

Baluk olas (Eighteen) Sasak Scripts in the Digital Era Based on the Mobile Games

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Abstract—Sasak *baluk olas* scripts are the cultural heritage of the ancient Sasak people used to write in manufacturing books, ancient manuscripts, Sasak songs, inscriptions, or correspondence, which are very important to preserve. Therefore, this research developed a model and software for recognizing Sasak alphabets. This research is a model and software built using feature extraction zoning. In comparison, the algorithm used is the Self Organizing Maps (SOM) algorithm. Test results and level of accuracy ANN SOM in recognizing the Sasak alphabets are quite satisfying. *Baluk Olas* Sasak alphabets have become one of the compulsory subjects for students from elementary to junior high school. Complaints of students accommodated in the parents' questionnaire showed that as many as 52.86% stated that learning the Sasak language, especially the Sasak alphabet, was felt students to be difficult. These problems can be overcome with technology they can be overcome with a new learning method in Information Technology, one of which is by utilizing Game-Based Smartphone technology. *Baluk Olas* Script Learning is implemented into an Android-based educational game using the Multimedia Development Live Cycle (MDLC) method and designed as attractive as possible, aiming for students' interest in learning the *Baluk olas* alphabet more increase. The results of community surveys, especially among children, "*Baluk Olas* Alphabet" Game got a good response as a media aid in learning the *Baluk Olas* script, with a percentage of 76,67% interested in the aspect of user-friendly.

Keywords— *Scripts, Sasak, Baluk Olas, Game, Education.*

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I. INTRODUCTION

Sasak script is the writing used by the Sasak natives to write *lontar* and *geguritan*. The Sasak script is derived from the Ancient Brahmi script of India [1]. The Sasak script has many similarities with modern scripts in South and Southeast Asia, which come from the same script family [2]. The Sasak script in the 11th century got much influence from the ancient Kawi or Sasak language[3]. This modified version of the Sasak script is also used to write the Sasak language used on the island of Lombok [4].

The Sasak language borrowed some words from Sanskrit, which later influenced the Sasak scripts. Traditional Sasak writings are written on palm leaves (a type of palm), stacked, tied, and called *lontar* [5]. Sasak scripts have now become one of the compulsory subjects for students ranging from elementary to junior high. The research results stated that based on the data collected in the questionnaire for students, as many as 52.86% stated that learning the Sasak language, especially the Sasak scripts, was difficult for basic education

students, namely elementary and junior high schools. On the one hand, school students were familiar with the use of information technology (IT), especially mobile phones, which are developing rapidly and can be used in almost all fields[5].

Information technology is developing rapidly and has an important role in human life. Technology was created to help and facilitate humans in this life [6]. Information technology, one of which is the most rapid technology, is the mobile phone which used to be only a tool for calling and SMS (short message service). However, over time, the mobile phone became a tool for calculating, typing, storing data, processing data, system intelligence, expert systems, image processing (image processing), games, and robotics [7].

Mobile phone technology is expected to do everything that humans do, and mobile phones can act like humans. Several methods are needed to make the mobile phone a smart machine[8]. Along with the development of an increasingly modern era, in the last few years, there has been a rise in mobile devices or mobile devices [9].

The fastest mobile device is a cellphone which everyone has it. Originally a communication tool, mobile is now more than its basic function. Various features have been embedded, such as image and video processing and document processing [10].

The operating system on mobile phones and, lately, Android has become an operating system often used by mobile users[11]. Like on a computer, a cellphone can also be installed with various desired applications[12]. Mobile device-based technology in its development is one of the attractive options because its use is relatively more practical and easy to operate [13]. Mobile devices or mobile devices are technologies that experience continuous development and seem never to die.

The existing Sasak *Baluk olas* scripts learning applications are mostly desktop or computer-based. If using a computer, the user must require more space and time so that the learning process is still considered less effective and efficient [5]. Therefore, a new media other than a computer is needed, namely an Android-based learning application that can be operated using a smartphone. This research offers to produce a mobile game-based Sasak Baluk Olas (eighteen) script learning application in the current digital era.

Taking into account the problem of preserving the Sasak *Baluk olas* scripts, which can be related to the current advances in mobile technology, it can be formulated a problem that will be discussed is "How to make an application to preserve the Sasak *Baluk olas* (eighteen) scripts using the game-based Android operating system. This application was built using the MDLC (Multimedia Development Life Cycle) method, to increase the interest of elementary and junior high school students in learning the *Sasak Baluk Olas* alphabets and understanding the *Sasak Baluk Olas* script.

II. MATERIAL AND METHOD

A. Text Font of Entire Document

Sasak Baluq Olas or Eighteen Scripts is called the *Baluk olas* scripts because the number of scripts is 18 words of pronunciation. The pronunciation of each script consists of a consonant and a vowel ending "a"[4]. Composing words with Sasak scripts is enough by juxtaposing two or more scripts according to the words needed. In its use, Sasak script has no space between words [1]. The following Sasak script [4], [14] is shown in Fig. 1.

ဟ	၁	၃	၄	၅
Ha	Na	Ca	Ra	Ka
၇	၈	၉	၁၀	၁၁
Da	Ta	Sa	Wa	La
၁၂	၁၃	၁၄	၁၅	၁၆
Ma	Ga	Ba	nga	Pa
၁၇	၁၈	၁၉	၂၀	၂၁
Ja	Ya	Nya	Tha	Dha

Fig. 1 *Baluk olas* (eighteen) Sasak Scripts

1) *Gantungan*

Gantungan can be said to be another form of *baluk olas* scripts. The writing of the *gantungan* cannot stand alone, the *gantungan* must be attached to the *baluk olas* scripts [4]. The *Gantungan* is shown in Fig. 2 below.

ဟ	၁	မဟ၃၅၆၇၈၉
၁	၃	၁၃၅၆၇၈၉
၃	၅	၃၅၆၇၈၉
၄	၆	၄၆၇၈၉
၅	၇	၅၇၈၉
၆	၈	၆၈၉
၇	၉	၇၉
၈	၁၀	၈၁၀
၉	၁၁	၉၁၁

Fig. 2 *Gantungan* Sasak Scripts

Gantungan replaces the vowel in the script where it hangs with the sound of the *gantungan* in question, as in the example below.

ဟ	၁	ဟ၃၅၆၇၈၉
၁	၃	၁၃၅၆၇၈၉
၃	၅	၃၅၆၇၈၉
၄	၆	၄၆၇၈၉
၅	၇	၅၇၈၉
၆	၈	၆၈၉
၇	၉	၇၉
၈	၁၀	၈၁၀
၉	၁၁	၉၁၁

Fig. 3 Examples of *Gantungan*

2) *Sandangan Paten*

Sandangan Paten is divided into two types, namely vowel *sandangan* and consonant *sandangan*. Vowels are additional punctuation marks used to replace the vowels of a script. Meanwhile, consonants are used to add a certain letter at the end of the letter.

Examples of *Sandangan patents* are as follows:

Bunyi	Simbol	Nama	Contoh
i		Wulu	
u		Suku	
é		Taleng	
e		Pepet	
o		Taleng tarung	

Fig. 4 Example of Sandangan Paten

Actually, one more is not included in the *sandangan* category, but try juxtaposing it with *Sandangan paten*. This mark is used at the end of every sentence. Paten is used to remove vowels from the last script in a sentence. The use of voice pads can change the sound as follows:

Jejawan	Bacaan	Arti
	Nawuri	Berkata
	Abinawa	Baru
	Binihaji	Isteriraja
	Wiku	Awas, Cerdas
	Kuninga	Seketika, Sesaat
	Lokika	Duniawi
	Lesu	Lelah
	Lepaka	Bernoda
	Pacira	Balai Tertutup
	Sutapa	Petapa

Fig. 5 Example used of sandangan

3) Vowel Scripts

This vowel is usually used at the beginning of writing to indicate self-identity, place names, etc.

[a]	[ā]	[i]	[u]	[e-é/ə]	[ai]	[o-ō]	[au]

Fig. 6 Vowel Scripts

4) Number Scripts

Numbers in the Sasak scripts also have their own symbols, the use of which can be seen in the example below:

Fig. 7 Number Scripts

5) Additional Scripts

These additional scripts are used to accommodate loan words from Arabic [5]. It is written by affixing three dots above the scripts with close pronunciation.

ae	ai	au	é	è	ia	kh	ng	ny
[æ]	[ai]	[au]	[e]	[é]	[ia]	[x]	[ŋ]	[ɲ]
ó	ò	oe	sy	ts	ue			
[o]	[ɔ]	[oe]	[sj-ʃ-ç]	[s]	[ua]			

Fig. 8 Additional Scripts

B. Android

Android is a Linux-based mobile device information system that includes an operating system, middleware, and applications [13]. Various other meanings of Android, namely[15]:

- It is an open platform (Open Source) for developers (Programmers) to create applications.
- It is an operating system purchased by Google Inc. from Android Inc.
- Not a programming language but only provides a live environment or run time environment called DVM (Dalvik Virtual Machine), which has been optimized for devices/tools with small memory systems.

Android applications are written in the Java programming language, which is java code compiled with the data and resource files required by the application combined by adapt tools into an Android package, a file marked with the suffix: *.apk[16].

C. Unified Modelling Language

UML is a standard language in visual modeling that works in object orientation to determine, visualize, construct, and document information elements contained in software systems [9]. UML allows developers to do visual modeling, i.e., the emphasis is on depiction, not narrative-dominated. Visual modeling helps capture objects' structure and behavior, making it easier to describe the interactions between elements in the system[17].

D. Game-Based Learning

Game-Based Learning is a learning method that uses game/game applications specifically designed to assist in learning [18], [19]. The pattern used in this media is the learning process through learning by doing [20]. Game-Based Learning can stimulate three important parts of Learning: Emotional, Intellectual, and Psychomotor [21]. Game-Based Learning is one of the learning methods that is considered suitable for the conditions of the current digital generation or millennial generation for the following three reasons[22]:

- Creating a fun learning environment and making students more motivated to learn.
- Competition and teamwork in completing missions in-game applications can also add a motivational component to students.
- Quick and specific feedback makes it easy for students to think of other appropriate ways to complete their assignments.

E. Pattern Recognition

Pattern Recognition can be interpreted as classifying objects or patterns into several categories or classes and aiming for decision-making [23]. Patterns are shapes or models that can be used to make or produce something. Basic pattern detection is called pattern recognition[24]. Pattern recognition is used to recognize complex objects from a property of the object that will be recognized by the characteristics of the object[25]. Pattern recognition can be formally described as a process of receiving patterns or signals based on measurement results which are then classified into one or more certain categories [26]. The classification method used in the pattern recognition system has two types of approaches, namely[15]:

1) Statistical Approach

This approach uses probability theory and statistics. Statistical recognition is based on the statistical characteristics of existing patterns, assuming that a probability system generates these patterns. The characteristics possessed by a pattern are determined by its statistical distribution [27]. Different patterns have different distributions. There are two phases in pattern recognition, namely, the training phase and the recognition phase. Several sample images are studied in the training phase to determine the characteristics used in the recognition process and classification procedures. Finally, the characteristics are taken in the image recognition phase, and then the group class is determined[28].

2) Structural Approach

Structural recognition is based on the structural relationships of the features of each pattern. This approach uses formal language theory. Primitives determine the characteristics contained in a pattern, and the structural relationships between primitives are then arranged in grammar [29]. From these grammatical production rules, groups of patterns can be determined. The approach used in forming grammar to recognize patterns is to follow the object's contours with a number of line segments that will be connected [30]. Then proceed with coding each line. Each line segment represents an object forming [7]. The structure of a pattern recognition system consists of a sensor (e.g., camera), an algorithm or feature finding mechanism, and an algorithm for classification or recognition, depending on the approach taken[16].

- Sensor. The sensor functions as a captured object from the real world and is then converted into a digital signal (consisting of a collection of numbers) through digitization.
- Pre-Processing. Pre-processing serves to prepare the image or signal to produce better features at the next stage. In this stage, the information signal is highlighted, and the disturbing signal is minimized.

- Search and Selection Features. The search and selection feature's function is to find distinguishing characteristics that represent the main properties of the signal and, at the same time, reduce the signal dimensions to a smaller but representative set of numbers.
- Classification Algorithm. This algorithm serves to group features into proper classes.
- Description Algorithm. This algorithm serves to describe the signal.

F. Research Stage

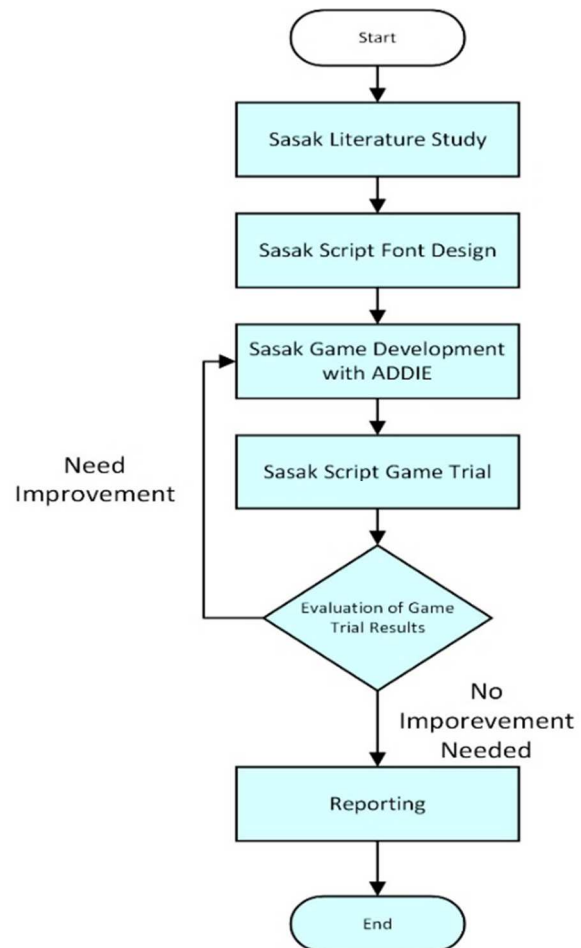


Fig. 9 Research Stage

The stages in this study, according to Figure 9, are as follows:

1) Sasak Literature Study

Studying literature on the *Sasak* script is a must; at this stage we collect and study ancient texts in the *Sasak* language.

2) *Sasak Script Font Design*. After studying the literature of the *Sasak* language, the researchers designed the font according to the *Sasak Baluk Olas* script (eighteen) so that students could easily recognize the font in the *Sasak Baluk Olas* script.

3) *Sasak Game Development Using MDLC*. The next stage is to develop the *Sasak Baluk Olas* script game using the MDLC method, which consists of six stages: concept, design, material collecting, assembly, testing, and distribution.

4) *Sasak Script Game Trial and evaluation.* Trial and evaluation are carried out to determine how far the application can be used, whether it is under user needs, and whether the application requires improvement; if it requires improvement, it will return to the development stage.

5) *Reporting.* The last stage is compiling a report on the research results.

G. Research Type

This type of research with the title "Baluk olas (Eighteen) Sasak Scripts in the Digital Era Based on the Mobile Games" is included in the type of experimental research [31]. This study makes an application that functions as a medium to recognize the Sasak *Baluk olas* scripts by providing information about the Sasak scripts [32].

The steps applied in this study used a linear sequential design method. The stages of this method are as follows[33]:

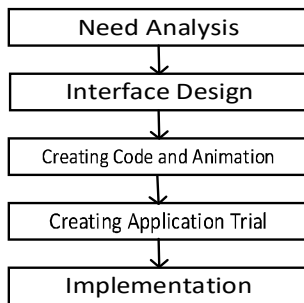


Fig. 9 Linear Sequential Design Method

1) *Stage of Needs Analysis:* Collecting data or information needed and related to research. The data or information needed is in the form of information on user needs and problems in recognizing Sasak scripts.

2) *Stage of Interface Design:* Designing applications based on user needs and solving problems in recognizing the Sasak-*Baluk olas* scripts with the results of the user interface so that the application will have an interactive display and be easy to use or implement.

3) *Stage of Creating Codes and Animation:* Creating codes and animations application in terms of providing information and teaching users about the scripts of the Sasak *Baluk olas* scripts based on user needs analysis and application design with the results of the Sasak scripts recognition media application

4) *Stage of Creating Application Trial.* Testing the results generated from the design and manufacture of applications to determine whether they have met the needs of users in using the application as a medium for learning the Sasak *Baluk olas* scripts. If it still doesn't meet user needs, then go back to the design phase and continue with the application creation phase.

5) *Stage of Implementation.* Conducting trials of applications made and implementing applications made as a medium for recognizing the Sasak *Baluk olas* scripts based on mobile games.

H. Method of Data Collection

The data collection methods used in this research are[23]:

1) *Interview Method:* Conducted at the beginning of the research and implementation by asking questions to users of the Sasak *Baluk olas* scripts to elementary and junior high school students in the city of Mataram to find out whether this research has achieved the results and has met the goals desired by the users[23].

2) *Literature Study Method:* Collecting data and information by reading and studying theories related to making Learning media applications as well as data and information about learning the Sasak *Baluk olas* scripts. This method is used in finding various reference sources that can help research both at the time of design, analysis, coding, or application creation, the material for the Sasak *Baluk olas* scripts to implementation. This reference source can come from both print media and electronic media [34].

3) *Questionnaire Method:* Collect data by providing a list of questions that have been made to obtain information and opinions from the community. This questionnaire will be conducted at the beginning of the study to know the need to create a mobile game-based Sasak *Baluk olas* script.

III. RESULT AND DISCUSSION

A. Multimedia Development Life Cycle (MDLC)

Multimedia Development Life Cycle (MDLC) was carried out in six stages: concept, design, material collecting, assembly, testing, and distribution[35].

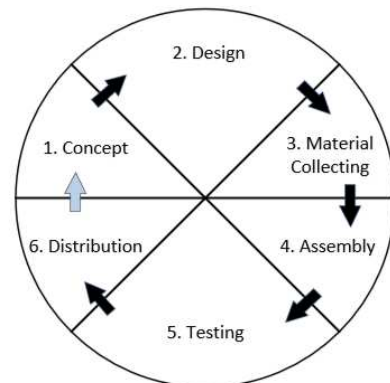


Fig. 10 Stage of Multimedia Development Life Cycle

1) Concept

This stage is done to determine the purpose and who are the application users (audience identification). At this stage, the application system requirements are also determined, such as the concept of the application and the developed gameplay[24]. The purpose of this application is to design an interesting, interactive, and educative Sasak scripts introduction game, later this game will be made with attractive images so that elementary and junior high school students are interested in the games that are made and cheerful background music to make it more comfortable to play [35].

This game is made in 15 levels that have different levels of difficulty and increase with each level. This is made because the game's main concept is something that can be played with certain rules so that there are winners and losers with the aim of refreshing [31]. The description of the developed game concept can be seen in table 1.

TABLE I
GAME DESCRIPTION

Information	Description
Title	Game-based <i>baluk olas</i> scripts
Audience	Elementary and junior high school students and children of primary education age
Genre	Unlimited
Graphic	3D
Audio	Vocals and back sound music
Animation	3D animation
Interactive	Choose the menu according to the ability to play the game

2) Design

Multimedia design is the stage where specifications are made, which contain several aspects, including application architecture, style, appearance, and material/material requirements for the application to be made [36]. This research, to make it easier to make the Sasak script game, was designed with a navigation structure [37].

The navigation structure is the relationship between scenes so that the flow or activity of an application is formed. The design of this game is made in the form of a navigation structure [13]. The navigation structure describes the relationship between menus in a hierarchical form. The navigation structure of the Sasak script game can be seen in the image below.

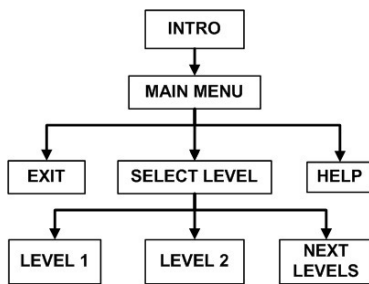


Fig. 11 Display Design Concept

3) *Material Collecting*: The developer stage collects materials according to needs [6]. Planning materials to be made and collected are 2D objects, audio, background, and other supports. The 2D objects that will be collected are images of item names, bird names, trees, boxes, and others. The audio that will be used is cheerful music and also sound effects, so that later the game will be interesting and not boring.

4) Assembly

The assembly stage is where objects or multimedia materials are made in the application to be developed. This stage is also called the assembly stage, where objects and multimedia materials are made into an application [17]. Making Sasak script game applications based on navigation structures or object diagrams from the design stage. All objects or elements that have been collected at the material collecting stage are combined into a single application and integrated using the Construct 2 software.

The first process is to create a background or application background image and other images, such as logos and icons using Adobe Photoshop CS6. While the vector-shaped image is separated from the original background image with the

move tool in Adobe Photoshop CS6, then transferred to the prepared background image.

The second process of making navigation buttons is making navigation buttons using the Iconian application by selecting symbols that suit the needs. After the background image and the required navigation buttons are complete, the next step is to create an animation.

The third process is to make animation material made in picture frames with different motion variations. Making animation based on the number of image frames added, the more frames and motion variations in the image, the better the animation. The animation is made in the Construct 2 application, which is illustrated in figure 12.



Fig. 12 Process of making Sasak scripts

The next stage of constructing a game on Construct 2 is entering the event sheet command. The event sheet serves to give commands or navigation between displays and buttons found in educational game applications, as shown in Figure 13 below.



Fig. 13 Front page display

5) Testing

Testing aims to ensure that the application developed is free from errors [21]. In this study, the Sasak script game will be tested on teachers and parents as well as elementary and junior high school students by asking questions about the games that have been built and related information in the application. The teacher fills in the test results after seeing students and their children playing the game[38].

6) Distribution

The last step in MDLC is distribution. Distribution is carried out for the distribution and delivery of products to users from applications that have been completed and have gone through testing. Distribution of the *Sasak Baluk olas* script game[39].

B. Experimental Results

The design of Sasak Script Recognition Application with the Mobile-Based Game-Based Learning Method is designed in the form of an Android-based application. This section will show some views of the Sasak script recognition application using the Android game-based learning method.

1) *Application Initial Display*: The initial interface of this application displays the title or theme of this application where to continue to the menu display, the user touches the screen.

2) *Main Menu Display*: The main menu display of the Sasak scripts recognition application displays four options: script material or discussion material, which contains basic material about the Sasak scripts, writing techniques, and additional material. In addition to script material, there is also a choice of a glossary or word list. Another menu is wise sentences, where there are wise sentences or proverbs. There is also a writing menu where users can learn how to write Sasak characters. The last option is the choice of Literacy Examination or self-evaluation.



Fig. 14 Main Menu Display

3) *Scripts Material Menu Display*: The display of the character material menu begins with an introduction. In this introduction it is explained that there are 18 alphabets of the Sasak *Baluk olas* where if the user wants it easier to remember the 18 alphabets, there is a way to help users make it easier, namely the initial alphabet that represents the entire Sasak alphabet, the other is the alphabet 'ha, na, ca, ra, ka, to ja, ya, nya'.



Fig. 15 Scripts Material Menu Display

4) *Sasak Baluk Olas Menu Display*: Displays words starting with the alphabet ha until there is a panel tab to move from one alphabet to another. There is also audio for each word.



Fig. 16 Sasak Scripts Menu Display

5) *Game Level Menu Display*: The display of the game level menu where the user wants to play according to the complete level by selecting each level.

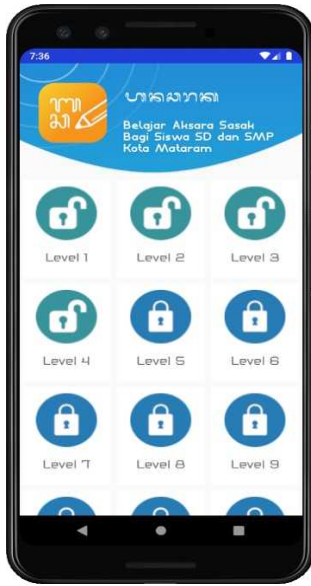


Fig. 17 Game-level selection menu

6) *Alphabet Guess Menu display*: The display of the practice of guessing Sasak characters where the user has followed all the patterns provided by the application, and a notification will appear that the user has succeeded in guessing the characters of the Sasak *Baluk Olas*.



Fig. 18 Alphabet guess menu display

7) *Picture Guess Display*

Picture guess level: the user can choose an unlocked game level. Picture guess game will appear, and the application will validate the answer choices of characters the user enters. The answer will appear in one of these four options, namely:

- Wrong answer
- Correct answer
- Unlock levels for the next guessing game.
- The help button provides help to answer questions.



Fig. 19 Picture Guess Menu Display

C. *System Evaluation*.

This questionnaire was distributed to 50 people from various groups, such as elementary and junior high school students. When testing the Sasak *Baluk Olas* scripts recognition application, the questionnaire was again distributed to 30, to find out whether the user's needs have been met with the character recognition application Sasak *Baluk olas*.

Survey research methods carry out system analysis of this game, application of variables, data collection, data presentation, and analysis to manage data. The results of this questionnaire analysis will get the percentage value (less, sufficient, good, and very good) for the highest and lowest criteria for each aspect. The survey involved 30 respondents aged 07-15 years (grades 4-6) for elementary school and grades VII to IX for junior high school. Testing this game, several variables will be observed, among others, in the graphic aspect of the game, the software engineering aspect, the entertainment aspect, and the content aspect. The results of the assessment of 30 respondents for the game user interface can be shown in Figure 20.

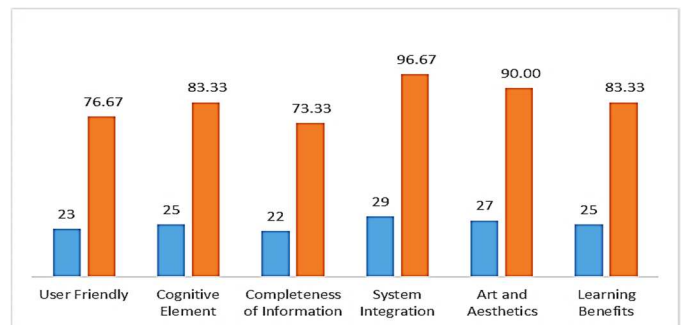


Fig. 20 Test result graph

IV. CONCLUSION

The game-based Sasak character recognition application has an attractive appearance. It is easy to use and displays material information that is easy to understand. There is also an easy-to-follow Sasak script writing practice with scratch patterns or stages that have been provided, and there is a list of words and quizzes for self-evaluation that can help users. Through the results of a survey of elementary and junior high school students, the "Sasak Baluk Olas" game received a good response as an internal aid media. The percentages obtained from the survey results are 67% attractive in terms of art and

aesthetics, 96% in terms of system integration, 73% in terms of completeness, and 76.67% in terms of user-friendliness. Applications for learning the Sasak Baluk olas scripts for elementary and junior high school education levels can be a medium for Learning and preserving the Sasak scripts.

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