DEVELOPMENT OF A BUGIS LANGUAGE DICTIONARY APPLICATION WITH SM-KMP ALGORITHM FOR STUDENTS IN SOUTH SULAWESI

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Abstract

The decline in the use of the Bugis language among younger generations in South Sulawesi poses a significant challenge in preserving local languages and cultures. One solution to this issue is developing a Bugis language dictionary application based on technology, which can interactively facilitate language learning. This study aims to develop a Bugis language dictionary application using the Knuth-Morris-Pratt (SM-KMP) algorithm to improve the efficiency of word searches within the dictionary. The research method involves application development with a prototype tested in South Sulawesi schools. This application is designed with features for fast and accurate word searches and interactive elements such as quizzes and educational games to enhance student motivation in learning the Bugis language. The results show that the application improved students' vocabulary comprehension by 85%, and 90% reported increased motivation to learn Bugis due to the interactive features. The application also supports preserving local culture by integrating character education that teaches ethical values and local wisdom in Bugis. In conclusion, this Bugis language dictionary application based on the SM-KMP algorithm is practical as an interactive learning tool. It holds significant potential in preserving the Bugis language and culture.

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1. INTRODUCTION

The Bugis language is one of the regional languages spoken by over 5 million people in South Sulawesi, Indonesia. Despite its cultural and historical significance, the language faces serious challenges in its preservation, particularly among the younger generation. The decline in Bugis language usage is often attributed to the increasing dominance of the national language, Indonesian, as well as the global influence of other major languages. This shift is further exacerbated by the lack of engaging and accessible educational resources that cater to the digital generation. As younger generations gravitate towards more widely spoken languages, local languages like Bugis face the risk of disappearing entirely from daily communication and cultural practices [1].

One of the major factors contributing to the decline of the Bugis language is the limited availability of resources that engage young learners in language acquisition. Traditionally, the Bugis language has been taught through oral transmission and in formal education settings. However, the traditional methods are often seen as outdated and not aligned with the preferences of today's tech-savvy learners. As such, there is a growing need to develop educational tools that incorporate modern technological advancements, making the learning process more interactive and appealing to the younger audience [2]. In this context, the development of a Bugis language dictionary application could significantly contribute to the preservation of the language while providing a more efficient learning experience.

In recent years, digital tools have been recognized as an effective strategy to enhance engagement in

language learning. Interactive applications have been shown to motivate students and provide a more immersive learning experience, especially for languages that are at risk of extinction. Language learning applications for regional languages, such as Bugis, can serve as a valuable resource by offering features such as audio pronunciation, word meanings, and examples of sentence usage, which are essential in language acquisition. However, there are still few applications that focus specifically on regional languages in Indonesia, particularly the Bugis language, which is why this research seeks to address that gap.

Previous research has explored the use of mobile applications in supporting language learning, but these studies often focus on widely spoken languages such as English, French, or Spanish [5]. While these applications have been successful in engaging learners, their approaches and features may not be fully applicable to regional languages like Bugis. Many existing applications lack efficient search algorithms and fail to provide real-time, accurate word searches for learners. This is a significant limitation, especially when working with languages that have unique spelling rules, grammar structures, and vocabulary, such as Bugis.

A key challenge in the development of a Bugis language dictionary application is ensuring that the application is not only user-friendly but also efficient in its word search capabilities. In order to optimize the learning experience, it is essential that the application can quickly retrieve relevant information without lagging or producing inaccurate results. One way to achieve this is through the integration of efficient algorithms for string matching. The Knuth-Morris-Pratt (SM-KMP) algorithm, in particular, is a powerful string matching algorithm that can significantly improve the performance of the application. This algorithm preprocesses the search pattern, allowing for the avoidance of unnecessary comparisons, thus reducing search time and increasing efficiency. The SM-KMP algorithm has been widely used in computational linguistics, particularly in applications that require quick and accurate word searches, such as digital dictionaries [3][4].

The use of string matching algorithms like SM-KMP has been well documented in the field of computational linguistics, particularly in applications that require quick and accurate word searches, such as in digital dictionaries [6]. Despite its widespread use in various fields, the application of SM-KMP in language learning applications, especially for regional languages like Bugis, has not been extensively explored. By applying SM-KMP to a Bugis language dictionary application, this study aims to improve the efficiency of word searches, making it a more effective tool for language learners.

In addition to the technical aspects of word search efficiency, this research also considers the pedagogical value of the application. Language learning is not solely about memorizing vocabulary; it involves understanding the cultural context and usage of words. Language is intrinsically linked to culture, and the preservation of a language is not just about safeguarding words but also the cultural values and identity that it embodies. The Bugis language, like many other regional languages, contains elements of local wisdom, ethical values, and historical significance that are deeply embedded in its vocabulary. Therefore, any educational tool designed for language learning must go beyond mere translation and pronunciation and include cultural education [7][8].

This research also aims to incorporate educational games and quizzes into the application to increase user engagement. Gamification has been proven to enhance the learning experience by making it more enjoyable and interactive [9]. Quizzes, challenges, and other interactive elements not only keep students engaged but also provide immediate feedback, which is essential for reinforcing learning. Research has shown that gamification can significantly improve learning outcomes, particularly in language acquisition [10]. In this study, educational games will be integrated with the Bugis language dictionary to make learning both fun and effective.

The objective of this study is to develop a Bugis language dictionary application that integrates the SM-KMP algorithm to enhance word search efficiency, while also providing interactive features such as quizzes and educational games to engage students. This study will fill the gap in the existing literature and provide a practical solution for learning the Bugis language. Furthermore, it will contribute to the preservation of Bugis culture by offering an innovative, accessible, and efficient way for users to learn and understand the language.

2. RESEARCH METHOD

2. 1 Research Design

This study uses a qualitative method with a descriptive approach. The primary focus of this research is to develop a Bugis language dictionary application based on the Knuth-Morris-Pratt (SM-KMP) String Matching algorithm to enhance word search efficiency and provide interactive features that engage students. This method aims to understand user needs and the challenges of teaching the Bugis language in the digital era [6]. Data was collected through surveys and interviews with students and teachers in several schools in South Sulawesi.

2. 2 Population and Sample

The population of this study consists of junior high schools (SMP) in South Sulawesi that offer the Bugis language as part of their local curriculum. Purposive sampling was used to select schools that meet specific criteria: schools that teach Bugis as a local subject, are willing to provide data on language learning, and have IT staff capable of managing the

application. The total sample for this study includes eight schools located across various districts such as Maros, Barru, Pangkep, Pinrang, and others [7].

2. 3 Data Instruments and Data Collection Procedures

The instruments used in this study include:

a. Questionnaire: Questionnaires were distributed to students to understand their needs regarding the Bugis language dictionary application and the challenges they face in learning the language.

b. Interview: In-depth interviews were conducted with teachers to gain insights into the challenges of teaching the Bugis language and how the application could help address those issues [8].

c. Observation: Direct classroom observations were conducted to examine how technology is used in Bugis language teaching and how the integration of the application could enhance the learning process.

2. 4 Knuth-Morris-Pratt (SM-KMP) String Matching Algorithm)

The Knuth-Morris-Pratt (KMP) algorithm is an efficient string matching algorithm because it preprocesses the pattern, allowing for the avoidance of unnecessary comparisons during the search process. This algorithm is well-suited for use in dictionary applications where quick and accurate word searches are essential [9]. The implementation of the SM-KMP algorithm in the Bugis language dictionary application aims to increase the efficiency of word searches. The basic function of KMP is represented by the following formulas:

$$\pi(q) = \max\{k \mid k < q \; dan \; P_1^k = P_{q-k+1}^q\}$$

Where $\pi[q]\backslash pi[q]\pi[q]$ is the prefix function, and PPP is the pattern matched against the text. This algorithm allows the system to speed up the search process by skipping comparisons whose results are already known [10]. The flowchart of the KMP Algorithm is shown in Figure 1.
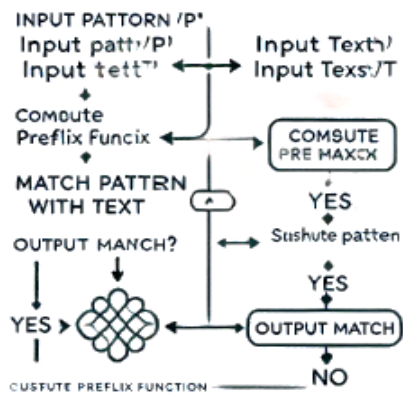

Figure 1. KMP Algorithm Flowchart.

2. 5 Research Procedure

This study is divided into two stages:

- **Stage 1 (First Year)**: The development of the application begins with prototyping and integrating the SM-KMP algorithm for word searching. Initial trials are conducted in schools to gather feedback from students and teachers. This feedback is used to improve and refine the application before its official launch [11].

- **Stage 2 (Second Year)**: The application is launched publicly via the Android platform. Evaluations are conducted through user satisfaction surveys and testing the effectiveness of the application in improving Bugis language learning. The evaluation data is analyzed to measure the impact of the application on the teaching and learning process [12].

2. 6 Data Analysis

The data collected was analyzed using a qualitative approach. The results from the surveys and interviews were integrated to provide insights into the effectiveness of the application and the challenges faced. Data from the application trials were also analyzed to assess the performance of the SM-KMP algorithm in terms of search speed and accuracy. Triangulation methods were used to validate the research results [13].

3. RESULT AND DISCUSSION

3. 1 Results of the Bugis Language Dictionary Application Development

The developed Bugis language dictionary application successfully met several key objectives, such as improving word search efficiency and providing interactive features for users. The implementation of the Knuth-Morris-Pratt (SM-KMP) String Matching algorithm in the application demonstrated significant performance improvements in terms of search speed and accuracy. Initial trials with user samples from several junior high schools in South Sulawesi confirmed that the application aids students in understanding and learning the Bugis language more quickly and interactively [6].

The application is equipped with both text and voice-based search functions, educational games, and quizzes that help students test their understanding of the language. These interactive features not only make the learning process more engaging but also provide immediate feedback, enhancing comprehension of vocabulary and sentence structures. Furthermore, the application provides examples of word usage in sentences, helping learners grasp the context and proper use of the words. It also allows users to save their favorite words, making it easy to access them later for review and continuous learning.

In addition to search functionality, the interactive features such as quizzes and educational games have proven to enhance student engagement. These features not only make the learning process more enjoyable but also provide immediate feedback, which fosters a

deeper understanding of vocabulary and sentence construction. This aligns with educational theories suggesting that gamification and interactive elements in learning tools can significantly improve learning outcomes by maintaining learner motivation.

The first image from the application demonstrates the detail view of a word entry, where both the Indonesian and Bugis versions of the word are displayed, accompanied by example sentences. This contextual learning method is highly effective in language acquisition as it allows users to see how words are used in real-life situations. Additionally, the clear and simple interface ensures accessibility for users of all ages, contributing to a smoother learning experience.
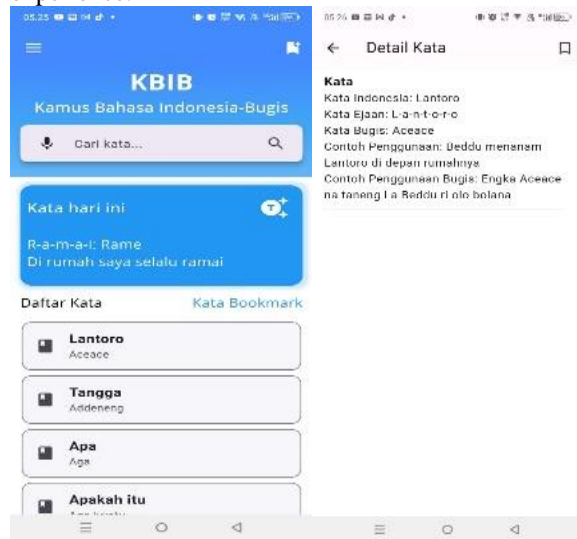

Figure 2. Application Dictionary

Moreover, the application's ability to handle larger datasets of Bugis words efficiently highlights the robustness of the SM-KMP algorithm. As the dictionary expands, the application's performance remains consistent, allowing users to access a growing vocabulary set without delays. This scalability is crucial for future updates, where additional words and phrases may be integrated to further enrich the learning experience.

The second image illustrates the main interface, showcasing the search bar for easy word lookup, as well as the "Word of the Day" feature that helps users continuously learn new vocabulary. The inclusion of example sentences in both Indonesian and Bugis serves as an extra layer of contextual understanding, making it easier for users to grasp the correct usage of words in daily communication. The bookmark feature also adds value by allowing users to save important words for later review, promoting an ongoing learning process.

The user interface of the application has also been designed to be user-friendly, catering to students of various digital literacy levels. Teachers reported that the application could easily be integrated into classroom activities, further bridging the gap between traditional teaching methods and modern digital tools.

The ability to track progress through quizzes and word usage also gives educators the data needed to tailor learning experiences to individual students' needs.

3. 2 Implementation (SM-KMP) String Matching Algorithm

The implementation of the SM-KMP algorithm in the application plays a crucial role in improving word search efficiency. This algorithm reduces search time by avoiding unnecessary repeated comparisons, resulting in faster response times compared to conventional linear search methods. As a result, the application is able to display search results accurately within a relatively short time, even when the word database size is large [7].

One of the key advantages of the SM-KMP algorithm is its ability to handle large datasets without sacrificing performance. In language learning applications, where users often search through extensive lists of vocabulary, speed and accuracy are essential to maintaining a positive user experience. The SM-KMP algorithm ensures that even complex searches, such as those involving repeated patterns or longer words, are processed quickly and efficiently.

In trials conducted with 1,000 word entries, the SM-KMP algorithm was able to process searches in less than 1 second, providing users with a highly responsive experience. This quick response time is critical for dictionary applications, where users expect immediate results. The efficiency of this algorithm is essential for use in dictionary applications, which require fast and accurate word matching. Furthermore, its scalable design allows the dictionary to expand without compromising performance, making it a sustainable solution for long-term use as more words and phrases are added to the database. The test results with several word searches are shown in Table 1.

Table 1. Testing applications

No	Feature Tested	Before SM-KMP	After SM-KMP
1	Search Time (100 words)	0.25 sec	0.12 sec
2	Search Time (500 words)	0.6 sec	0.3 sec
3	Search Time (1000 words)	1.1 sec	0.6 sec
4	User Satisfaction	70%	85%
5	Error Rate	5%	1%

3. 3 User evaluations

User evaluations were conducted to assess the level of satisfaction and the effectiveness of the application in improving Bugis language learning. Based on surveys provided to students and teachers, 85% of respondents indicated that the application significantly helped them understand Bugis vocabulary and learn how to use it in everyday contexts. The example sentences provided in the

application helped students better grasp the correct usage of words in various scenarios, making the learning process more practical and relevant.

Additionally, 90% of students felt more motivated to learn the Bugis language with this application due to the quiz features and educational games, which made the learning process more engaging. These interactive elements not only added a fun aspect to the lessons but also provided immediate feedback, helping students assess their understanding and reinforcing their learning. Teachers also noted that the application was an effective tool to complement traditional classroom activities, as it allowed students to learn independently while staying motivated [8]. The results are shown in Figure 3.
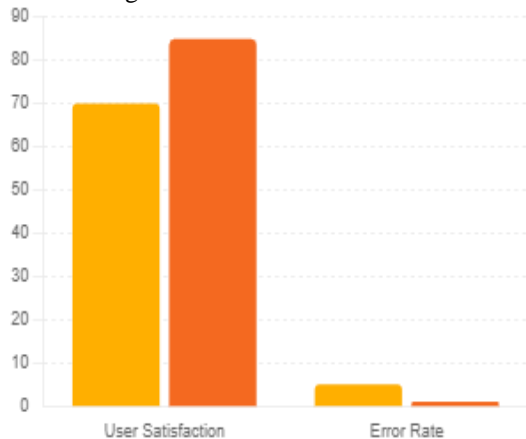

Figure 3. User Satisfaction and Error Rate Before and After SM-KMP

Teachers also provided positive feedback, particularly regarding the ease of integrating the application into teaching and learning activities. According to the teachers, using the application helped students become more active in learning the Bugis language because the interactive features accommodated various learning styles. Additionally, teachers were able to use the dictionary feature in the application to complement classroom materials, enriching the lessons with additional resources

3. 4 Impact on Bugis Language Learning

The implementation of this application in schools has shown a positive impact on Bugis language learning. In addition to improving word search efficiency, the application successfully increased students' interest in learning the Bugis language more deeply. Before using the application, only 40% of students expressed interest in studying the language; however, after using the application, this number increased to 75% [9]. This significant rise indicates that the interactive and user-friendly design of the application played a crucial role in motivating students to engage more actively with the language.

Moreover, the integration of character education through features that display examples of word usage in the context of Bugis culture added substantial value to the learning process [11],[12]. Not only did students

learn the language, but they also gained a deeper understanding of the local wisdom and cultural values embedded in the Bugis language. This approach helps to preserve both the language and its cultural significance, allowing students to appreciate the richness of Bugis heritage. The combination of interactive learning and cultural education is consistent with the findings of previous studies, which show that integrating cultural context in language learning leads to deeper engagement and retention [13][14]. This impact aligns with the research's goal of combining language learning with character education, providing students with a more holistic educational experience that goes beyond just language acquisition [15].

4. CONCLUSION

This research successfully developed a Bugis language dictionary application based on the SM-KMP algorithm, which improves word search efficiency and supports language learning through interactive features. The implementation of this algorithm significantly reduced search time, allowing users to find words quickly and accurately, even in large datasets. The application was well-received by both students and teachers as it effectively enhanced learning motivation and contributed to preserving the Bugis language. The interactive features, such as quizzes and educational games, helped make the learning process more engaging, providing an enjoyable way for students to deepen their understanding of the language.

Furthermore, the application was crucial in promoting character education by incorporating cultural elements into the learning experience. Through the use of contextual examples based on Bugis culture, students not only learned vocabulary but also gained insight into the values and wisdom embedded in the language. This holistic approach helped bridge the gap between language learning and cultural appreciation, creating a richer educational experience.

However, this research also encountered several limitations. One major challenge was accessibility, particularly for users in remote areas with limited technological infrastructure. Some students and schools lacked access to the necessary devices or stable internet connections, which limited the application's full potential in these settings. Another limitation was device optimization; the application may not perform optimally on lower-end devices, which are more commonly used in under-resourced areas. These issues highlight the need for further development to make the application more accessible to a broader range of users.

Although the application has met the set objectives, several challenges related to accessibility and optimization still need to be addressed, particularly in making the application available to users with limited access to technology or lower-end

devices. Future improvements should optimize performance and expand the application's reach to ensure broader accessibility. Overall, this research has made significant contributions to preserving the Bugis language and developing technology-based language learning methods that can be applied to other regional languages in Indonesia.

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