Mathematics Learning Management System (MLMS) Based on Vocational Realistic Education (VRE)

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Abstract. The concept of Vocational Realistic Education (VRE) integrates students' real-life experiences with contextual problem-solving relevant to their vocational fields. To implement this approach effectively, mathematics teachers in vocational schools must adopt pedagogical strategies that align with digital advancements. A Learning Management System (LMS) serves as a valuable tool to support this integration. While previous studies have demonstrated the benefits of combining LMS with realistic learning approaches, several challenges persist in implementing hybrid mathematics instruction. This study aims to develop a prototype of a VRE-based mathematics LMS and evaluate its effectiveness through limited field trials involving vocational school teachers and students. The research consists of three main phases: (1) problem and needs analysis, system survey, design, development, and initial implementation; (2) technical assistance and technology transfer; and (3) product evaluation. This article discusses the system development stage, including design, construction, and limited implementation. The resulting LMS prototype aligns with the instructional needs of vocational education, with several improvements identified during pilot testing in terms of user interface, functionality, and system security.

Keywords: Hybrid Learning, Learning Management System, Realistic Mathematics, System Development, Vocational Education

1 Introduction

The rapid advancement of digital technology has compelled vocational education institutions to transform their learning models to remain relevant and responsive to the demands of the 21st century. Vocational schools (SMKs) in Indonesia are expected to produce graduates who are not only theoretically competent but also capable of applying knowledge and skills aligned with real-world industrial needs. In this context, mathematics education is often perceived as abstract and disconnected from vocational practice, requiring urgent reform to become more meaningful, contextual, and applicable (Abaté & Cantone, 2005).

One promising pedagogical framework for this transformation is *Vocational Realistic Education* (VRE), which adapts principles from *Realistic Mathematics Education* (RME). VRE emphasises the integration of mathematical concepts with real-life vocational contexts, enabling students to understand mathematics as a functional

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tool to solve domain-specific problems (Pratiwi & Widjajanti, 2020; Yonathan & Seleky, 2023). Instead of treating mathematics as a collection of abstract formulas, the VRE approach positions it as applied knowledge that supports tasks and decisions in professional settings. This shift is significant in vocational education, where students benefit from learning experiences that are grounded in relevance and practicality.

Implementing VRE in mathematics instruction, however, requires a learning system that accommodates the diverse characteristics of vocational students, including variations in learning styles, technological readiness, and time constraints. A Learning Management System (LMS) offers a promising solution in this regard. LMS platforms can support structured, interactive, flexible learning environments, allowing educators to design and deliver content that is accessible anytime and anywhere (Bradley, 2020; Munna et al., 2024; Sohaib et al., 2025). It was also found to be very feasible for improving learning satisfaction and facilitating online learning adaptation in a vocational high school (Rabiman et al., 2020; Meiramova et al., 2025). Within blended learning models, an LMS facilitates not only the delivery of content but also continuous assessment and feedback, promoting both learner autonomy and engagement.

Although LMS technology has been widely adopted in general education, a gap remains in the development of LMS platforms tailored to the needs of vocational education, particularly regarding the VRE approach in mathematics instruction. This gap is especially evident in contexts where mathematics content remains disconnected from students' vocational fields, and where educators face challenges in developing and delivering contextually relevant digital materials. In many vocational schools, the lack of integration between instructional technology and vocational learning outcomes contributes to student disengagement and limited conceptual understanding (Main, 2004).

In response to these challenges, this study aims to develop a Mathematics Learning Management System based on the Vocational Realistic Education approach. The research seeks to design a contextualised, adaptive LMS that meets the needs of vocational mathematics instruction. The study further investigates the system's effectiveness in enhancing students' understanding, motivation, and engagement by linking mathematical concepts to their vocational specialization and real-world applications.

2 Methodology

2.1 Research Stages/Research and Design (R&D)

The proposed research is scheduled to be conducted over a period of six months. The development process follows the ADDIE instructional design model, which consists of five systematic phases: Analysis, Design, Development, Implementation, and Evaluation (Sugiyono, 2019). In its implementation, modifications were made to the Development, Implementation, and Evaluation stages by incorporating research procedures aligned with the Tetra-Helix Model Concept developed in the previous year (Putrawan & Ayuni, 2022). The primary outcome of this research is a prototype of a mathematics Learning Management System (LMS) based on the Vocational Realistic Education (VRE) approach. In addition to the prototype, supplementary outputs include

product trial documentation, which consists of an implementation analysis and a review of teacher responses collected through structured questionnaires. The system's effectiveness is evaluated based on the observed improvements in mathematics teaching practices among vocational school teachers following the intervention. Data from the product trials were analysed using statistical methods to assess the system's impact, with all research participants included in the analysis. The following section outlines the development process and provides a detailed description of each stage.

Analyse. This stage carries out a needs analysis and curriculum analysis. A needs analysis was conducted to assess the initial environment, current teaching conditions, and any challenges faced by teachers, as well as the mathematics learning media used in vocational schools. The analysis aimed to identify the innovations required as outputs of the research collaboration. Curriculum analysis is conducted to determine the material and competency requirements that teachers must master.

Design. this stage is divided into two phases, namely designing research instruments and designing a mathematics learning management system. The research instruments prepared include validity test sheets, system implementation sheets, and response questionnaires from students, teachers, and DU/DI partners. Meanwhile, system design is carried out based on the results of the needs analysis carried out in the previous stage.

Develop. This stage carries out system prototyping with the following details.

Focus group discussion. It involves representatives from academia, education, and research. Discussions were held to gain a comprehensive understanding of the teachers' conditions, the curriculum, and the mathematics content provided during learning. This is done to identify potential problems that may be present in the system being developed.

Prototyping. This phase involved designing a prototype mathematics learning management system in the form of a VRE-based e-learning system. Development is carried out while taking into account the review of related literature as well as the results of relevant previous research. The preparation of teaching content is adapted to the material presented in the syllabus and used directly. This process was also accompanied by validation carried out by two experts in the fields of mathematics education and educational technology.

Product Implementation and Evaluation. The mathematics learning management system prototype, which had been declared valid, was then tested on a limited basis involving a small number of students from a vocational school, representing the entire population. The selection of students is adjusted to the teaching content being prepared. In the research carried out, limited product trials were conducted to assess the implementation of the prototype, which was structured according to the stages of the developed model. The evaluation results from the limited trial implementation are then analyzed for further revision.

Dissemination. It was carried out by presenting research results to stakeholders to obtain suggestions and improvements to the model developed.

The flow diagram of the research implementation stages described above is presented in Figure 1.

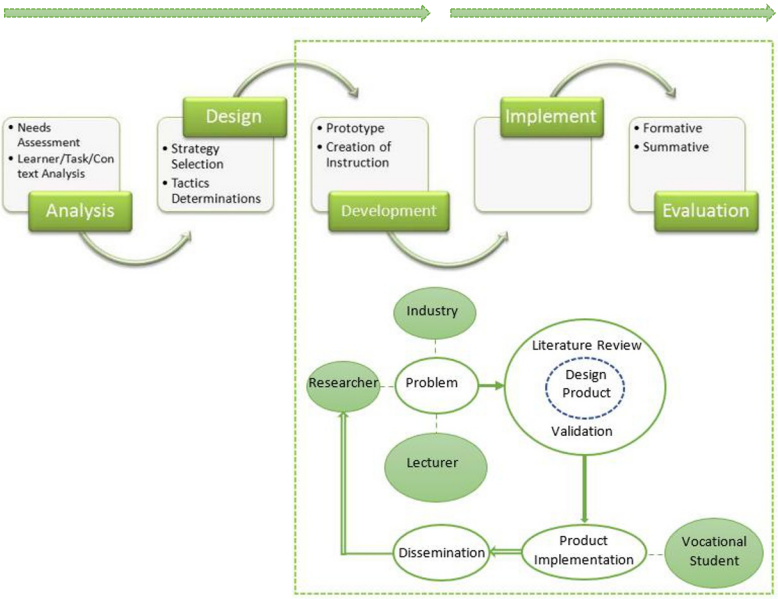


Figure 1. ADDIE's Core Elements are Based on the Tetra-Helix Model Concept

2.2 System Development Procedures

The development of a VRE-based mathematics learning management system prototype at the Prototyping stage above follows the procedures established in the software development life cycle as depicted in Figure 2.

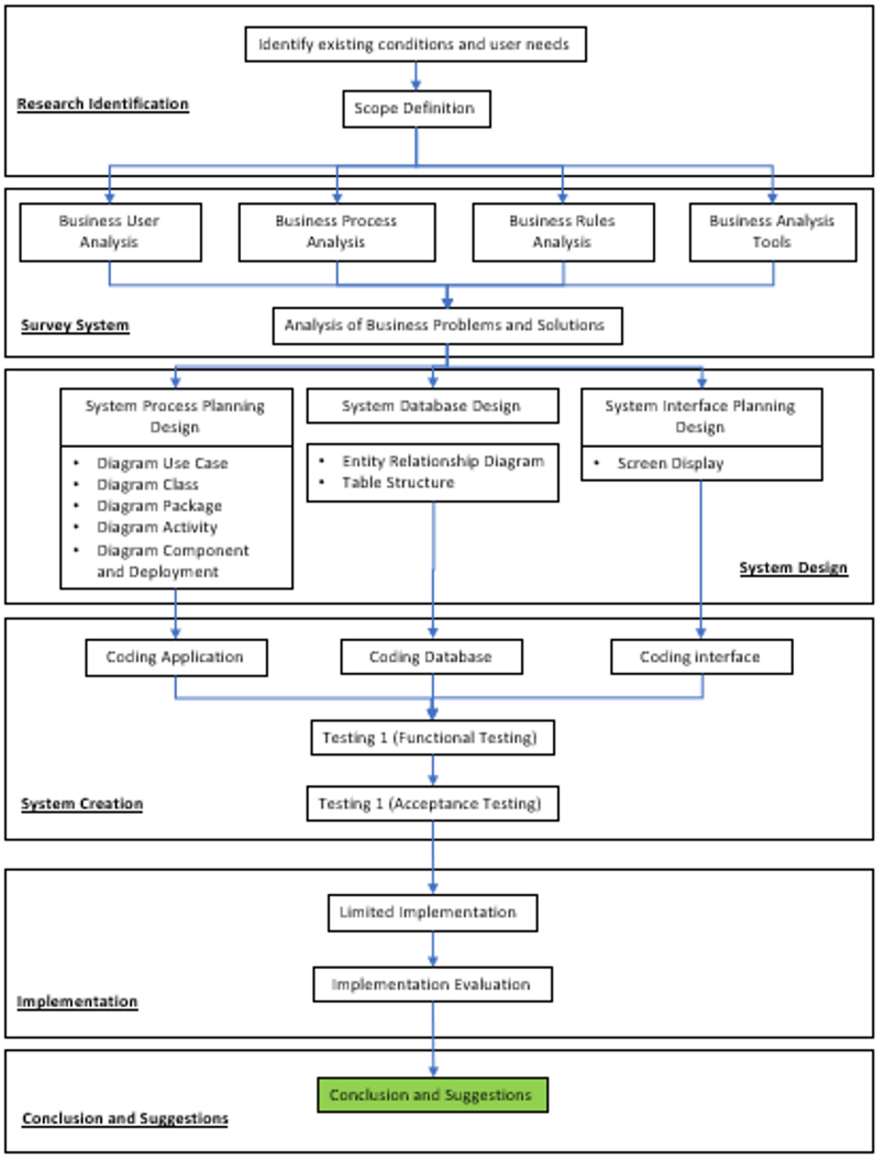


Figure 2. System Development Life Cycle

System Survey. At this stage, two activities are carried out, namely identifying the conditions of existence and user needs, and defining the scope of work. Identification of existing conditions is conducted through interviews, observation, and review of existing documentation. Meanwhile, user needs surveys are carried out using limited online surveys.

System analysis. It is carried out after the conditions of existence and user needs have been identified, and the scope of application and work has been defined. Several key points are analyzed at this stage, including business users, business processes, business rules, business tools, and business problems and solutions.

System Design. The system design stage is divided into three types, namely system process design, system database design, and system interface design.

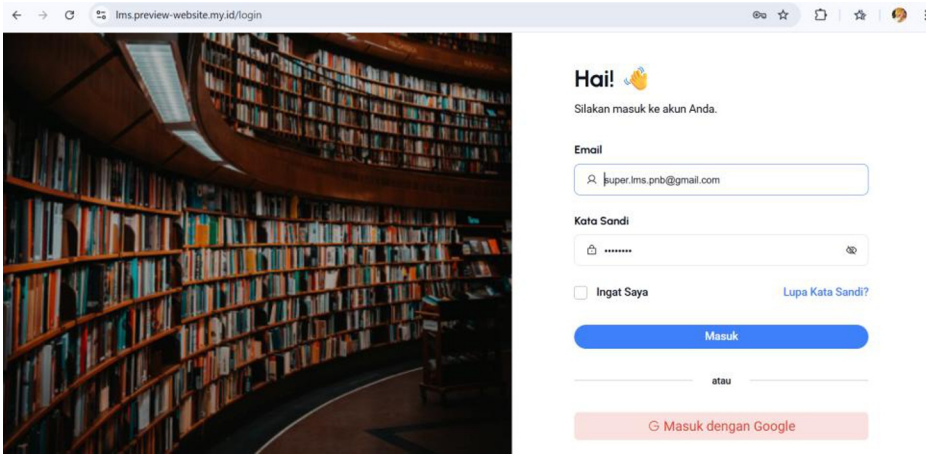
System Creation (Coding). It is carried out after all the designs have been completed. System creation involves creating a system database, an application program, conducting testing and evaluation, and developing a user manual.

System Implementation. Although limited overall testing was carried out, the mathematics learning management system, in the form of VRE-based e-learning, is ready to be implemented in wider field trials.

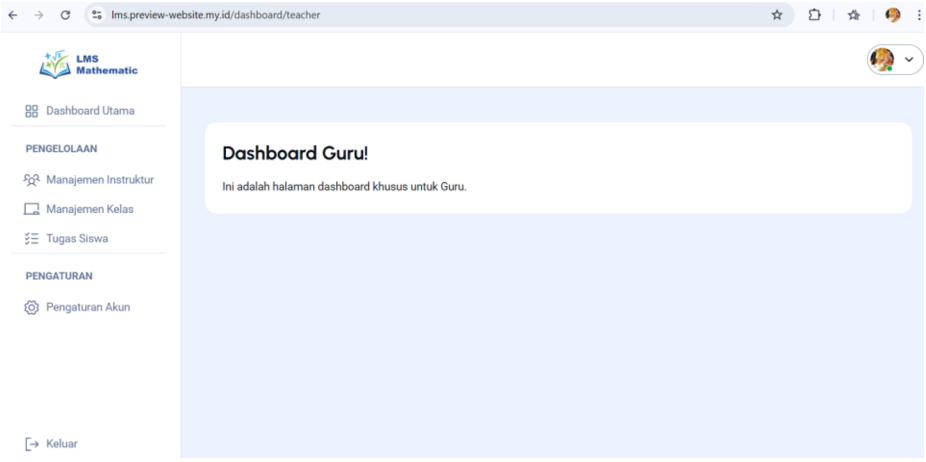
3 Result and Discussion

3.1 Result

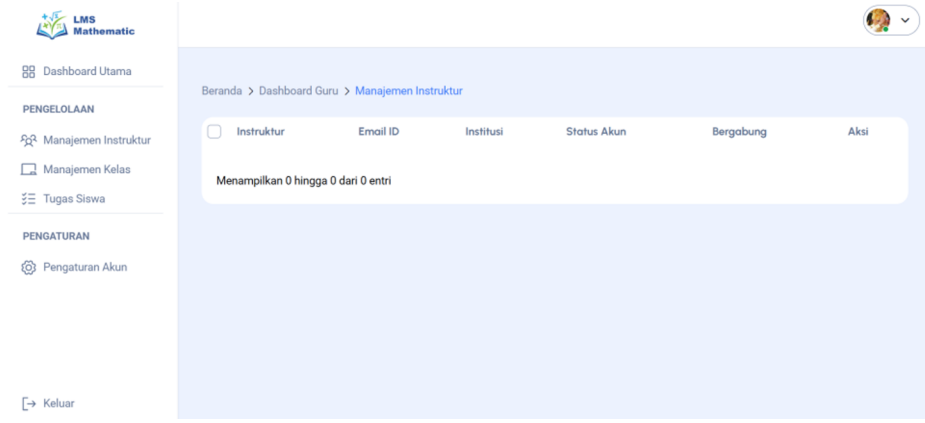
The research carried out successfully developed a mathematics learning management system prototype ready for use by vocational school partners. The resulting website still requires limited testing before being deployed on a broader scale. The following is the user interface of the product produced in the research.



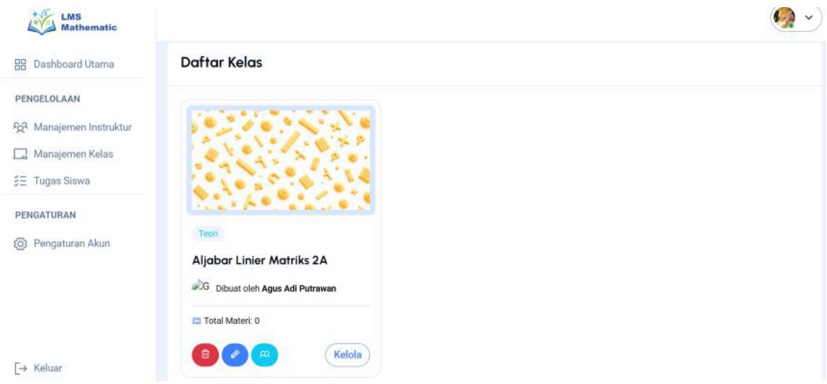
(a) Login Page (in Indonesian)



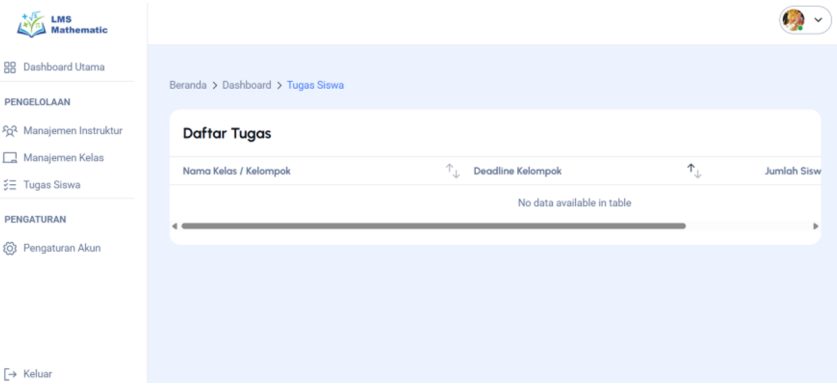
(b) Dashboard (in Indonesian)



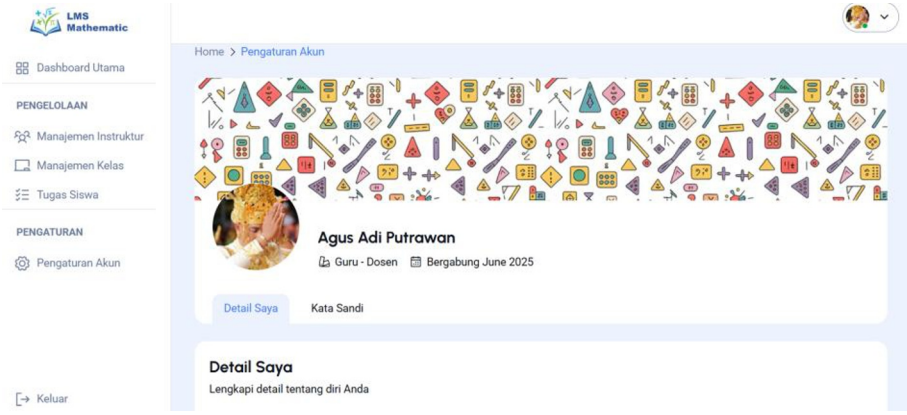
(c) Instructor Management Page (in Indonesian)



(d) Class List Page (in Indonesian)



(e) Assignment List Page (in Indonesian)



(f) Account Setting (in Indonesian)

Figure 3. The User Interface of the Mathematics Learning Management System

Further activities in this research include enhancing the products and conducting limited testing to assess the implementation of media in vocational school learning. Additionally, the research results obtained will be disseminated at international conferences, with the primary output being the publication of international proceedings.

3.2 Discussion

The development of the VRE-based Mathematics Learning Management System (MLMS) provides a meaningful response to long-standing challenges in vocational mathematics education. Mathematics instruction in SMKs has often been criticised as abstract and disconnected from vocational practices, resulting in low engagement and limited conceptual understanding. The prototype addresses this gap by embedding mathematical concepts within vocationally relevant contexts, enabling students to transition from abstract theory to applied knowledge.

In addition, the LMS platform mitigates practical challenges faced by vocational teachers, such as limited instructional time, diverse learning needs, and the demand for flexible access to materials. Teachers reported more structured and interactive instruction, while students indicated greater motivation and stronger perceived relevance of mathematics to their vocational field. These findings demonstrate the system's potential not only to improve mathematical comprehension but also to enhance students' readiness for industrial demands. The prototype thus serves as both an instructional innovation and a strategic response to the broader agenda of aligning vocational education with 21st-century skills and digital learning ecosystems.

4 Conclusion

This research successfully developed a prototype of a Mathematics Learning Management System (LMS) grounded in Vocational Realistic Education (VRE). The initial implementation showed promise in bridging abstract mathematical concepts with vocationally meaningful applications. To maximise its instructional impact and scalability, further development is required, particularly in expanding content and refining features to accommodate the needs of diverse vocational programs. In light of the findings, the prototype not only represents a technological innovation but also addresses critical gaps in vocational mathematics education, offering a practical and adaptable model for broader educational contexts.

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