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Effectiveness of Moodle-Based E-Learning Development with the Addie Model in Vocational High Schools

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Abstract
The utilization of technology in vocational education is crucial for overcoming the limitations of face-to-face learning and enhancing student competence. This study aims to analyze the implementation of a Moodle-based Learning Management System (LMS) developed using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model within Vocational High Schools (SMK). The method employed was a systematic literature review of 11 scientific articles published between 2016 and 2025. The analysis results indicate that the ADDIE model provides a structured framework to ensure the media's validity and feasibility. Moodle proved to be flexibly applicable across various expertise spectrums, ranging from Information Technology, Automotive Engineering, and Electrical Engineering to Office Administration. The main findings demonstrate that Moodle implementation consistently significantly improves student learning result, is considered valid by media and material experts, and receives positive responses from users. Recent trends in 2025 highlight the integration of Moodle with the Project-Based Learning (PjBL) model and the Computational Thinking (CT) approach to address industrial needs.

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1. INTRODUCTION

Vocational High Schools (SMK) face dual challenges in the digital era: the demand for high-quality industry competencies and the limited time available for face-to-face learning to deliver complex vocational material. Conventional learning methods, dominated by lectures, often leave students passive and uninterested, resulting in poor learning outcomes. To address this, innovative learning media that can be accessed flexibly without the constraints of space and time are needed, one way being through the use of technology, *E-Learning*. *E-learning allows* the educational process to occur without direct face-to-face meetings, and the delivery of knowledge to students can be done easily using internet media or computer networks.

One of the most dominant E-Learning platforms used in developing learning media Learning *Management System* (LMS), based Moodle (*Modular Object-Oriented Dynamic Learning Environment). Theoretically*, Moodle is defined as web-based software designed to help educators create online learning with a focus on student interaction and knowledge construction. Moodle's main advantage lies in its comprehensive features that can create a "digital classroom." Moodle not only functions as a material repository but also provides interactive features such as *online* quizzes, discussion room (forum), assignments (*assignment*), to track student progress (*tracking This* flexibility allows Moodle to

accommodate a variety of learning styles, be accessible anywhere and anytime, and support both independent and collaborative learning.

However, the successful implementation of technology like Moodle depends not only on sophisticated software but also on systematic instructional design. This is where the ADDIE development model plays a crucial role. ADDIE is a learning systems design framework consisting of five cycle stages: *Analysis* (Analysis), *Design* (Design), *Development*, Implementation, and *Evaluation*. The stages in detail are:

- *Analysis:* The stage of analyzing student needs, curriculum, and student characteristics to determine appropriate problems and solutions.
- *Design*: The stage of designing the material structure, learning flow (flowchart), delivery strategy, and assessment instruments.
- *Development*: Product realization stage, digital content creation, and validation by subject matter experts and media experts.
- *Implementation*: The stage of testing media in real learning situations for students to determine its effectiveness.
- *Evaluation*: Formative and summative assessment stages to measure the validity, practicality, and effectiveness of media on learning outcomes.

The ADDIE model has been chosen in many development studies due to its logical, structured, and product-oriented nature, which is both valid and effective. The integration of Moodle's advanced features with the ADDIE systematic framework is expected to produce learning media that are not only visually appealing but also pedagogically valid and effective in improving the competency of vocational high school students.

This article aims to synthesize 11 selected studies (2016–2025) that applied the ADDIE model to develop Moodle in a vocational high school environment. The goal is to map the effectiveness of Moodle use across departments, test the validity of products generated through the ADDIE stages, and identify the latest pedagogical trends integrated into the LMS.

Table 1. List of Journal Articles and Proceedings Related to the Development of E-Learning Moodle in Vocational Schools Using the ADDIE Model

No	Penulis	Judul	Tahun
1	Alfin Ridha Mafaza	Pengembangan Media Pembelajaran E-Learning Berbasis Moodle Pada Mata Pelajaran Sistem Operasi Di SMK Negeri 3 Bojonegoro	2016
2	Zyazyang Leo Pratama dan Meini Sondang Sumbawati	Pengembangan Media Pembelajaran E-Learning Berbasis Moodle Pada Mata Pelajaran Administrasi Server Di SMK YPM 1 Taman	2017
3	Nur Indah Sari, Abdul Muis Mappalotteng, Bakhrani A Rauf	Pengembangan Pembelajaran E-Learning Berbasis Poodle (Portable Moodle) Pada Mata Pelajaran Komputer Dan Jaringan Dasar Di SMK	2018
4	Arrika Febby Suci Deandan Sari dan Meylia Elizabeth Ranu	Pengembangan Media Pembelajaran E-Learning Menggunakan Moodle Pada Mata Pelajaran Administrasi Sarana Dan Prasarana Untuk Siswa Kelas XI APK 3 Di SMK PGRI 13 Surabaya	2019

No	Penulis	Judul	Tahun
5	Ign. Hendra Wicaksono, Mustaji, Retno Danu	Pengembangan Media E-Learning Dengan Pemanfaatan Aplikasi Moodle Sebagai Bahan Ajar Siswa Kelas X di SMK Kristen Petra Surabaya	2019
6	Feber Dhika Purba, Hamonangan Tambunan	Pengembangan Media Pembelajaran E-Learning Menggunakan Moodle Berbasis E-Modul Pada Pembelajaran Intalasi Penerangan Listrik Untuk Kelas XI TITL SMK Swasta Imelda Medan	2021
7	Indra Maulana, Mohammad Rega Permana	Rancang Bangun Media Pembelajaran E-Learning Di SMK Negeri 1 Majalengka	2021
8	Rivaldo Akmalul Akhsan, Jan Wantoro	Implementasi E-Learning Berbasis Moodle Pada Mata Pelajaran Informatika	2024
9	Alvina Febrianti, Bambang Sujatmiko	Pengembangan LMS Moodle Berbasis PjBL dengan Pendekatan Computational Thinking untuk Meningkatkan Kompetensi Junior Web Developer	2025
10	Lulu'ul Janah, Adhetya Kurniawan	Pengembangan Learning Management System Berbasis Moodle Pada Kompetensi Dasar Perawatan Sistem *Continuously Variable Transmission*	2025
11	Yazid Fatihur Rizki, Bambang Sujatmiko	Pengembangan LMS Moodle Berbasis PjBL Untuk Meningkatkan Programmer Dasar di SMK Semen Gresik	2025

2. RESEARCH METHODS

This research uses a literature study method (*literature review*) by analyzing 11 journal articles, documents, and proceedings related to the development of e-learning Moodle in vocational schools uses the ADDIE model. The literature review spans from 2016 to 2025. Data was obtained through a review of scientific articles and other sources supporting the discussion. The collection process began with selecting literature based on topic relevance criteria. After data collection, analysis was conducted using a qualitative descriptive approach, interpreting the literature to identify key concepts, patterns of findings, and effectiveness test results in developing learning materials for *e-learning Moodle* in vocational schools, using the ADDIE model.

3. RESULTS AND DISCUSSION

Based on the synthesis of data from 11 selected studies, the development of E-Learning Moodle-based learning using the ADDIE model in vocational schools showed measurable success in three main aspects, namely 1) product validity; 2) effectiveness on learning outcomes; and 3) user response.

1. Validity and Feasibility of Media Based on the ADDIE Model
   Consistent application of the ADDIE stages results in valid and testable media products. Based on assessments by subject matter and media experts, Moodle has proven capable of meeting the needs of the vocational school curriculum. This is demonstrated in:
   - Most studies report high validation scores. Mafaza's (2016) study recorded a format score of 85.33% and a content score of 84.4%, categorizing it as highly valid. A

similar finding was found in the development of an e-module for electrical lighting installations, where media experts gave an average score of 4.13 and material experts a score of 4.00, categorizing it as adequate.

- The trend of high validity continued into the latest research in 2025. In the development of automotive CVT materials, material experts gave a score of 96.25% and media experts 82.5%. Similarly, in the development of PjBL-based Moodle, all media, material, and learning module components were deemed highly valid, with scores ranging from 83% to 93.43%. Maulana and Permana (2021) also confirmed that basic programming e-learning received an average rating of 4.2 from material experts, meaning "Very Good."

2. Significant Effectiveness on Learning Outcomes of Expertise Competencies
   The implementation of Moodle has a real impact on improving the cognitive competencies and skills of vocational school students, as proven through statistical tests and value comparisons.
   - Significant statistical test. Febrianti and Sujatmiko's (2025) research showed a drastic increase post-implementation, where the knowledge score rose from 55.07 to 86.07 and project skills from 53.91 to 86.46. This significance was reinforced by Rizki and Sujatmiko (2025) through the Wilcoxon Signed-Rank Test, which produced a p-value <0.001, indicating a significant increase in basic programmer competency. Janah and Kurniawan (2025) also recorded a t-test significance value of 0.008 ($p<0.05$) on the CVT system material.
   - In the Server Administration subject, the experimental class using Moodle achieved an average of 77.32, significantly superior to the control class, which only achieved 69.87.
   - Effectiveness is also evident in the pass rate. For the operating systems course, the pass rate reached 84.375%, while for the basic networking course, 18 out of 20 students (90%) achieved the minimum completeness criteria (KKM).
3. Material Flexibility and Positive User Response
   Moodle has proven to be adaptable for a wide range of subjects, from IT to non-IT, and has received high acceptance from students and teachers.
   - Student Response: Student acceptance of this media was very high. Sari and Ranu (2019) recorded a 98% (very strong) response rate for the Infrastructure Administration course. Positive responses were also recorded for the Server Administration course at 77.25% and Operating Systems at 82.35%.
   - Practicality and Interest: Akhsan and Wantoro (2024) found that Moodle made Informatics learning more engaging and the material easier to understand. In the context of English language learning, Wicaksono et al. (2019) concluded that this medium was engaging for students and helped teachers' effectiveness.
   - Accessibility Solution: Sari et al. (2018) demonstrated Moodle's flexibility through the development of Poodle (*Portable Moodle*), which is practical to use offline, with student response reaching 90.36%.
4. Integration of Complex Learning Models (PjBL & CT)
   Recent findings from the 2025 literature highlight the successful integration of Moodle with advanced pedagogical models. The use of models of *Project-Based Learning* (PjBL) combined with the approach of Computational *Thinking* (CT), has been proven to train students' logic. Febrianti and Sujatmiko (2025) noted that the integration of CT (decomposition, pattern recognition, abstraction, and algorithms) in Moodle helps students think more systematically in completing projects. This aligns with the findings of Rizki and Sujatmiko (2025), who confirmed that a PjBL-based LMS effectively

improves basic programming competencies through structured project monitoring features.

4. CONCLUSION

Based on a systematic review of 11 scientific articles for the period 2016–2025, the development of E-Learning Moodle-based learning using the ADDIE model has been shown to significantly impact the quality of vocational education. The use of ADDIE stages consistently produces valid and testable media products, with average validation scores from material and media experts exceeding 85%. Moodle demonstrates high flexibility because it is effectively applied to a wide spectrum of expertise in vocational schools, from Information Technology to non-technical fields such as Office Administration and English. This implementation has empirically contributed significantly to improving student learning outcomes, as evidenced by the significant difference between the scores pretest and *posttest and* positive student responses to the ease of use of the media.

The evolution of recent pedagogical trends demonstrates Moodle's shift from a mere repository of materials to a complex learning ecosystem. Recent findings from 2025 highlight the successful integration of Moodle with other learning models of *Project-Based Learning* (PjBL) and an approach to Computational *Thinking* (CT), which has been proven effective in training students' logical and systematic thinking skills according to industry demands. In addition, innovative features such as e-monitoring, accessibility projects, and solutions offline (*Portable* Moodle) provide added value in addressing infrastructure constraints. It is recommended for further development to strengthen the adoption of hybrid learning models that combine Moodle's advanced features with face-to-face methods to maximize the competency of vocational school graduates.

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