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Development and Evaluation of the MARVOCAB Application for Enhancing Maritime Vocabulary Acquisition

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Abstract
This study aimed to develop and evaluate the effectiveness of the MARVOCAB application in improving maritime vocabulary acquisition among students at Politeknik Ilmu Pelayaran Semarang. Many students face challenges in mastering maritime terminology, which negatively impacts their academic performance and their preparedness for professional communication within the maritime industry. The study employed a Research and Development (R&D) methodology, encompassing the stages of Planning, Production, and Evaluation. The sample consisted of cadets from the Politeknik Ilmu Pelayaran Semarang. The application was designed with key features, including system modeling, database construction, user interface development, and was followed by implementation and black-box testing to ensure functionality and usability. The effectiveness of the MARVOCAB application was assessed using the N-gain score, a measure of learning improvement. The results demonstrated a high level of effectiveness, with an average N-gain score of 0.77, indicating a substantial improvement in students' maritime vocabulary acquisition. These findings suggest that the MARVOCAB application significantly enhances students' comprehension of maritime-specific terminology and holds strong potential for integration into maritime education curricula. The results indicate that technology-assisted vocabulary learning tools can address domain-specific language gaps effectively, supporting learners' academic and professional readiness.

Keywords: Educational Technology, Vocabulary Acquisition, Language Learning Application, Maritime Education, MARVOCAB.

Introduction

In the modern educational environment, the integration of technology in the classroom has become increasingly vital. Educational technology encompasses a wide range of tools and resources designed to enhance learning experiences and outcomes (Alam & Mohanty, 2023). One of the critical areas where educational technology has made a significant impact is vocabulary development. With the rise of digital platforms, educators now have access to innovative methods for teaching vocabulary that were previously unavailable. This innovation facilitates tailored educational experiences and adapts to a range of learning styles, leading to more effective vocabulary development among learners.

Vocabulary plays a critical role in academic achievement, with empirical evidence consistently demonstrating its strong association with reading comprehension, written expression, and overall educational performance. Students with strong vocabulary skills tend to perform better in reading assessments, which are foundational for success in all subject areas. Consequently, the integration of educational technology into vocabulary instruction is not merely advantageous, but a crucial component in promoting literacy development and improving academic outcomes among students (Valverde-Berrocoso et al., 2020). However, based on a preliminary survey, many students still experience difficulties in mastering accurate maritime terminology in both written and oral communication. This limited vocabulary proficiency

can hinder student performance during their studies as well as their future careers in the maritime industry. Furthermore, existing methods for teaching maritime vocabulary, such as textbooks and dictionaries, are perceived as insufficiently interactive and not always effective in promoting deep comprehension among students

The integration of interactive learning technologies, including educational applications and online platforms, has significantly transformed vocabulary instruction (Makoe & Shandu, 2018). These tools frequently incorporate gamification elements that enhance learner engagement and motivation. Empirical findings from Pasicolan et al., (2021) indicate that students utilizing gamified vocabulary tools exhibit superior retention compared to those receiving instruction through traditional methods. In addition, such tools often provide immediate feedback, a feature shown to be essential for effective vocabulary acquisition. Real-time feedback enables learners to promptly identify errors, refine their understanding, and adjust their learning strategies, thereby facilitating deeper internalization of word meanings. Students who employed interactive vocabulary tools also demonstrated enhanced ability to recall and apply new vocabulary in appropriate contexts (Kose & Mede, 2018). Furthermore, the inclusion of multimedia elementssuch as videos and interactive games addresses diverse learning modalities, including visual, auditory, and kinesthetic styles (Rohmah, 2022).

Educational technology facilitates collaborative learning environments that significantly contribute to vocabulary development. Digital tools such as online discussion forums, collaborative writing platforms, and shared document editing systems enable learners to interact constructively with peers (Ali & Abdalgane, 2022). These interactions promote the contextual use of vocabulary through meaningful dialogue and cooperative tasks. Engaging in group discussions encourages students to articulate their thoughts using newly acquired vocabulary, thereby reinforcing both comprehension and application. This process not only enhances lexical acquisition but also fosters the development of higher-order thinking and communication skills. Empirical observations reveal that students participating in technology-mediated collaborative discussions exhibit marked improvements in their ability to integrate new vocabulary into their written outputs (Pradana et al., 2022). Exposure to a wide array of linguistic expressions and contextual usages broadens students' vocabulary and deepens their understanding of language use in culturally relevant contexts. Such cross-cultural engagement promotes not only lexical enrichment but also intercultural competence and empathy.

A key advantage of educational technology lies in its capacity to deliver personalized learning experiences that align with the unique needs and proficiency levels of individual learners. Such tailored instruction enables students to progress at a self-regulated pace, thereby minimizing the cognitive strain and frustration frequently encountered in conventional classroom environments. Learners can allocate additional time to mastering complex or unfamiliar vocabulary while swiftly progressing through already-acquired content, resulting in a more streamlined and effective learning trajectory (Dangi et al., 2023). Moreover, the adaptable nature of digital platforms allows for extended access to instructional materials beyond classroom hours. This accessibility facilitates ongoing vocabulary practice and consolidation, supporting long-term retention and fostering autonomous learning habits.

The research gap addressed in this study lies in the limited attention given to vocabulary instruction within the context of vocational maritime education. While previous studies on English vocabulary acquisition have predominantly focused on general English learners or students in academic settings such as Palangngan (2022) and Panmei & Waluyo (2023), very few have explored vocabulary development specifically within merchant marine vocational institutions. This lack of focus is notable, given that English language proficiency particularly in domain-specific vocabulary is a critical component of professional competence for seafarers. In maritime operations, accurate understanding and usage of English maritime terminology are essential for safety communication, navigation, and compliance with international maritime standards. Therefore, equipping cadets at vocational maritime institutions with specialized English vocabulary is not merely academic but directly linked to their future performance and safety on board ships. This study addresses this gap by examining the effectiveness of a targeted vocabulary learning tool,

MARVOCAB (Maritime Vocabulary), designed specifically for the needs of merchant marine cadets at Politeknik Ilmu Pelayaran Semarang.

An innovative learning approach that aligns with the needs of modern students is essential. Digital applications have proven to be effective tools for enhancing language skills. In response, the MARVOCAB application was developed to improve maritime vocabulary mastery among students at Politeknik Ilmu Pelayaran Semarang. This application is designed to provide an interactive, adaptive learning experience aligned with the existing curriculum, thereby facilitating students' acquisition of maritime terminology more effectively. However, its effectiveness has yet to be determined. The primary objective of this study is to analyze the development process and evaluate the effectiveness of the MARVOCAB application at Politeknik Ilmu Pelayaran Semarang. MARVOCAB is a digital learning tool designed to support students in mastering maritime vocabulary, which is essential for academic success and professional communication in the maritime sector. The research focuses on two key aspects: first, the systematic steps involved in designing, developing, and implementing the application, including content creation, user interface design, and integration of gamified elements; and second, the extent to which the application enhances students' vocabulary acquisition and retention. The study employs both qualitative and quantitative methods to assess user engagement, learning outcomes, and student satisfaction. Feedback from users and performance data are used to determine the pedagogical value of the tool. By evaluating the effectiveness of MARVOCAB, the study seeks to provide evidence-based recommendations for the integration of digital vocabulary applications in maritime education and training.

Materials And Methods

This study employs the Research and Development (R&D) method. The R&D method is a systematic scientific process aimed at investigating, planning, designing, creating, and testing the validity of a developed product (Gustiani, 2019). According to Richey and Klein (2014), the design and development research process can focus on a comprehensive analysis from initial stages through to completion, encompassing Planning, Production, and Evaluation, abbreviated as PPE. The PPE framework serves as the guideline for designing the MARVOCAB application at Politeknik Ilmu Pelayaran Semarang.

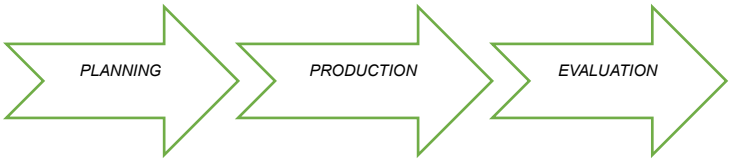

Figure 1. Research Step

Planning is the process of designing a product intended for a specific purpose; production involves creating the product based on the established design; and evaluation is the process of testing the product to assess the extent to which it meets predetermined specifications. The effectiveness of the MARVOCAB application was measured by administering questionnaires to 120 students at Politeknik Ilmu Pelayaran Semarang before using the application (pretest) and after using it (posttest). Hair et al., (2017) states that statistical effectiveness testing produces robust and reliable models with sample sizes ranging from 30 to 60 or 120 to 250, while samples exceeding 500 are not recommended. The data obtained were analyzed using the normalized gain (N-gain) method. Gain refers to the difference between posttest and pretest scores and indicates the level of effectiveness of the MARVOCAB application, calculated using the average normalized gain score formula (Rahi, 2017).

Table 1. N Gain Table

N-Gain Score	Category	Interpretation
$g \geq 0.70$	High	The intervention is highly effective.
$0.30 \leq g < 0.70$	Medium	The intervention is moderately effective.
$g < 0.30$	Low	The intervention is less effective.

Result

Development Steps of the MARVOCAB Application

The development of the MARVOCAB application at Politeknik Ilmu Pelayaran Semarang follows a systematic design process. The initial phase, planning, involves creating a detailed and structured design tailored specifically to meet the needs of maritime students. This design phase incorporates visual elements such as diagrams and flowcharts to provide clarity and facilitate comprehensive evaluation and refinement . Following the planning stage, the system modeling concept is developed to outline the architecture and operational framework of the software, ensuring all functional requirements are clearly defined.

A critical component of the development process is the database design, which serves as the backbone for data storage within the application. Utilizing an Entity Relationship Diagram (ERD), the design team maps out the relationships and dependencies between data entities to meet the application's organizational needs effectively. The database tables are then structured with defined attributes, primarily focusing on managing administrator accounts and the maritime vocabulary entries essential for student learning. Simultaneously, the interface design phase develops the visual and interactive elements of the application, including the home page, sign-in screen, and dashboard, prioritizing user-friendliness and accessibility to enhance student engagement.

Implementation of the MARVOCAB Application

The production phase translates the planned design into a functional application through programming and interface development. Coding is implemented using PHP Native within the Visual Studio Code environment, while the interface leverages Bootstrap's core UI templates to ensure responsiveness and modern design standards. The application's backend relies on MySQL for database management, hosted on an Apache server integrated within the XAMPP platform. This setup enables seamless interaction between the application components, with the database tables reflecting the previously planned relational structure to maintain data integrity and operational efficiency. In parallel, the interface implementation ensures that the application's layout supports intuitive user interactions. The interface design emphasizes clarity and ease of navigation to help students at Politeknik Ilmu Pelayaran Semarang engage effectively with the application. By combining robust backend development with a user-centered interface, the MARVOCAB application aims to facilitate a smooth learning experience for maritime vocabulary acquisition.

Figure 2. Interface of the MARVOCAB Application Home Page

Evaluation and Refinement of the MARVOCAB Application

Evaluation of the MARVOCAB application was conducted through a rigorous testing and refinement process to ensure reliability and functionality prior to deployment. Black box testing was employed to examine the software's behavior without reference to its internal code structure, focusing on identifying errors in user-facing features. During this testing phase, an error was detected on the "index" page, where the search functionality failed to process specific vocabulary terms, highlighting an issue with database queries. Following error identification, a first-phase improvement was executed, specifically addressing database call errors within the index.php file to restore correct search operations. After successful debugging and validation, the application was deployed by uploading it to a web hosting server, assigning a dedicated domain, and importing the MySQL database to the live server environment. This deployment marked the

transition of MARVOCAB from a development prototype to a fully operational educational tool accessible to students.

Figure 3. Revised Script in the index.php File

Assessment of the Effectiveness of MARVOCAB

The effectiveness of the MARVOCAB application was quantitatively assessed through pretest and posttest evaluations involving 120 students from Politeknik Ilmu Pelayaran Semarang. Before the application was introduced, students scored a total of 228 out of 720 on the vocabulary questionnaire. After engaging with the MARVOCAB application, the total score increased significantly to 604 out of 720. To measure the improvement statistically, the normalized gain (N-gain) method was applied, which is widely recognized for evaluating learning gains in educational research. An N-gain value of 0.77 was calculated, classifying the application's effectiveness as high.

N-Gain Formula:

N-gain = (Post-test Score − Pre-test Score) / (Maximum Score − Pre-test Score)

Calculation:

N-gain = (604 − 228) / (720 − 228)

N-gain = 376 / 492

N-gain = **0.77**

This indicates that MARVOCAB substantially enhanced students' maritime vocabulary acquisition, confirming the application's potential as a valuable educational resource. These findings demonstrate that technology-enhanced learning tools, when properly designed and implemented, can significantly improve the mastery of specialized terminology necessary for maritime careers.

DISCUSSION

MARVOCAB, an educational technology specifically designed for students in merchant marine vocational schools, exemplifies the effective application of technology in vocabulary development. This platform focuses on maritime terminology, which is essential for students pursuing careers in the maritime industry. Students who engaged with the MARVOCAB platform exhibited a marked improvement in their comprehension of maritime vocabulary compared to their peers who did not utilize the software. This substantial advancement highlights the effectiveness of MARVOCAB's customized approach in meeting the distinct lexical needs of its users. The integration of educational software into vocabulary development has garnered significant attention in recent years. Karacan & Akoğlu (2021) indicates that using technology in the classroom can enhance students' learning outcomes by providing interactive and engaging methods for vocabulary acquisition. This aligns with constructivist learning theories, which emphasize active engagement and meaningful context in the learning process.

Digital platforms, particularly those designed with adaptive features and user-centered interfaces, offer learners the opportunity to practice vocabulary in dynamic ways that traditional methods often lack (Chen et al., 2019). Moreover, studies have shown that educational technologies can support differentiated instruction, allowing learners to progress at their own pace while receiving immediate feedback. This personalization is especially beneficial for students with diverse language backgrounds or varying

proficiency levels, as it addresses individual learning needs more effectively than uniform, textbook-based approaches.

The use of software such as MARVOCAB provides clear evidence that tailored vocabulary instruction leads to significant learning gains. MARVOCAB targets the specific lexical needs of its users and integrates features like spaced repetition, gamification, and contextual usage examples. These components directly contribute to increased learner motivation and improved vocabulary retention. The observed improvements in vocabulary acquisition within technology-supported environments indicate that well-designed educational software can effectively enhance, and in some cases exceed, the impact of traditional instructional methods, particularly in terms of learner engagement and measurable outcomes.

Previous studies support that digital tools can significantly enhance vocabulary acquisition, particularly when designed to meet learners' specific needs. For instance, Zaidi et al., (2020) emphasized the importance of repeated exposure and context-rich learning environments in vocabulary developmentboth of which are commonly integrated into educational technology platforms. Similarly, Bhatti et al., (2022) and Fauziah et al., (2023) found that mobile and web-based vocabulary tools improve retention and engagement by offering learners immediate feedback and adaptive learning experiences. Rohmah (2022) further reinforce the idea that gamification elements, such as point systems, interactive tasks, and progress tracking, contribute to increased learner motivation and sustained participation. These features encourage learners to engage more deeply with vocabulary tasks, resulting in greater long-term retention and application. Additionally, Fu et al., (2021) demonstrated that the integration of vocabulary apps into content-specific instruction, such as in scientific or technical disciplines, led to measurable improvements in students' subject-specific vocabulary knowledge. This finding supports the broader implication that digital tools can be especially effective when tailored to the linguistic demands of specific academic or professional domains.

Patahuddin et al., (2017) also found that learners who used context-based digital vocabulary tools acquired a larger vocabulary and exhibited improved accuracy in usage. This outcome suggests that educational technology promotes both lexical knowledge and functional language application as key components of communicative competence. Moreover, educational software often employs gamification techniques, which can significantly increase student motivation and engagement. This finding highlights the effectiveness of educational software in promoting long-term vocabulary retention. Additionally, educational technology provides personalized learning experiences that cater to individual student needs. Furthermore, the use of multimedia resources within educational software can enhance vocabulary comprehension.

Conclusion

This study aimed to develop and measure the effectiveness of the MARVOCAB application for improving maritime vocabulary among students at Politeknik Ilmu Pelayaran Semarang. The research used the Research and Development (R&D) method with three main stages: Planning, Production, and Evaluation. The results show that the MARVOCAB application effectively increased students' mastery of maritime vocabulary. The N-gain score reached 0.77, which falls into the high category. Students showed clear improvement in understanding maritime terms after using the application. The development process followed a structured and systematic approach. Each stage from preparing materials, designing the system and database, to testing and deploying the application ensured the final product met the needs of learners and supported vocabulary development. The MARVOCAB application successfully addressed students' difficulties in learning maritime vocabulary. It improved both their written and spoken communication. This tool is suitable for use in vocabulary instruction at Politeknik Ilmu Pelayaran Semarang and can support student performance during studies and future maritime careers.

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