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Design of a Mobile Microlearning Application for Informatics Learning in Vocational High Schools

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ABSTRACT

The use of mobile devices as a structured learning medium for Informatics subjects in Vocational High Schools (SMK) is still not optimal. This study aims to design an Android-based Mobile Microlearning application that integrates *microlearning* and *mobile learning principles* to support Informatics learning. The study uses a research and development approach with the ADDIE model limited to the development stage, including needs analysis, learning design, application design, and prototype implementation. The results of the study produced an application prototype that presents material in short learning units according to learning outcomes and integrates materials, illustrations, learning videos, exercises, and interactive quizzes in one platform. The application also features simple navigation, user authentication, and direct feedback on assessments to support independent learning. The research findings indicate that the designed application has integrated pedagogical and technological aspects in supporting flexible, structured, and learner-centered learning. This study produced an application prototype that has the potential to become an alternative Informatics learning medium in SMK.

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1. INTRODUCTION

The development of digital technology has brought significant changes to learning practices in vocational education. The increasing availability of mobile devices provides opportunities for students to access learning materials more flexibly without being limited by space and time [1], [2]. The use of mobile technology in education can increase learning motivation and enable more interactive and responsive learning to students' needs [3]. This condition encourages a shift in the learning paradigm from one that was initially centered on delivering material in the classroom to a more adaptive, personalized, and student-oriented learning experience. Learning that optimally utilizes digital technology not only expands access to learning resources but also provides opportunities for students to construct knowledge independently according to their characteristics and learning pace [4], [5], [6]

This need is increasingly evident in Informatics subjects in Vocational High Schools (SMK) [7], [8]. This subject encompasses both conceptual and procedural competencies, requiring students to understand basic concepts, master technical skills, and apply them in various contexts. The complexity of the material is often not matched by adequate learning time, while the diverse characteristics of students lead to differences in their ability to understand the material [9].

Learning, which is still dominated by classical delivery, also limits students' opportunities to review the material independently when experiencing learning difficulties [10], [11]. As a result, the learning process is not fully able to accommodate the individual learning needs that are a key characteristic of vocational education. The microlearning approach offers a relevant alternative to address these challenges by presenting material in short, structured learning units focused on a specific competency. Presenting material in micro-content helps students learn concepts gradually, thereby minimizing cognitive load and enhancing their understanding [12], [13].

The effectiveness of this approach is further enhanced when integrated with mobile learning, which allows materials to be accessed via mobile devices at any time, according to students' learning needs [14], [15]. The integration of these two approaches not only supports flexible learning but also provides opportunities for students to learn independently, review material continuously, and gain a more personalized learning experience.

Various studies have shown that both microlearning and mobile learning contribute positively to increasing student engagement, motivation, and independence [16]. However, most research focuses on implementing learning media or testing their effectiveness after product development. Studies specifically describing the design process for mobile learning-based microlearning applications for Informatics learning in vocational schools are still relatively limited.

The design phase is a crucial foundation that determines the suitability between user needs, material characteristics, learning design, and application features to be developed [17]. The lack of discussion on the design process has resulted in scientific contributions to the design aspects of digital learning being under-represented [9], [18]. This article focuses on the design of a mobile learning-based microlearning application for Informatics learning in Vocational High Schools.

The design process begins with an analysis of learning needs, followed by the development of a microlearning structure, the design of a learning flow, and the design of an application interface tailored to the characteristics of students and Informatics learning outcomes. The results of this study are expected to provide a conceptual contribution in the form of an application design that systematically integrates the principles of microlearning and mobile learning, as well as serve as a reference for learning media developers and educators in designing digital learning applications relevant to the needs of vocational education.

2. METHODS

This study uses a Research and Development (R&D) method focused on the initial design and implementation stages of the application [19], [20]. The research aims to produce a mobile learning-based microlearning application that is ready to be used as an Informatics learning medium in Vocational High Schools (SMK). The scope of the research is limited to the prototype implementation stage , so that validity, practicality, and effectiveness testing have not been carried out and are part of further research [21], [22]. The research stages consist of five activities, namely needs identification, literature study, data collection, application design, and prototype implementation [23], [24]. The research flow is shown in Figure 1 below.

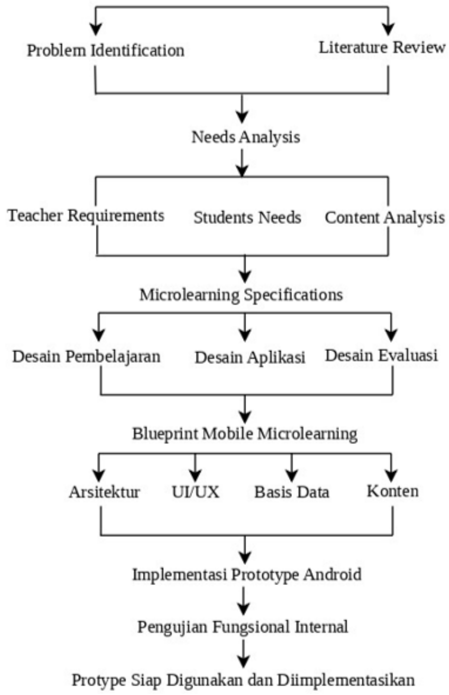

Figure 1. Research Flow

The initial stage was carried out to identify the problems of Informatics learning in vocational schools, student characteristics, and teachers' needs for digital learning media. Identification was carried out to obtain an overview of the application specifications required to meet learning needs [25]. A literature review was conducted by reviewing various references on microlearning, mobile learning, Informatics learning, digital learning design, and relevant previous research. This stage aims to build a conceptual foundation as a basis for designing the application [26], [27].

Data collection was conducted through observation, interviews, and documentation studies [20]. Observations were used to obtain an overview of the Informatics learning process in schools. Interviews were conducted with Informatics subject teachers to identify material needs, learning strategies, and expected application features [28], [29]. Documentation studies were conducted on learning outcomes, learning objectives, teaching modules, and learning tools used as the basis for compiling microlearning content.

The design process begins with the development of a learning structure based on microlearning principles, followed by the design of the system architecture, navigation flow, user interface (UI), user experience (UX), and application database structure. Each material is structured into short learning units containing learning objectives, core materials, supporting media, exercises, and evaluations, creating a flexible and structured learning experience. The design results are then implemented in the form of an Android application. Implementation is carried out by integrating all learning components into the application, resulting in a prototype that has the main functions, including the presentation of microlearning materials, supporting media, exercises, quizzes, and learning navigation. The resulting prototype is ready to be used as a learning medium and serves as the basis for the validation and implementation process in subsequent research.

3. RESULTS AND DISCUSSION

3.1 Result

A. Learning Needs Analysis

The needs analysis stage is the foundation for designing mobile-based microlearning applications [30]. This analysis aims to identify the conditions of Informatics learning, student characteristics, and user needs for learning media that can support a more flexible learning process. This information is obtained through observations of the learning process, interviews with Informatics teachers, and analysis of learning documents covering learning outcomes, learning objectives, and teaching materials [31], [32].

Observations show that Informatics learning at SMK Negeri 1 Siak is still dominated by presentations and direct classroom explanations. Although the school has technology-based learning support facilities, its utilization as a means of independent learning is not optimal. The learning process takes place primarily during face-to-face sessions, leaving students with limited opportunities to review the material outside of class. This presents a challenge, especially for conceptual and procedural materials, as they require a gradual learning process and repeated practice.

Interviews with teachers revealed that students have varying levels of understanding of Informatics materials. Differences in initial abilities mean that some students require more time to grasp concepts than others. Furthermore, limited learning time makes it difficult for teachers to provide individual support to all students. Teachers also reported that nearly all students own Android-based smartphones for daily use, but these devices are not yet being optimally utilized as learning tools.

Analysis of learning documents shows that Informatics material consists of a number of interrelated competencies, thus requiring systematic presentation. The delivery of material in a single meeting often includes several concepts simultaneously, so students experience difficulty in understanding the relationships between concepts. This condition indicates the need for learning media that can present material in small, structured, and easy-to-learn sections in stages according to the characteristics of microlearning. This finding is in line with the research assumption that Informatics material requires learning media that is flexible, concise, and adaptive to students' needs.

Based on the needs analysis, several specifications were formulated that the developed application must meet. The application must be accessible via Android devices, present material in short learning units, provide visual aids to support conceptual understanding, and be equipped with exercises and evaluations to help students monitor their learning progress. Furthermore, the application must have a simple interface so it is easy to use without requiring intensive teacher guidance.

Table 1. Results of User Needs Analysis

Analysis Aspects	**Analysis Results**	**Implications for Design**
Characteristics of students	Most of them have Android smartphones and are used to using digital technology.	The application is developed based on Android so that it can be easily accessed at any time.
Informatics Learning	The material is conceptual and procedural and requires gradual practice.	The material is arranged in structured microlearning units.
Learning Activities	Learning is still dominated by face-to-face and learning time is limited.	The application supports independent learning outside the classroom.

Teacher needs	Media are needed that can help deliver material more flexibly.	The application is equipped with materials, videos, exercises, and quizzes to support learning.
Student needs	Requires media that is easy to use, interesting, and can be accessed repeatedly.	The interface is designed to be simple, responsive, and easy to navigate.

The results of the needs analysis indicate that the development of a mobile- based microlearning application is highly relevant to the characteristics of Informatics learning in vocational schools. Utilizing mobile devices already owned by students provides an opportunity to provide a more flexible learning experience by presenting material in small units (micro-content). This finding supports various previous studies that state that the integration of microlearning and mobile learning can increase learning flexibility, support independent learning, and help students understand complex material gradually. Therefore, the results of the needs analysis serve as the main basis for compiling learning designs and designing the features of the developed application.

B. Microlearning Learning Design

The results of the needs analysis serve as the basis for developing the learning design implemented in the application. The learning design refers to the principle of microlearning, namely the presentation of material in short, focused learning units, and oriented towards achieving a single competency in each learning session. This approach was chosen to accommodate the characteristics of vocational high school students who have varying learning speeds and require flexible learning media that is easily accessible via mobile devices. The preparation of material in the form of micro-content is expected to reduce students' cognitive load so that the process of understanding concepts can occur gradually.

The learning structure is designed based on the learning outcomes and objectives of the Informatics subject in the material focused on by the research. Each topic is analyzed and then broken down into several sequential learning units. Each unit contains only one main concept so that students can learn the material gradually before moving on to the next. This structure allows students to review the material as needed without having to study the entire topic simultaneously.

Each microlearning unit consists of several main components: learning objectives, presentation of core material, supporting media, exercises, and a brief evaluation. Learning objectives are presented at the beginning of each unit as a guide to the learning outcomes that students must master. The core material is written using simple language and is complemented by illustrations to facilitate conceptual understanding. The presentation of the material is supported by visual media and learning videos so that students obtain a more concrete representation of the concepts. After studying the material, students can complete exercises and quizzes as a form of feedback on their level of mastery.

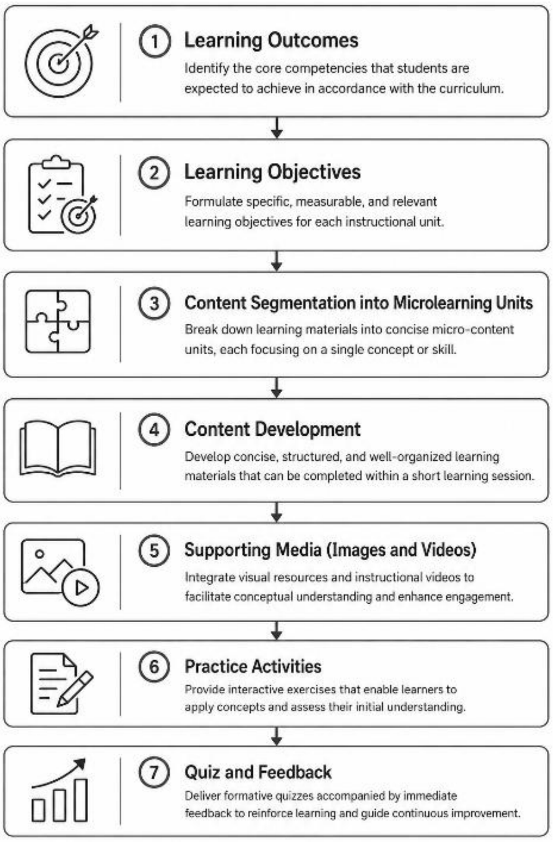

Figure 2. Microlearning Learning Planning Flow

The learning design also adheres to the principle of self-paced learning, which allows students to determine the time, place, and pace of learning according to their individual needs. Through an Android-based application, students can re-access each learning unit without relying on a face-to-face class schedule. This flexibility is expected to increase learning opportunities and assist students who need to review material before moving on to the next competency. Microlearning principles in this study is demonstrated not only by breaking down the material into smaller units but also through the systematic arrangement of learning activities. Each unit is designed to have a clear relationship between learning objectives, materials, supporting media, exercises, and evaluations, creating a cohesive learning experience. This approach aligns with the characteristics of microlearning, which emphasizes concise, structured, and easily learned content presentation in a short time, while also supporting independent learning through the use of mobile devices.

Table 2. Microlearning Learning Structure

Learning Unit	Learning Components	Objective
Unit 1	Learning objectives and core material	Introducing the basic concepts of Informatics material.
Unit 2	Advanced material with illustrations	Deepen understanding of concepts.

Unit 3	Learning videos	Provides visualization of concepts and procedures.
Unit 4	Exercise	Measuring students' understanding of each unit.
Unit 5	Quizzes and feedback	Provide initial evaluation of learning outcomes.

This learning design serves as the basis for developing mobile learning applications. The alignment between material structure, learning activities, and student characteristics is expected to produce a more focused, flexible learning experience that supports Informatics learning in vocational schools. Furthermore, this design serves as a reference in determining the features implemented in the application, ensuring that each component has a clear pedagogical function, rather than simply serving as an interface element.

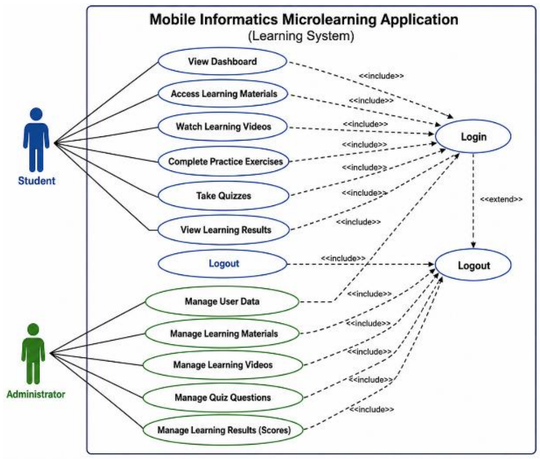

Figure 3. Use Case Diagram of the Informatics Mobile Microlearning Application

Figure 3 shows the Use Case Diagram of the Mobile Microlearning application, which illustrates the interaction between users and the system. The application involves two main actors: students and administrators. Students have access rights to authenticate (log in), access learning materials, watch videos, do exercises and quizzes, view learning outcomes, and log out of the application. Meanwhile, the administrator is responsible for managing user data, learning materials, videos, quiz questions, and learning outcomes so that all content in the application can be updated according to learning needs. The design of these functions aims to build an application that is not only easy to use by students but also makes it easier for teachers to manage learning resources centrally.

C. Application Prototype Implementation

This section explains that the design results have been implemented into an Android application that can be used as a learning medium for Informatics. The application contains several key integrated features, namely the main page (home), learning material menu, supporting videos, and interactive quiz-based assessments. The implementation was carried out by considering ease of navigation, interface consistency, and the relationship of each feature to the previously designed microlearning flow.

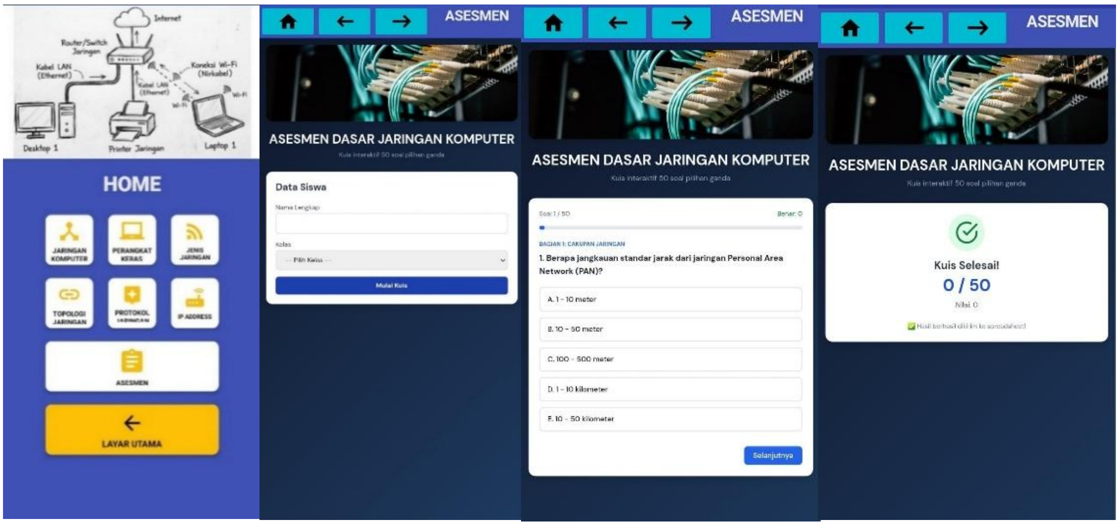

Figure 4. Initial Product Components

The homepage is the application's homepage and navigation center, designed to facilitate student access to all learning materials. The main menu is structured based on the Informatics material structure, which includes Computer Networks, Hardware, Network Types, Network Topologies, Network Protocols, IP Addresses, and Assessments. The menu is structured using simple icons and a grid-based layout, making it easier for users to recognize the function of each menu item. In addition to enhancing usability, this navigation structure also supports the characteristics of mobile learning , which emphasizes quick access to learning resources via mobile devices [33], [34].

Before starting the quiz, students are asked to fill in their identity details, including their full name and class. This information is used to record assessment results, allowing each score to be linked to the student participating in the lesson. This mechanism supports the process of documenting learning outcomes while also facilitating teachers in monitoring student progress. The assessment feature is structured as an interactive quiz consisting of 50 multiple-choice questions. Each question is presented in stages, allowing students to focus on one problem at a time. The quiz interface also features a progress indicator and information on the number of correct answers obtained during the course. This presentation supports the principles of microlearning, which provides a structured, focused learning experience and allows students to receive feedback gradually [35], [36].

After all questions are completed, the application displays a summary of the assessment results, including the number of correct answers, the score obtained, and the data storage status. Assessment results are automatically sent to a database so teachers can access student learning outcomes for evaluation purposes. Providing direct feedback is expected to increase student awareness of learning outcomes and encourage them to repeat the material if their results are not optimal [37].

Table 3. Implementation of Mobile Microlearning Application Features

Feature	Function	Microlearning Implementation
Computer network	Presents basic networking concepts	The material is presented in short learning units.
Hardware	Explaining the devices that make up a network	The material is equipped with illustrations to clarify the concept.
Network Type	Explaining network classification	Presentation of material in stages according to competency.
Network Topology	Explaining various forms of topology	Equipped with images to make visualization easier.
Network Protocol	Explain the function of communication protocols	The material is presented concisely and is easy to understand.
IP Address	Explain the concept of network addressing	The material is accompanied by examples of application.
Assessment	Measuring student understanding	Interactive quizzes with automatic feedback.

Overall, the implementation of the application's features demonstrates a strong integration between pedagogical and technological aspects. Each feature serves not only as a navigation menu but is also designed to support a systematic learning flow, from material presentation and concept reinforcement through visual media to evaluation of learning outcomes. This integration demonstrates that the application meets the basic characteristics of microlearning and mobile learning , namely providing a concise, flexible, interactive, and student-centered learning experience in Informatics learning in Vocational High Schools [38].

These findings align with previous research showing that presenting material in small units (learning chunks) can increase learning flexibility and make it easier for students to understand complex material through mobile devices [39], [40]. The integration of concise content, visual media, and interactive assessments also supports the creation of a more independent and adaptive learning experience in accordance with the characteristics of microlearning. Thus, the designed application not only meets the functional needs as a digital learning medium but also implements relevant pedagogical principles to support Informatics learning in vocational high schools [41].

3.2 *Discussion*

The research results show that the designed Mobile Microlearning application has integrated microlearning principles into the learning design and application features. This integration is evident in the presentation of material in concise, competency-oriented learning units, and is arranged sequentially starting from the delivery of concepts, provision of supporting media, exercises, and assessments [42], [43]. This learning structure allows students to learn the material gradually without having to process large amounts of information at one time. This approach is in line with the concept of learning chunks in microlearning , namely breaking material into smaller, more easily understood parts, thereby reducing students' cognitive load and increasing the effectiveness of the learning process [44], [45].

The characteristics of microlearning are also reflected in the provision of short but continuous learning activities. Each unit of material is equipped with illustrations, visual media, and interactive quizzes that provide immediate feedback after students complete the learning. The integration of material, media, and assessment creates a learning experience that is not only centered on delivering information but also encourages students to reflect on their learning outcomes [46], [47]. Thus, the application functions not merely as a storage medium for material but also as a digital learning environment that supports independent learning through a systematic learning cycle [48], [49].

From a technological perspective, Android-based application development offers flexibility that aligns with the characteristics of mobile learning [50]. A needs analysis shows that most students already own smartphones and are accustomed to using them in their daily activities. This presents an opportunity to expand access to learning resources without being limited by space and time. Implementing applications on mobile devices allows students to access materials, review learning, and complete assessments independently outside of face-to-face hours. This flexibility is one of the advantages of mobile learning because it provides more personalized learning opportunities tailored to the needs and learning pace of each student [51], [52].

The findings of this study also demonstrate that the success of mobile learning implementation is determined not only by the use of digital devices, but also by the integration of learning design and application features. The material menu, visual illustrations, learning videos, and interactive assessments are designed as a unified whole that mutually supports the learning process. This approach demonstrates that pedagogical aspects are the primary foundation in application development, enabling technology to function as a learning facilitator, not simply a medium for conveying information [53], [54].

Compared to previous studies, the developed application shares similar characteristics in utilizing microlearning to increase learning flexibility and support independent learning. However, this study offers a more specific contribution through the integration of microlearning with mobile learning in Informatics subjects in Vocational High Schools. Learning materials are structured based on learning outcomes, then translated into microlearning units that are implemented directly in the Android application. This approach demonstrates that microlearning principles are not only applied to content presentation but also form the basis for designing learning flows, navigation structures, supporting media, and assessment mechanisms [55], [56].

Another contribution of this research lies in the development of an application that integrates the needs of students and teachers into a single learning system. Students gain access to materials that can be flexibly studied through mobile devices, while teachers gain access to tools that facilitate material management and monitoring of student learning outcomes. The integration of these two needs makes the application not only suitable for use as a self-learning medium but also has the potential to support the implementation of digital learning in Informatics subjects in Vocational High Schools [57], [58].

However, this research still focuses on the design and implementation stages of the application prototype, so its effectiveness in improving learning outcomes has not been evaluated through trials with students. Further testing is needed to examine the effect of application use on cognitive aspects, learning motivation, student engagement, and user experience. These findings can form the basis for developing further research so that the designed application not only meets the design aspects but also has empirical evidence regarding its effectiveness in Informatics learning.

4. CONCLUSION

This research resulted in a prototype of an Android-based Mobile Microlearning application that integrates microlearning and mobile learning principles into Informatics learning in Vocational High Schools. The application is designed with structured materials, simple navigation, and learning and assessment features that support a flexible, interactive, and learner-centered learning experience. Therefore, the resulting prototype has the potential to become an alternative digital learning medium to support Informatics learning in Vocational High Schools and serve as a basis for further research on the validity, practicality, and effectiveness of its use.

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