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Game for Sasak Script Based on Knuth Morris Pratt Algorithm and ADDIE Model

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ABSTRACT

Knowledge of the Sasak script is very few Sasak people are interested in learning it. The writing system of the Sasak script is in danger of becoming extinct, so the local government must carry out literacy education so that the Sasak script does not become extinct from the face of the Lombok earth and must be applied to elementary and junior high schools, not only in the learning and teaching process. Directing children can be done by introducing them to the game-based Sasak baluk olas script. The Sasak script game based on KMP (Knuth Morris Pratt) Algorithm and ADDIE (Analysis, Design, Development, Implementation, Evaluation) which integrates game thinking and game elements has proven helpful in learning new knowledge. For this reason, the purpose of this study is to discuss how to develop applications for the Sasak Baluk Olas script on smartphones based on the Android system. designed based on the famous visual novel concept that combines multimedia elements including audio, animation, graphics, and images to make it more interesting and lively. All of these elements combine with gamification elements such as quizzes, rewards, badges, and feedback to make it a gamification application. Based on all the abilities of the Sasak Baluq Olas script, it can help potential users, especially elementary and junior high school students in Mataram City to increase the level of understanding and awareness of the Sasak script so that it does not become extinct.

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1. INTRODUCTION

In all provinces in Indonesia, there are regional language subjects, as well as the province of West Nusa Tenggara (NTB) which consists of two islands, namely the island of Lombok and the island of Sumbawa [1]. The island of Lombok, which is dominated by the Sasak tribe, whose tribal language is also called the Sasak language, has its own script which is taught in schools with Sasak language subjects [2]. In the implementation of teaching the Sasak language in schools, many students have difficulty understanding it and require sufficient time and detailed understanding to learn it [3], while the time to study Sasak language subjects at school is very limited [4]. The difficulty factor in learning the Sasak script is because the Sasak script is different from the script that is commonly used [5], has its own rules in each character [6].

In addition to the factor of limited study time at school and the difference between the Sasak script and the Indonesian script, another factor that affects students' understanding at school is the influence of the globalization era which makes students generally reluctant to study the Sasak script in more detail [7]. so that interest in learning Sasak script has not yet fully developed and students consider Sasak script a difficult subject, especially the chapter on writing Sasak script makes them dislike it[7]. To overcome the difficulties mentioned above, it is necessary to innovate to attract learning interest while preserving culture and customs by using information technology according to the times, namely with applications that can be accessed via Android-based smartphones.

Smartphones of the last decade have experienced great growth with the level of demand and interest in mobile computing [8], thus reducing interest in purchasing desktop computers, as they have shifted to buying new mobile technologies at extraordinary prices. There are two platforms available for launching this app to mobile devices, [9] namely Android and IOS, where for this application using the Android platform. The focus of this research is to discuss how to develop Sasak script applications on smartphones based on the Android platform. This application is used to help elementary and junior high school students to increase the level of understanding and public awareness about the importance of preserving and preserving the Sasak script against extinction, with the name of the Sasak Baluq Olas Script Game application.

Digital games increase interest in educational potential, in particular the use of games to support learning in a variety of contexts both formal and informal, inside and outside of school [10]. It is on the basis of the potential and role of digital games that drives the Sasak Baluq Olas script, which discusses how game developers, the forms and structures that games might take; in an effort to preserve the Sasak cultural heritage through its script. In practice this research will investigate considering, emphasizing, and prioritizing stakeholders involved in digital game development when designing games [11]. Therefore, to meet the needs of diverse audiences, stakeholders and goals to produce consistently enjoyable and effective games, technology and structure are needed that are inherent in game design [12].

Knuth Morrsis Pratt Argorithm found a better algorithm regarding reducing space and time complexity, and effective in string matching method [14]. Most of its implementation has led to translations, for example English to Indonesian translations [13]. Research conducted by Harco Leslie Hendri Spits Warnars, et al. with the title "Translation Learning Tool for Local Language to Indonesian using Knuth-Morris-Pratt Algorithm" states that the use of the Knuth-Morris-Pratt algorithm to translate Palembang language into Indonesian can help students learn palembang language with the application and can also be easily understood by everyone who is interested in learning it [14]. Other studies also explain using the same algorithm for the Mandailing-Indonesian language translator application [14], shows that the Knuth Morris Pratt algorithm is very important for a more natural word translation process [15]. Game development using the ADDIE Model has five stages of the framework, namely (A) analysis, (D) design, (D) development, (I) implementation and (E) evaluation. The ADDIE model has several advantages, such as being easy and systematic to produce effective, creative, and efficient products [16]. Mostafa Hamsea, et al. dnature of his research states that the ADDIE Model is one of the well-known instructional design models. In the needs analysis phase, two-thirds of participants expressed a need for a variety of forms of content: structured text in the title, video clips, recording images and sound [17].

This research on sasak Baluq Olas script uses game media that can be accessed via smartphones. The result of this study is that Games are more effective as a learning medium at the elementary and junior high school levels. This research uses a mobile application, its use can be offline so that it does not require an internet connection. In develop this baluq olas script game using a combination of Knuth Morris Pratt Algorithm and ADDIE Model which distinguishes this study from other studies.

Games have become the most prominent technological development that can enhance human engagement, where games use game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems [18]. In this application, game elements such as users, levels, feedback, scores and badges will be used, to implement this technique, tools such as mobile applications that embed gamification elements can be introduced. With the recent development of mobile, where mobile devices are produced with the integration of various techniques with portability and mobility that encourage users to use mobile devices not only to contact people but have become helpers for students, teachers, people, and the community, and others such as game [19, 20].

2. RESEARCH METHOD

Researchers combined the Knuth Morris Pratt (KMP) algorithm and ADDIE Model for the Sasak script game baluq olas. KMP algorithm matching using strings can be carried out and retrieved, which have some similarities, to determine game solutions related to the Sasak script letter model and its reading. The KMP algorithm can be developed and implemented into many search processes.

2.1. Knuth Morris Pratt Algorithm

The Knuth-Morris-Pratt algorithm is a string matching algorithm developed from the Brute Force Algorithm [11]. The KMP algorithm was discovered separately by James H. Morris, Vaughan R. Pratt, and Donald E. Knuth, who later published the algorithm together in 1977. The KMP algorithm is efficient and suitable for all types of string searches, where the KMP algorithm uses prefixes and suitable ending. First, we calculate the failure table of a pattern with a prefix and a suffix, then match the pattern to the text. When a mismatch occurs, the pattern will move according to the number of characters that were previously matched. This information is found in the failure table. The KMP algorithm is noticeably faster as there is no need to back up after a partial match.

String matching is an algorithm to find all occurrences of a short string called pattern in a longer string called text and string matching makes it easy for us to check for the presence of a pattern in a text [20]. String matching has three directions for matching pattern strings to text, namely from left to right, from right to left, and from right to left to the second character of the first character to the second character of the last character. String matching consists of various algorithms, in particular the Naive String Matching algorithm, the Boyes-Moore algorithm, the Rabin Karp algorithm, and the Knuth Morris-Pratt (KMP) algorithm.

Knuth Morris Pratt algorithm, featuring a better algorithm performance and more efficient to use. Another case is using the Knuth Morris Pratt algorithm in genome detection, which results in significantly faster, efficient and significant computations [21]. Other researchers introduced a parallelization and optimization approach for the KMP algorithm on heterogeneous architectures based on multi-core GPUs. Through overlapping calculations or communication, most data transfers have errors in calculations and also optimize the allocation of work items and workgroups [22]. The use of the KMP algorithm in string search combines the advantages of the algorithm, and the KMP algorithm gives rise to higher effectiveness [23].

2.2. ADDIE Model (Analysis, Design, Development, Implementation and Evaluation)

The ADDIE model is a design model that emerged in the 1990s developed by Reiser and Mollenda [24]. This model can also be applied in game creation. The ADDIE model has several stages, namely Analysis, Design, Development, Implementation, and Evaluation. Therefore, this model is often referred to as the ADDIE model.

According to Hall, the ADDIE model is a clear form of instruction and can be integrated into any development strategy. In addition, the ADDIE model is a generic model [25], which has a systematic approach to the process of designing instruction and provides an organized framework to ensure that educational products are produced efficiently and effectively. The ADDIE design model shows the basic design steps being simple and easy to learn [26]. The five phases or stages of the ADDIE model need to be carried out systematically as shown below [27].

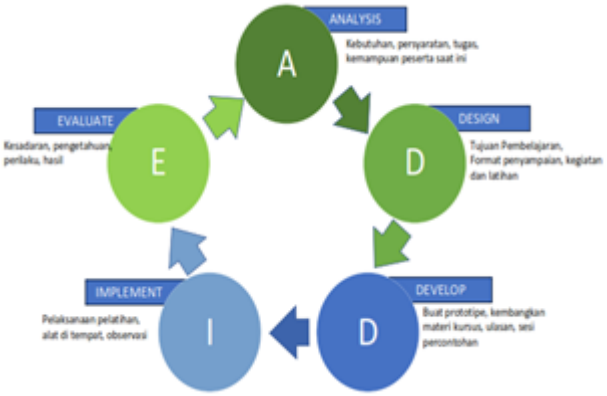


Figure 1. Research Phase using the ADDIE Model

2.3. Games

Defining games in general and video games in particular has been a challenge since the beginning of game studies and the works of Johann Huizinga (1949) and Roger Caillois (1962) [28]. Both of these works were influential on later texts on the subject, especially those that are important texts in the brief history of video game studies [29]. The narratology or ludology debate is an example of a definitional struggle, where this study attempts to move past the hostile tone of the discourse. A strict focus on video games has yielded useful results for media criticism [29], and propose a definition based on the concept of an active video game model [30]. Working from the notion of an ergodic text consisting of interconnected parts, and the difference between the rules and the fiction presented.

The word game comes from the word gamen (Old-Middle English) which means sport, excitement, excitement, entertainment, game, entertainment, fun [18]. In the Indonesian dictionary, the game comes from the word play which means doing for fun by having a tool or not. According to Encarta, games are activities or contests governed by certain rules [31]. Meanwhile, according to Prensky, "games have goals, rules, and win states that provide structure and motivation to the user". [32].

Based on the genre and gameplay, games are classified [33, 29]:

1. Action Games are a type of game that emphasizes physical challenges, including hand-eye coordination and reaction time.
2. Adventure Game is a type of game where the player is assumed to be the main character in an interactive story that is supported by exploration and puzzles.
3. Puzzle Game is a type of game that emphasizes solving puzzles. Puzzles can test the ability to solve many problems including logic, strategy, pattern recognition, and word completion.
4. Role Playing Game (RPG) is a role-playing game, which has an emphasis on the character or the role of the player's representative in the game, usually the main character, where when we play it, the character can change and develop. in the direction the player wants (usually getting better, stronger, more influential, etc.) in various parameters, usually determined by leveling up, from intelligence, speed and strength of the character, weapons or number of friends or pets.
5. Simulation Game is a type of game with simulation by players in the game.

The implementation stage is the stage where the researcher refers to the stages that exist in the ADDIE model since it was used by researchers to develop multimedia learning based on adventure games. In data processing and analysis, the researcher processed the student score data based on the results of the pretest and posttest, evaluated students on adventure game-based multimedia learning by applying the ADDIE model, and analyzed the research data by conducting tests. normality, homogeneity, gains and hypotheses, as well as drawing conclusions from research results.

The instruments used to obtain the data are non-test and test. The comprehension ability test instrument was developed in the form of 40 multiple choice questions, consisting of 20 branching algorithm questions and 20 repetition algorithm questions. While the non-test instrument used interview techniques, expert validation, and student evaluation questionnaires on multimedia.

3. RESULT AND ANALYSIS

3.1. Mobile Application

Mobile applications are applications that can be used and even move easily from one place to another without any communication breaks. This application can be accessed via wireless devices such as mobile phones or gadgets. There are several characteristics of mobile applications, namely:

1. Small Size
2. Limited memory
3. Limited processing power
4. Consume lace power
5. Strong and reliable
6. Limited connectivity
7. Short lifitime

The types of mobile applications based on their functions are as follows:

1. Information
2. Communication
3. Entertainment
4. Productivity tools
5. Trade and Bangking

6. Location Based

The essential game of the Sasak Baluq Olas script is the vocabulary of the Sasak script itself. In this study, there were 18 (eighteen) vocabularies collected from several sources. The glossary starts from the letter Ha to the letter Nya. From Figure 2, you will see some examples of vocabulary in this study [34].

Figure 2. The Sasak Baluq Olas script

3.2. Knuth Morris Pratt Algorithm (KMP)

The Knuth-Morris-Pratt Algorithm, one of the applications of is to create a program that can help especially in the game of Sasak script balluk olas. This game is to help students better understand the Sasak script baluk olas. The flowchart for the Sasak script balluk olas game using the KMP algorithm is as follows:

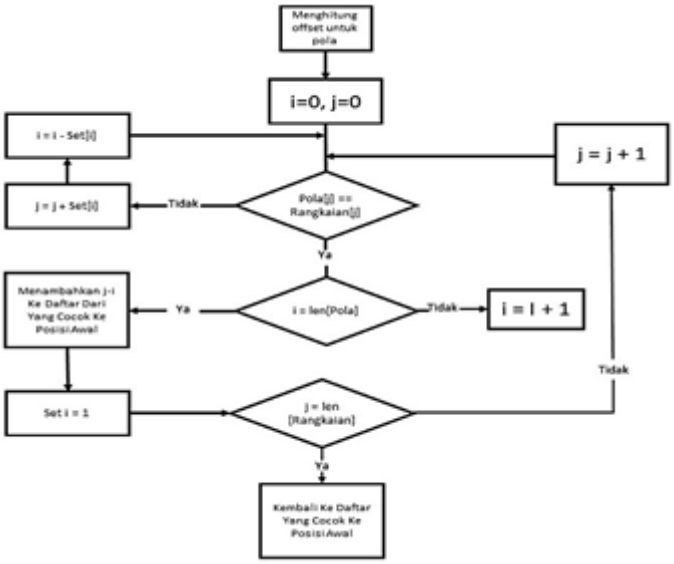


Figure 3. Game Flowchart using the KMP algorithm

Based on the flowchart of the Knuth Morris Pratt algorithm, the initial process is to initialize the variables i and j as a place to perform shift calculations when there is no match between the pattern and the string. Furthermore, pattern and string matching will be carried out, and if both conditions match it will be stored in a new variable as the result of the match. On the other hand, if there is no match, a shift will be made from left to right. The Knuth-Morris-Pratt algorithm has the following calculation per shift, if there is a mismatch when the pattern and text are aligned $[i..i+n-1][i..i+n-1]$, if the first mismatch occurs between the text $[i+j][i+j]$ and model $[j][j]$ with $0 < j < n0 < j < n$. It means text $[i..i+j-1] = pattern[0..j-1][i..i+j-1] = pattern[0..j-1]$ and $a = text[i+j]a = text[i+j]$ does not match then $b = pattern[j]b = pattern[j]$. When sliding, it's perfectly natural that the vv pattern prefix will be the same as multiple endings of some text. The U pattern can be shifted to align the prefix with the suffix. The search stage can be done $O(m+n)O(m+n)$. Knuth Morris Pratt's algorithm performs most of the comparisons of $2n-12n-1$ text characters, during the search phase. The delay (maximum number of comparisons for one text character) is limited by log $\Phi + (m)log\Phi + m$, where $\Phi\Phi$ is the golden ratio as below [23].

$$\Phi = \frac{1+\sqrt{5}}{2}\Phi = \frac{1+\sqrt{5}}{2} \tag{1}$$

Based on the steps performed by the Knuth Morris Pratt algorithm when matching strings are as follows:

1. The Knuth Morris Pratt algorithm starts matching the pattern at the beginning of the string.
2. KMP performs from left to right, this algorithm will match character by character pattern with characters in the corresponding string, until one of the following conditions is met:
   a. The characters in the pattern and in the string being compared do not match (mismatch).
   b. All strings in the pattern match. Then the algorithm will notify the discovery at this position.
3. The KMP algorithm then shifts the pattern based on the next table, then repeats step 2 until the pattern is at the end of the string.

The application of the Knuth Morris Pratt algorithm to the Sasak script baluq olas game is explained in the following steps:

String S:

m	a	n	g	a	p	a	d	a	j	a	y	a

Pattern P:

a	n	g	s	a	l

Step 1: Compare pattern [1] with string [1]

m	a	n	g	a	p	a	d	a	j	a	y	a
↑												
a	n	g	s	a	l							

Pattern [1] does not match string [1]. Then the pattern will shift one position to the right.

Step 2: Compare pattern [1] with string [2]

m	**a**	n	g	a	p	a	d	a	j	a	y	a
	↑											
	a	n	g	s	a	l						

Pattern [1] matches string [2]. Because there is a match, the Knuth Morris Pratt algorithm will store this information, and the pattern will not shift and continue matching pattern [2] with string [3].

Step 3: Compare pattern [2] with string [3]

m	**a**	**n**	g	a	p	a	d	a	j	a	y	a
	↑											
	a	**n**	g	s	a	l						

Pattern [2] matches string [3]. Because there is a match, the Knuth Morris Pratt algorithm will store this information, and the pattern will not shift and continue matching pattern [3] with string [4].

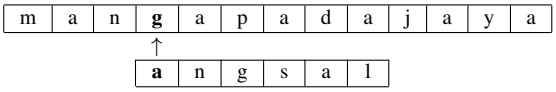
Step 4: Compare pattern [3] with string [4]

m	**a**	**n**	**g**	a	p	a	d	a	j	a	y	a
	↑											
	a	**n**	**g**	s	a	l						

Pattern [3] matches string [4]. Since there is no match, the Knuth Morris Pratt algorithm will use the information stored in steps two and three to determine the next shift. So that the matching is not between pattern [1] and string [3] as if using a brute force algorithm,

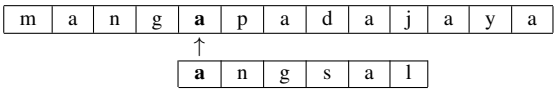
but between pattern [1] and string [4] so that it can speed up the string matching process.

Step 5: Compare pattern [1] with string [4]



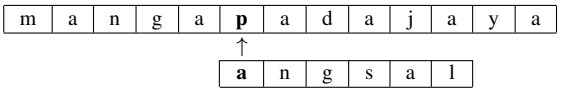
Pattern [1] does not match string [4]. Then the pattern will shift one position to the right.

Step 6: Compare pattern [1] with string [5]



Pattern [1] matches string [5]. Then the pattern will shift one position to the right.

Step 7: Compare pattern [1] with string [6]



Pattern [1] does not match string [6]. Because of the mismatch, the Knuth Morris Pratt algorithm will shift and continue matching pattern [2] with string [7] and so on.

3.3. ADDIE Model

In the implementation phase, the researcher developed a game with the Sasak baluq olas script. The development of the game includes stages in the ADDIE model:

1. Analysis
   The analysis consists of two parts, namely performance analysis and needs analysis. In the analysis of the performance of the material obtained by branching and looping, it is one of the materials that is difficult to understand, so it is necessary to develop material for the Sasak script baluk olas game. In needs analysis, the preparation of requirements such as hardware and software needed to develop or use game-based Sasak script.
2. Design The design stage is the stage after the analysis process where this stage is a continuation or core activity of the analysis. The stages are divided into several points which consist of designing flowcharts, storyboards. Here is the flowchart designya.

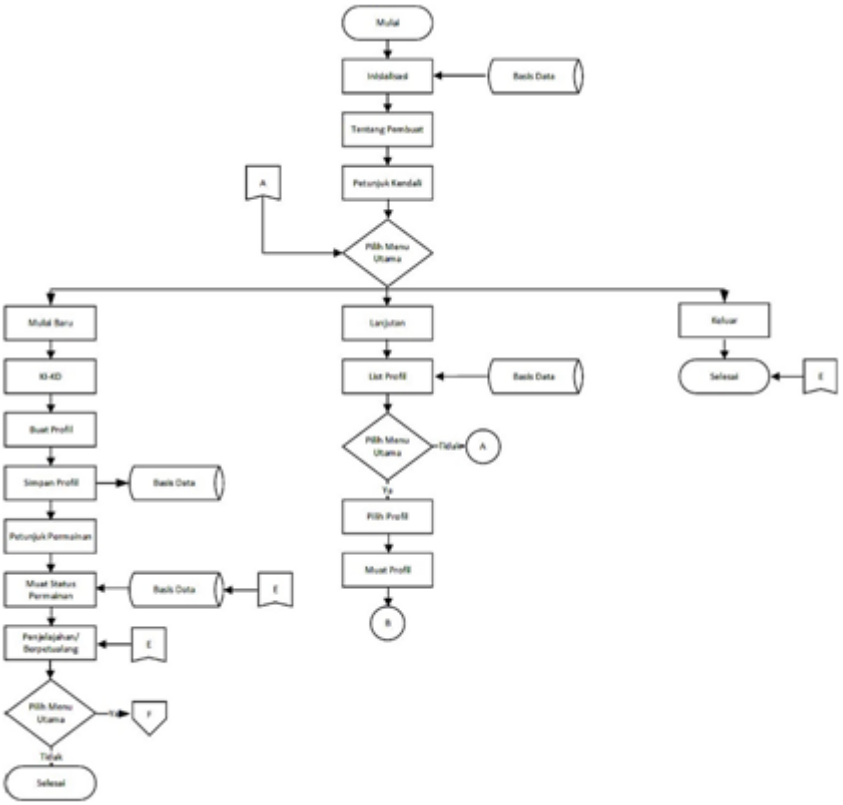


Figure 4. Initial flowchart of ADDIE model

Storyboard is the basis of interface design in making adventure games based on multimedia learning. Here are some interfaces (Figure 5).

Figure 5. Storyboard Game Interface Sasak Baluq Olas

3. Development
   The development of the Sasak baluq olas script game was made with RPG Maker VX Ace because it is basically an application to build and develop the Sasak baluq olas script game. There are 2 (two) types of stages, namely encoding using the Ruby Game Scripting System (RGSS), and game logic events which are used to create game plots.

After the game is made through the coding and event stages, the next step is game validation by game experts and script experts. Here are the results of the development carried out.

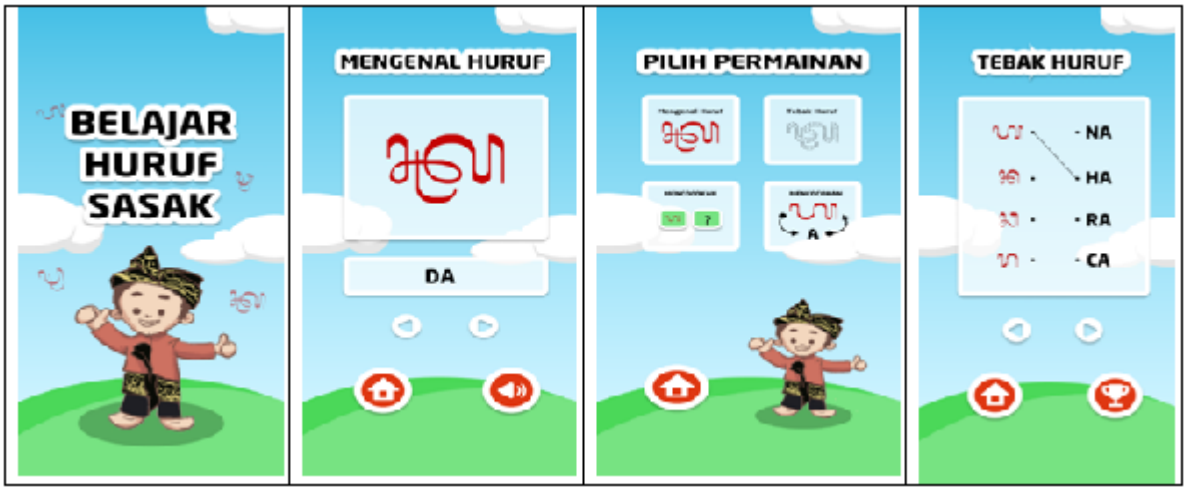


Figure 6. Game development results

4. Implementation
   Implementation was carried out four times. This study consisted of pre-test, treatment, post-test and validation of the ADDIE model. This game of Sasak Baluk Olas script is carried out at the stage of data collection, data processing, and verification.

Table 1. Test results using the Sasak script game baluk olas

Presentation Desain	User Engagement	Accessibility	Rediscovering	Standard
88	84,36	83	89	87
Average value (%)	**86,27**			
Catagory	**Good**			

Table 2. Test results Sasak script game content baluk olas

Content Kuality	Learning media	Feed Back	Motivation
73	68	77	69
Average value (%)	**71,75**		
Catagory	**Good**		

5. Evaluation
   Student responses as learning media based on the Sasak baluq olas script game need to be evaluated. Students are given a questionnaire to assess three aspects, namely software, learning aspects, and visual communication. The questionnaire consists of four answer choices from a scale of 1 to 4. Student responses can be seen in the following table:

Table 3. Evaluation of the results of the Sasak script game baluk olas

Software	Learning media	Visual Communication
87.96	88.10	83.61
Avarage Value (%)	**86.56**	
Category	**Verry good**	

Before the Sasak Baluk Olas script game was tested, the researcher gave a pretest to the students. Pretest (initial test) is given to determine students' understanding of the material. The results of the pre-test conducted on 88 5th grade elementary school and 7th grade junior high school students in the city of Mataram obtained an average score of 62.00 with a minimum score of 33.2 and a

maximum score of 74.6. After the pretest is given, the learning process is carried out by applying the Sasak script game baluq olas. The post-test results obtained an average value of 89.80, with a minimum value of 67 and a maximum value of 100.

Table 4. Gain index of Sasak baluk ola. script

Lowest score		Highest score		Average score		Gain Index
Pre- test	**Post- test**	**Pre- test**	**Post- test**	**Pre- test**	**Post- test**	
31.4	59	70.5	92	50.45	76	0.591
Gain Criteria						**Intermediate**

From the results of the pre-test and post-test, the researcher analyzed the data by performing normality and gain tests. Normality test aims to see whether the data taken is normal or not. From the results of the normality test using the Kolmogorov-Smirnov equation — Ft Fs — pre-test max (0.091) ¡ Kolmogorov table (0.221), — Ft Fs — max posttest (0.091) ¡ Kolmogorov table (0.221), indicating that both criteria are normal.

Module validation using the ADDIE model is carried out in determining the feasibility of a module to be implemented in the teaching and learning process. Therefore, this module was validated to determine the suitability of the online module for acid-base topics based on the developed ADDIE model. This module was validated by 4 (four) experts in the field of Sasak Baluk Olas script. These experts have experience in teaching Sasak script in schools and communities. A 5-point Likert scale survey from very poor to very good was used by experts to validate the module. Module validity is evaluated in several aspects including module objectives, module content, usability, flexibility, language and learning media activities. The validity of the module is calculated using the percentage calculation method. The percentage score obtained for each aspect is calculated using the following formula:

$$\text{Score Percentage} \frac{\Sigma \text{Score obtained}}{\Sigma \text{Maximum Score}} \times 100 \tag{2}$$

Table 5. Analysis of the results of the validation of Sasak script experts

No	Aspect	Score Percentage (%)	Interpretation
1	Goal	88.0	Very good
2	Content	84.0	Very good
3	Utility	86.7	Very good
4	Fleksibility	92.0	Very good
5	Language	96.0	Very good
6	Learning Media	94,0	Very good
	Average	90,1	Very good

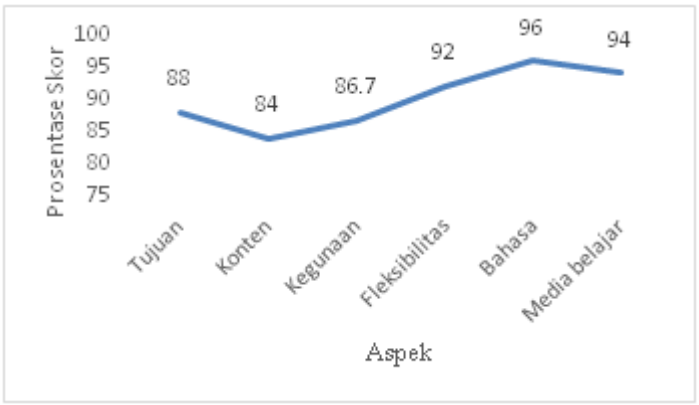


Figure 7. Graph of validation results of Sasak script experts

4. CONCLUSION

The Sasak Baluk Olas script game uses the KMP algorithm in matching strings for its implementation, getting the results of testing the classification algorithm, which is 100% able to find the words entered. In terms of performance, execution time in implementation is 0.01901 ms, and memory usage using the KMP algorithm is only 15.765 MB. The Sasak script game Baluk olas is a game-based learning media for the Sasak script developed with the ADDIE model that can be useful as an alternative learning medium to improve students' understanding of the subject of introduction to the Sasak script. The use of the ADDIE model can be applied in designing other games for different models or learning materials. This application can be equipped with a dictionary that can translate Sasak characters into the alphabet, and also create menus for writing Sasak characters using the touch screen.

5. ACKNOWLEDGEMENTS

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6. DECLARATIONS

AUTHOR CONTIBUTION

Muhammad Tajuddin: Main Author, determines the research topic and designs the research concept, determines and writes abstracts, backgrounds, research methods and analysis of research results. Ahmat Adil: Assisting the main author in designing research concepts, data processing, and writing background sections, research methods and analyzing research results, as well as finalizing published scientific articles Andi Sofyan Anas: Assisting the main author in designing research concepts, writing background sections, research methods and analyzing research results, as well as finalizing published scientific articles.

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COMPETING INTEREST

The continuation of this research is towards sasak script games with a wider content, because with 18 characters still very small, continuing towards research that is able to make special fonts sasak language, speech recognition research that is able to recognize the pronunciation of sasak language for children, developing text to speech and speech to text recognition in sasak language.

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