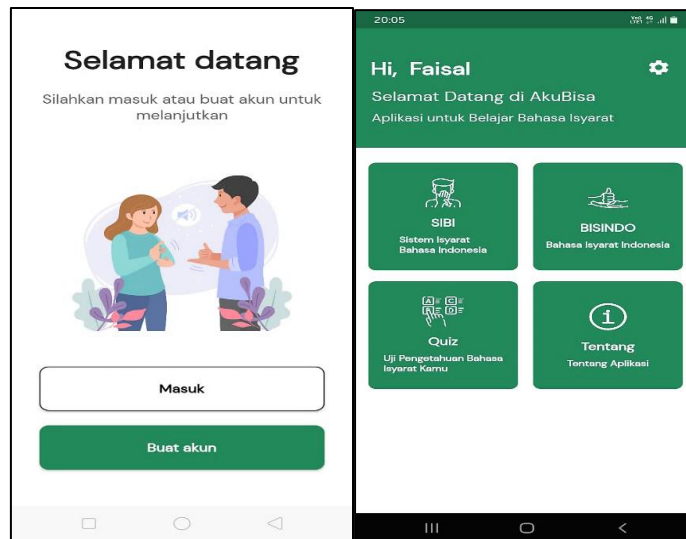


Fig. 1. Application Login/Create account Interface and Main Menu Interface

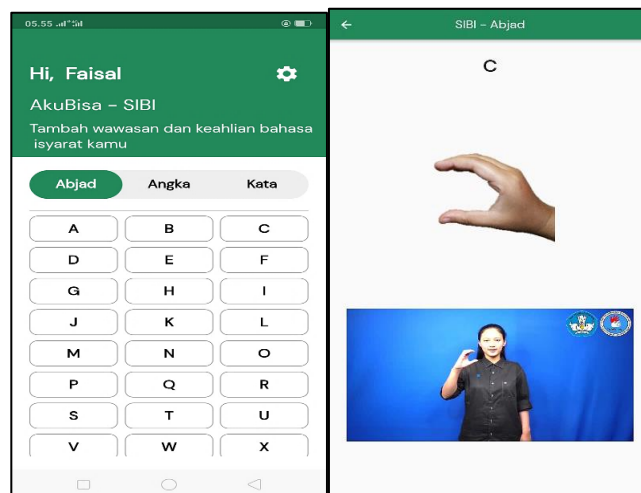


Fig. 2. Alphabet sub menu interface with images and video media

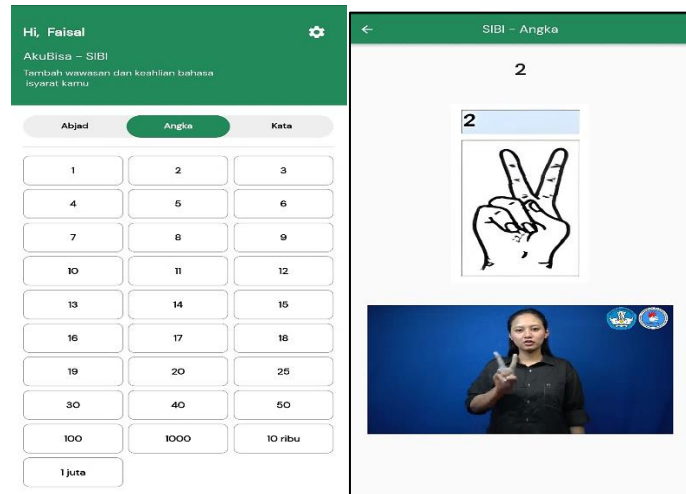


Fig. 3. Numbers sub menu interface with images and video media

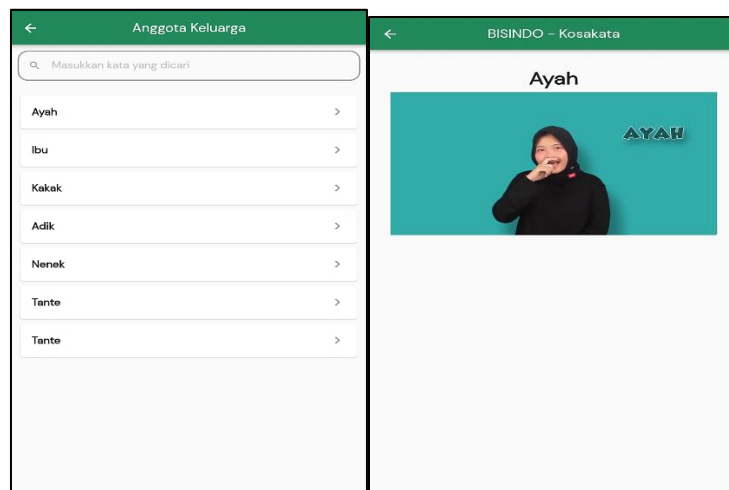


Fig. 4. Word sub menu interface with image and video media

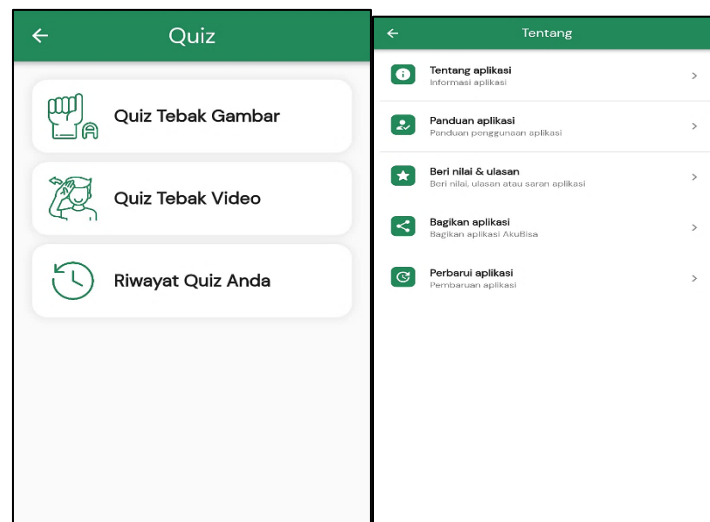


Fig. 5. Quiz menu interface and about menu

Table 1. Mean validity of the needs analysis instrument

No.	Criteria Data Component	Average
1	Characteristics of hearing-impaired students that require special handling	3,45
2	Teachers teach sign language recognition with gestures, mimics, body language supported by learning media using pictures, objects or props.	3,55
3	There is still a lack of learning media that utilizes information technology	3,35
4	Learning media used in the classroom are still in the form of pictures, objects and props.	3,45
5	Technological developments that utilize the android operating system	3,50
6	The use of android smartphones that are familiar among teachers and students with hearing impairments	3,40
Average number		3,45

(Source: Results of research data processing, 2024)

Table 2. Recapitulation of the average test of the Storyboard instrument

No.	Criteria Data Component	Average
1	Background of the Problem	3,19
2	Problem Identification	3,42
3	Problem Solving	3,48
4	Output	3,37
Overall average score		3,37

(Source: Results of research data processing, 2024)

Table 3. Average validity of the Display Design instrument Learning Media Interface criteria

	Criteria Data Component	Average
A	Interface	
1	Attractive, unique and memorable app name	3,55
2	The name of the application contains meaning and meaning that corresponds to the purpose of the android-based sign language recognition learning media.	3,45
3	Application icons contain meanings and meanings that correspond to the purpose of android-based sign language recognition learning media.	3,25
4	The interface is vertical	4,00
Average number		3,56

(Source: Results of research data processing, 2024)

Table 4. Average Validity of Display Design Instrument Learning Media Menu Presentation Criteria

	Criteria Data Component	Average
B	Menu Presentation	
1	Presentation of menus and sub menus are organized systematically	3,40
2	Corresponding font color and app background color	3,20
3	Naming menus and sub menus that are clear and in accordance with the function of the application	3,35
4	Simplified placement of the main menu and sub menus	3,55
Average number		3,31

(Source: Results of research data processing, 2024)

The About main menu consists of several sub menus, namely: About Application, Rate & Review, Application Guide, and Update Application. In this menu, users can later see the latest version of the application created, users can also provide ratings and reviews in the form of application

development suggestions. In addition, users on the about menu also include application guides that can be studied by users. The following shows some *user interface* designs from the development of android-based sign language recognition learning media applications.

3.2 User Interface Design Instrument Validation Analysis

To support the analysis of the user interface design of this android-based sign language recognition learning media, four instruments are used that are considered to represent the validity assessment of the application user interface design that has been made. There are three instruments that are assessed using a Likert scale, namely the media needs analysis instrument, the media development storyboard instrument, and the media display design instrument. While one instrument is assessed using a Guttman scale, namely the learning media Blackbox testing instrument. The results of the validation of the four instruments in question are explained as follows.

a. Validation of Learning Media Needs Analysis instrument

The validation of the learning media needs analysis instrument aims to obtain the validity level of the components of the observation and interview results at the research location, so that it becomes the foundation of the needs in developing the user interface design analysis of this android-based sign language recognition learning media. The following are the results of the validation of the media needs analysis instrument presented in the form of the following table.

From the results of the average validity of the learning media development needs analysis instrument in Table 1, the overall average value is 3.45 and based on the Likert scale used is in the very valid category.

b. Validation of Learning Media Development Storyboard instrument

The validation of the learning media development Storyboard instrument aims to obtain the validity level of the background process and problem identification, the reason for the purpose of developing learning media, to the expected output of this android-based sign language recognition learning media development.

From the results of the validation of the learning media development storyboard instrument, the overall average value = 3.37. By using the Likert scale, it can be concluded that the results of the validation of the learning media development storyboard instrument are in the very valid category.

c. Media Display Design instrument validation

As the most important instrument in analyzing the user interface design of this android-based sign language introduction learning media, the media display design instrument outlines a more detailed aspect criteria assessment compared to other supporting instruments. This instrument consists of 4 criteria, namely: interface, menu presentation, lesson material and language, with 14 items of the number of criteria / sub-aspect components. Validation of this media display design instrument aims to obtain the validity level of the display design of the sign language recognition learning media application, where it is expected that the design made is more attractive, communicative and provides comfort for users as application users. The following are the results of the validation of the learning media display design instrument based on the criteria of the aspects observed.

For the average validity of the learning media display design instrument with the criteria "Interface" is presented in the form of the following Table 2.

From the results of the average validity of the learning media display design instrument "Interface" criteria in Table 3, the overall average value is 3.56.

For the average validity of the learning media display design instrument with the criteria "Menu Presentation" is presented in the form of the following table.

From the results of the average validity of the learning media display design instrument criteria "menu presentation" in Table 4, the overall average value is 3.31.

For the average validity of the learning media display design instrument with the criteria "Learning Material" is presented in the form of the following Table 4.

From the results of the average validity of the learning media display design instrument "learning material" criteria in Table 5, the overall average value is 3.35.

For the average validity of the learning media display design instrument with the criteria "Language" is presented in the form of the following Table 6.

Table 5. Average validity of the display design instrument learning media criteria learning materials

Criteria Data Component	Average
C Learning Materials	
1 Developing sign language recognition learning media that uses <i>smartphones</i> so that it can be used independently anywhere.	3,55
2 Designing a sign language recognition system with the SIBI and BISINDO systems commonly used in Indonesia.	3,25
3 Incorporate creative, easy-to-understand, and fun learning materials	3,25
4 Add an Evaluation menu that can be used to evaluate student learning outcomes	3,35
Average	3,35

(Source: Results of research data processing, 2024)

Table 6. Average Validity of Display Design Instrument Learning Media Language Criteria

Criteria Data Component	Average
D Language	
1 The language used is ethical, aesthetic and communicative (easy to understand)	3,45
2 Use spelling, punctuation, vocabulary, sentences and paragraphs that are in accordance with Indonesian language rules	3,35
Average	3,40

(Source: Results of research data processing, 2024)

Table 7. Recapitulation of design instrument testing averages learning media display

No.	Criteria Data Component	Average
1	Interface	3,56
2	Menu Presentation	3,31
3	Learning Materials	3,35
4	Language	3,40
Overall average score		3,41

(Source: Results of research data processing, 2024)

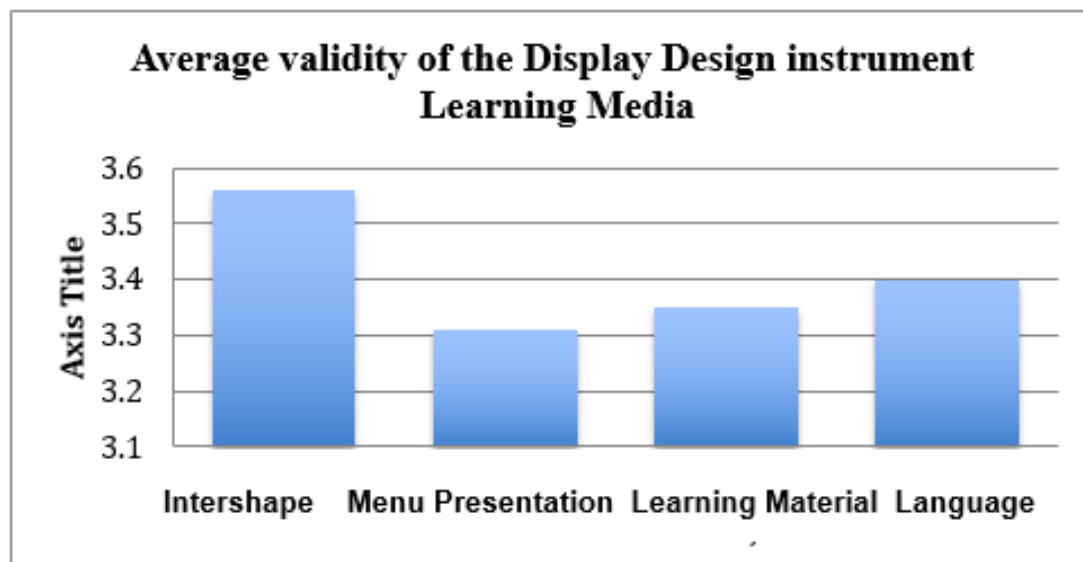


Fig. 6. Graph of instrument validity test results Learning media display design

Table 8. Recapitulation of the average results of *Blackbox* testing of learning media

No.	Test Scenario Criteria	Total Testing Results	
		Number of items Suitable	Number of items not suitable
1	Testing the interface and main menu	25	0
2	Testing the main menu of the SIBI method	35	0
3	BISINDO method main menu test	35	0
4	Testing the Quiz main menu	40	0
5	Testing the main menu About	25	0
Total		160	0

(Source: Results of research data processing, 2024)

From the results of the average validity of the learning media display design instrument "language" criteria in Table 6, the overall average value is 3.40.

From the results of testing the learning media display design instrument from each aspect of the data component criteria that have been described in Tables 3 to 6, it can be recapitulated the average overall validation results from all aspects of the data component criteria presented in the following tables and graphs.

From the results of the validation of the learning media display design instrument, the overall average value = 3.41. Based on the Likert scale used, it can be concluded that the results of the validation of the learning media display design are in the Very Valid category.

d. Learning Media Blackbox Testing instrument validation

Validation of learning media blackbox testing instrument aims to obtain the validity level of the functionality of the user interface design that has been made and the results of software testing in terms of functional specifications without testing the design and program code. This test is assessed by 5 IT media experts using a Guttman scale which aims to determine whether the user interface design, functions, inputs and outputs in this learning media application are in accordance with the required specifications. Testing

There are 5 criteria for blackbox testing of learning media that are tested using a Guttman scale with a "yes" answer for appropriate test criteria and a "no" answer for inappropriate test criteria. This blackbox testing includes: testing the interface and main menu with 5 test scenario items, testing the SIBI main menu with 7 test scenario items, testing the BISINDO main menu

with 7 test scenario items, testing the Quiz main menu with 8 test scenario items and testing the About main menu with 5 test scenario items. The following Table 8 presents a recapitulation of the results of blackbox testing by the five IT media experts.

From the results of the validation of the learning media blackbox testing instrument presented in Table 8, the total number of test results is 160 answer items that match the test results from a total of 160 answer items from 5 test scenario criteria with 32 test scenario aspects. While there are no (or zero) answer items that do not match the test results. With a percentage value of 100%, it can be concluded that the results of the validation of the learning media blackbox testing instrument are in the Very Valid category.

4. DISCUSSION

The development of this sign language recognition learning media application is focused on analyzing the user interface design of the android-based learning media. There are four instruments used in analyzing the feasibility of the application user interface that has been made, and has been tested and assessed by material experts and media experts. The results of the instrument assessment showed that the learning media needs analysis instrument obtained an average score of 3.45; the media development storyboard instrument with an average score of 3.37; the media display design instrument with an average score of 3.31; and the Blackbox testing instrument with a functionality percentage level reaching 100%. The results of testing and assessment of the four instruments show that the user interface design of android-based sign language recognition learning media "AkuBisa" is declared very valid in fulfilling the elements of accessibility, intuitiveness, and effectiveness as a learning media application and is very feasible to use as

an alternative learning media for sign language recognition in special schools.

5. CONCLUSIONS

The system design of android-based sign language recognition learning media is built on two main pillars: a user-friendly user interface and a system architecture that supports the effectiveness and efficiency of the system built. First, the user interface is designed to ensure high accessibility. Researchers integrated universal design principles, ensuring that the application can be used by teachers and students with different levels of ability. Second, the system architecture was designed to maximize the efficiency and effectiveness of the system in use.

Analysis of the user interface design of android-based sign language recognition learning media "AkuBisa" has fulfilled the elements of accessibility, intuitiveness, and effectiveness as an application of sign language recognition learning media for students with hearing impairments, where the results of testing the four supporting instruments of user interface design are in the category of very valid and very feasible to use as an alternative learning media for sign language recognition in special schools.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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ISSN: 1816-949X

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