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Development of a Project-Based Learning Management System to Improve VLAN Configuration Competence (Case Study of Class XI TKJ Students at SMKN 1 Surabaya)

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ABSTRACT

Objective: This study aims to develop a Moodle-based Learning Management System (LMS) integrated with a Project-Based Learning (PjBL) approach and to examine its effectiveness in improving Virtual Local Area Network (VLAN) configuration competencies among eleventh-grade students of the Computer and Network Engineering (CNE) program at SMKN 1 Surabaya. **Method:** The research employed a Research and Development (R&D) method using the ADDIE model. The subjects were an experimental and a control class. Data were collected through expert validation, cognitive tests, and psychomotor performance assessments. Data analysis was conducted using the Mann-Whitney U test and the independent-samples t-test based on the data distribution. **Results:** The developed LMS demonstrated very high feasibility, with a media validation score of 93.3%. Statistical analysis revealed significant differences in both cognitive and psychomotor competencies between the experimental and control groups ($p < 0.05$). These findings indicate that integrating a Moodle-based LMS with the PjBL approach effectively enhances students' VLAN configuration competencies in vocational education. **Novelty:** The novelty of this study lies in the explicit integration of Project-Based Learning syntax into the design and functionality of a Moodle-based LMS for VLAN configuration practice, enabling a balanced development of theoretical understanding and psychomotor skills within a vocational, project-oriented learning context.

INTRODUCTION

The development of information and communication technology has driven significant transformations in educational practices, particularly in vocational education, which demands a strong link between learning and workplace needs (Deaconu et al., 2018; Khan & Markauskaite, 2018). Vocational High Schools (SMKs) are required to produce graduates who not only understand theoretical concepts but also possess measurable practical competencies aligned with industry standards. However, various studies show that conventional lecture and demonstration-based learning still dominates vocational classes, resulting in low conceptual understanding and application skills for students, particularly in technical and procedural material such as Virtual Local Area Network (VLAN) configuration (Maritsa et al., 2021; Ayu, 2024).

The main problems that frequently arise in learning network infrastructure administration are limited time for practical work, a lack of interactive media, and low student engagement in the learning process (Mutohhari et al., 2021). These conditions make it difficult for students to connect networking concepts with real-world applications. Previous research reported that more than half of vocational high school students are unable to comprehensively understand networking material when learning relies solely on conventional methods without the support of structured digital media (Dila & Anggraeni, 2023). This situation indicates a gap between competency-based learning objectives and classroom learning practices.