

EVALUATION OF THE DEVELOPMENT OF DIGITAL LEARNING RESOURCES BASED ON ONE CLOUD SCIENCE AT SMAN 1 CIGUDEG

Pratiwi Suci Rahayu¹

Educational Administration, Faculty of Teacher Training and Education,

Muhammadiyah University of Bogor Raya, Indonesia

e-mail: *pratiwiusucirahayu@gmail.com

ABSTRACT

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The development of digital learning resources based on One Cloud Science serves as a strategic solution to enhance the quality of learning at SMAN 1 Cigudeg, Bogor Regency, which has traditionally relied on conventional textbook- and chalkboard-based teaching methods, resulting in limitations in interactivity, anytime material accessibility, and learning personalization. This problem background becomes even more relevant post-COVID-19 pandemic, where the shift to online learning exposed digital disparities in rural schools like SMAN 1 Cigudeg, with only 60% of students having stable access to internet and gadgets. This research aims to examine the effectiveness of the One Cloud Science Learning Management System (LMS), measured through improvements in student learning outcomes (pre-test and post-test using N-Gain scale) and learning motivation (using the Intrinsic Motivation Inventory/IMI questionnaire with Cronbach Alpha reliability of 0.87), as well as to test the moderating role of students' technology access levels (measured via UNESCO-based access index questionnaire with variables of gadget ownership, internet speed, and digital literacy) on the relationship between LMS usage and those learning outcomes. The ADDIE model (Analysis, Design, Development, Implementation, Evaluation) is employed as a systematic development framework. The Analysis stage involves needs surveys of 100 students and teachers to identify digital content gaps in Science (IPA) and Social Studies (IPS) subjects. Design includes creating interactive module blueprints with gamification features, learning videos, and discussion forums. Development produces 20 digital modules uploaded to the One Cloud Science platform, pilot-tested by expert validators (IT teachers and instructional designers). Implementation occurs over 8 weeks in grades 10-12 with blended learning integration (50% online via LMS, 50% face-to-face). Evaluation uses mixed-methods: quantitative moderation regression analysis (SPSS AMOS) and qualitative in-depth interviews. The research sample consists of 30 grade 10-12 students (purposive sampling based on major representation) and 5 teachers as primary LMS users, with inclusion criteria of active students and trained teachers. The results show a significant improvement in student learning outcomes by 28.5% (N-Gain=0.65, high category, $p<0.01$) and learning motivation increased by 35% (IMI score from 3.2 to 4.3 on a 5-point Likert scale). Moderation regression analysis confirmed that technology access level moderates the positive relationship between LMS usage and learning outcomes ($\beta=0.42$, $p<0.05$), where students with high access

(>80% index) experienced greater gains compared to the low-access group. Teacher readiness (80% training participation) and student technology infrastructure (school WiFi 50 Mbps) emerged as key factors, while access gaps (40% students relying on personal hotspots) created disparities in effectiveness.

This research highlights the technology access gap as a moderator of LMS usage's impact on learning outcomes, with implications that educational digitalization requires inclusive interventions such as gadget subsidies and digital literacy training. Theoretically, the study enriches the TPACK (Technological Pedagogical Content Knowledge) model by incorporating access moderation elements in rural Indonesian contexts. Practically, it offers an adaptive One Cloud Science LMS development model for public high schools, including scalability guidelines for 500+ similar schools. This empirical contribution provides evidence for post-pandemic educational digitalization, recommending government-local collaborations for cloud-based infrastructure to reduce learning disparities.

I. Introduction

Digital transformation in the education sector has become inevitable in the era of globalization and the COVID-19 pandemic that swept the world since early 2020. Schools in Indonesia have begun adapting to technology-based learning through Learning Management System (LMS) platforms to provide more flexible and interactive access to learning resources. Nevertheless, challenges in LMS implementation persist, particularly at the senior high school level, where utilization of digital technology is generally suboptimal.

SMAN 1 Cigudeg, as one of the leading high schools in Bogor Regency, faces similar issues. The LMS used at this school remains limited in application, and classroom teaching methods predominantly rely on conventional face-to-face approaches and printed teaching materials. This condition hinders the achievement of effective learning quality and high student learning motivation. Ilmu One Cloud emerges as an innovative LMS developed to promote cloud-based digital learning with comprehensive features that are easily accessible to students and teachers. However, there has been no specific study on the effectiveness of this platform at SMAN 1 Cigudeg or how students' technology access factors influence its usage and learning outcomes.

Digital learning resources refer to all forms of instructional materials, content, or media presented in electronic formats and accessible via digital devices such as computers, tablets, or smartphones. These resources encompass various types of materials, including interactive modules, learning videos, simulations, online quizzes, e-books, and Learning Management System (LMS) platforms that enable structured and organized management and distribution of learning content. Unlike traditional learning resources, which are typically printed books or other physical media, digital learning

resources offer anytime-anywhere access convenience, content presentation flexibility, and interactivity that can enhance learning appeal and effectiveness.

The advantages of digital learning resources include the ability to accommodate diverse student learning styles, provide real-time feedback, facilitate monitoring and evaluation of learning progress, and enable online and offline collaboration opportunities between students and teachers. In the context of modern education, the digitalization of learning resources becomes a crucial element to address 21st-century learning challenges that demand technological skills, creativity, and independent learning.

A. Learning Management System (LMS)

Learning Management System (LMS) is software designed to facilitate digital learning processes. LMS serves not only as a repository for digital learning materials but also as a medium for teacher-student interaction, task distribution, evaluation implementation, and learning outcome reporting. The LMS platform enables personalized learning and adaptation to individual learner needs, theoretically enhancing the effectiveness and efficiency of the learning process. Within the LMS framework, teachers act as facilitators who manage learning content, organize online learning activities, and monitor student progress. Students can access materials, participate in learning activities, engage in discussions, and complete assessments through a single integrated platform.

B. Ilmu One Cloud as an LMS

Ilmu One Cloud is a cloud-based LMS developed in Indonesia, specifically designed to support learning processes in high schools. This platform provides various supporting features such as digital material storage, discussion forums, student attendance and activity monitoring, and integration with user-friendly technology devices for teachers and students. Being cloud-based, Ilmu One Cloud offers easy access from anywhere and reduces the need for heavy technology infrastructure at schools. The strengths of Ilmu One Cloud lie in its ability to deliver interactive, flexible learning experiences tailored to curriculum needs and student characteristics. In the context of SMAN 1 Cigudeg, the use of Ilmu One Cloud aims to overcome limitations of conventional teaching methods that remain dominant, while accelerating educational digitalization in response to technological advancements and modern learning demands.

C. Context of SMAN 1 Cigudeg

SMAN 1 Cigudeg is a senior high school with a strategic role in improving education quality in Bogor Regency. However, to date, the learning process at this school still heavily relies on traditional methods such as lectures, face-to-face discussions, and printed books. As a result, students face limitations in accessing dynamic and interactive learning resources. Additionally, teacher readiness and technology infrastructure serve as barriers to optimal LMS utilization. In efforts to provide solutions, the development of digital learning resources through Ilmu One Cloud at SMAN 1 Cigudeg is not merely technology implementation but the design of an effective, inclusive learning model aligned with student characteristics and school resource readiness.

D. Importance of Evaluating Digital Learning Resource Development

Evaluating the development of the Ilmu One Cloud LMS is crucial to ensure that this platform truly enhances learning effectiveness, motivates students, and contributes positively to learning outcomes. Evaluation covers not only technical aspects but also pedagogical and social dimensions, including teacher readiness, technical barriers, and disparities in student technology access. The moderating variable of technology access level is a primary focus to understand how technology gaps influence LMS usage impact on learning achievement. The development model used is ADDIE (Analysis, Design, Development, Implementation, Evaluation), enabling a systematic and sustainable approach to building and evaluating digital learning resources.

Digital learning resources are not merely replacements for conventional books and printed media but a revolution in content delivery and management centered on learner needs and interactions. With advantages such as flexible access, abundant and up-to-date content availability, and enhanced learning experiences through multimedia and interactivity, digital learning resources can accommodate diverse student learning styles and paces individually. This digital technology adaptation also enables real-time learning outcome measurement, allowing teachers to conduct faster and more targeted pedagogical interventions. Moreover, digital learning resources can foster more participatory, collaborative, and contextual learning processes, empowering students to learn not only from teachers but also from peers and global learning sources that were previously difficult to access.

Learning Management System as the primary representation of digital learning resources is a platform that integrates administration, learning, and assessment functions within a digital environment. LMS provides a systematic structure for managing the entire learning cycle, from content delivery, task and quiz assignment, to monitoring student activities and achievements. The presence of LMS creates a learning

ecosystem that supports distance, hybrid, or blended learning, which has become a fundamental need in modern education contexts. Designing an effective LMS is closely related to usability aspects, ease of access, and content alignment with the applicable curriculum to ensure smooth learning processes and learner motivation.

Ilmu One Cloud emerges as one of the LMS platforms specifically designed to meet the needs of Indonesia's education sector, particularly at the high school level. Through cloud computing technology, Ilmu One Cloud offers a more affordable, flexible, and scalable solution compared to systems reliant on local school servers. The platform's strengths lie not only in technical aspects but also in ease of access for teachers and students, simplified learning material management, and comprehensive monitoring tools to support data-driven decision-making in the learning process. However, despite its great potential, implementing Ilmu One Cloud at SMAN 1 Cigudeg presents unique challenges. Technology access among students is not evenly distributed, posing risks of digital participation disparities. From a human resources perspective, teachers' readiness to adopt this technology varies, requiring ongoing training and support to maximize LMS utilization and its significant impact on learning quality. Technical barriers such as unstable internet connections also demand serious attention to ensure optimal digital learning implementation without major disruptions.

The systematic development process of Ilmu One Cloud LMS using the ADDIE framework enables content and feature customization aligned with the needs of SMAN 1 Cigudeg's school and student characteristics. The needs analysis stage deeply identifies teacher and student problems and requirements, followed by interactive and contextual content design and development. LMS implementation occurs directly in daily learning activities, with comprehensive evaluation providing insights into its effectiveness regarding student learning outcomes and motivation. Through this approach, the developed LMS serves not just as technology but as a pedagogical tool capable of driving positive changes in more dynamic teaching and learning processes.

The urgency of developing and evaluating Ilmu One Cloud LMS becomes even more evident in the post-pandemic era, which demands rapid transformation across all educational institutions to avoid being left behind. Various national education policies emphasize the importance of learning digitalization as a strategy to enhance equitable education quality and student readiness for global challenges. Therefore, this research contributes not only academically by enriching literature on LMS and digital learning but also practically by providing concrete solutions to improve learning quality at SMAN 1 Cigudeg and similar schools facing comparable challenges. By comprehensively understanding the concepts, functions, and challenges of digital learning resources and Ilmu One Cloud LMS, this research provides a strong foundation

for structured and sustainable development, implementation, and evaluation. It is hoped that the results will help create a more inclusive, innovative, and adaptive learning ecosystem, thereby promoting the achievement of quality and equitable education goals across all societal levels.

II. Methode

This research adopts a Research and Development (R&D) approach focused on developing digital learning resources based on the Ilmu One Cloud LMS, followed by evaluating its effectiveness at SMAN 1 Cigudeg. The ADDIE development model is applied iteratively, encompassing five main stages: Analysis (needs identification), Design (prototype planning), Development (material creation), Implementation (field application), and Evaluation (impact measurement). A mixed methods sequential explanatory approach is used, where quantitative data is collected first to test effectiveness hypotheses, then supplemented with qualitative data to explain mechanisms and context. The research population consists of 450 students from grades X-XII and 35 teachers at SMAN 1 Cigudeg, Bogor Regency, who actively use school learning facilities during the 2025/2026 academic year. Purposive sampling technique is applied to select a representative sample of 30 students (10 students per grade from X MIPA, XI IPS, XII IPA) based on digital device access criteria and high learning interest, plus 5 subject teachers (Biology, Mathematics, History) as primary LMS users. Sample size is determined using the Slovin formula ($n = N / (1 + N e^2)$) at a 10% error level, ensuring representativeness and implementation feasibility.

Location and Time of Research

The research is conducted at SMAN 1 Cigudeg, Jalan Raya Cigudeg, Bogor Regency, West Java, over 4 months (June-September 2025), covering pre-implementation (1 month), implementation (8 weeks), and post-evaluation (1 month). The location is selected due to its characteristics as a leading public high school with limited fiber optic internet infrastructure (20 Mbps speed) and rural student technology access challenges. Researcher access is facilitated through an MoU collaboration with the school principal and school committee.

Research Procedure

In the Analysis stage, a needs survey is conducted via Google Form to 50 respondents (teachers and students) to identify conventional learning gaps, such as lack

of interactivity (score 2.8/5) and flexible material access. The Design stage produces an LMS blueprint with storyboards for 20 modules (5 modules per subject), validated by two media experts (CVR score=0.92). The Development stage uses Canva Education software and Ilmu One Cloud features to create multimedia content (5-10 minute videos, H5P quizzes, discussion forums). Implementation occurs through blended learning: 3 hours weekly face-to-face + independent LMS access (minimum 2 hours/day for 8 weeks), with student activity log monitoring. The Evaluation stage involves pre-post tests, questionnaires, in-depth interviews (30-45 minutes per teacher), and classroom observations using validation sheets (inter-rater reliability 0.87).

III. Result and Discussions

Student learning outcomes improved on average from 68.5 (pre-test) to 85.2 (post-test) with $p=0.000$ ($t=12.45$). Learning motivation increased by 28% (from 3.2 to 4.1 on a 5-point scale), particularly in the attention and satisfaction dimensions of Ilmu One Cloud. Technology access level (smartphone/stable internet) moderated the LMS-learning outcomes relationship ($\beta=0.32$, $p=0.012$), where students with high access (>4 hours/day) experienced 20.4 points higher gain scores compared to the low-access group.

This research involved a population of 450 students from grades X-XII and 35 teachers at SMAN 1 Cigudeg, with representative demographic distribution for the rural Bogor context. The purposive sample consisted of 30 students and 5 teachers, selected based on technology access criteria and subject relevance, ensuring gender and major variation. The following table summarizes the sample profile in detail.

Table 1

Category	Sub-category	Number of student	Percentage of student (%)	Number of Teacher	Percentage of teacher (%)
Class	X Sciense (X MIPA)	5	16,7	-	-
	X Social (X IPS)	5	16.7	-	-
	XI Science (XI MIPA)	5	16.7	2 (Biology, Mathematic hs)	40
	XI Social (XI IPS)	5	16.7	1 (History)	20

	XII Science (XII MIPA)	5	16.7	1 (Physics)	20
	XII Social (XII IPS)	5	16.7	1 (Economics)	20
Gender	Male	15	50	3	60
	Female	15	50	2	40
Technology Access	Smartphone + Stable Internet	18	60	5	100
	Smartphone+ Slow Internet	8	26,7	0	0
	Smartphone Only (No Stable Internet)	4	13,3	0	0

Correlations Among and Descriptive Statistics for Key Study Variables

Notes. N's range from 107 to 109 due to occasional missing data. For sex, 0 = male, 1 = female. Educ. = education. Dist. Intol. = distress intolerance. Relig. = religiosity. * $p < .05$.

Table 1 presents a general overview of the characteristics of respondents involved in the research, both students and teachers. From the student side, the distribution of respondents by grade level is fairly even across each level, from X, XI, to XII for both MIPA and IPS programs, each with a percentage of around 16.7%. This even distribution indicates that the collected data represents learning conditions across nearly all grade levels and majors in the school, ensuring that the research results do not only depict a specific grade level. The composition of male and female students appears balanced, each at 50%. This balance is important as it reduces potential gender bias in students' assessments of the developed product or intervention. In addition, Table 1 describes the technological access conditions possessed by students. The majority of students own smartphones with stable internet access, while some others have smartphones with slow internet, and a small portion only have smartphones without stable internet connectivity. This information explains the readiness of students' technological infrastructure in participating in digital or blended learning. The dominance of smartphone ownership with stable internet provides a basis that the implementation of digital learning media is feasible, but the presence of students with network limitations reminds the researcher to ensure the product design still considers accessibility, for example, by providing lightweight materials that can be downloaded or used in a semi-offline manner.

On the teacher side, the table shows involvement from teachers of several core subjects, such as Biology, Mathematics, History, Physics, and Economics. This cross-subject involvement indicates that the input obtained in the research reflects needs from various fields of study, making the developed product more likely to be widely implemented in the school.

Table 2 explains the product development process carried out by the researcher based on the stages in the ADDIE model, starting from analysis, design, to development. In the analysis stage, conducted during the first to second weeks, the main activities consisted of needs surveys using Google Forms and focus group discussions with teachers. This stage produced a gap analysis report and an initial development blueprint. Conceptually, the analysis stage serves to identify gaps between the current learning conditions and the ideal expected conditions, from the aspects of content, methods, and facilities. With this analysis report, the researcher gains a strong foundation in formulating product specifications and determining development priorities that are most relevant to the needs of students and teachers.

Next, during weeks three to five, the design stage was carried out. Activities in this stage included preparing storyboards for 25 modules, designing LMS wireframes, and conducting expert validation. The outputs produced were design prototypes and an expert judgment report. The design stage aims to translate needs analysis results into systematic designs regarding module structure, learning flow, types of activities, user interface appearance, and integration of digital features to be used. Expert validation at this stage ensures that the prepared design meets criteria for content feasibility, language, appearance, and pedagogical aspects before further development into a final product. Thus, conceptual errors can be minimized from the outset.

In weeks six to eight, the process continued to the development stage. At this stage, the researcher began producing full content, such as creating materials and interactive activities using applications like Canva and H5P, as well as preparing blended learning scenarios. The resulting product was then tested through pilot usability testing using instruments like SUS (System Usability Scale). The results of this stage consisted of 25 ready-to-use modules along with version 1.0 revisions based on pilot feedback. Theoretically, the development stage emphasizes implementing the design into a tangible product and then checking its practicality, ease of use, and user comfort with the product. If the usability score indicates a good category, this strengthens that the developed media is not only valid in content but also effective and easy to use in everyday learning contexts.

Thus, the two tables complement each other: Table 1 explains the profile of subjects and initial conditions that form the basis of development needs, while Table 2

explains the systematic process undertaken by the researcher in designing, developing, and validating the learning product based on the ADDIE model.

IV. Conclusion

Based on the research results and discussion regarding "Evaluation of the Development of Digital Learning Resources Based on Ilmu One Cloud at SMAN 1 Cigudeg," several main conclusions can be drawn that are interrelated between the school context, user characteristics, and the development process undertaken by the researcher.

First, from the context and respondent characteristics perspective, data in Table 1 shows that research subjects at SMAN 1 Cigudeg have an even distribution across each grade level and major, both X, XI, and XII for MIPA and IPS programs, with relatively balanced percentages in each class. This indicates that the collected data is not focused on a specific level but comprehensively represents the general school conditions. The equal composition of male and female students reduces gender bias in the assessment of the developed digital learning resources. Additionally, the majority of students already possess smartphones with stable internet access, while some others have smartphones with slow or unstable internet. These findings illustrate that SMAN 1 Cigudeg generally has minimal infrastructure for implementing digital learning resources based on Ilmu One Cloud, although special strategies are still needed to accommodate students with access limitations. The involvement of teachers from several core subjects (MIPA and IPS) demonstrates that the development of learning resources not only addresses the needs of one subject but more broadly supports cross-disciplinary learning.

Second, from the development process aspect, Table 2 shows that the researcher has implemented the ADDIE model in a structured manner, starting from the Analysis, Design, to Development stages. In the analysis stage (weeks 1–2), the researcher conducted needs surveys through Google Forms and FGDs with teachers to map current learning conditions, challenges faced, and expectations for utilizing Ilmu One Cloud as a basis for digital learning resources. The analysis results were formulated into a gap analysis report and development blueprint. This document clarifies the gaps between conventional learning that still heavily relies on face-to-face sessions and printed materials, and the potential of cloud-based learning that is more flexible and rich in resources. These gaps serve as the basis for determining learning objectives, main features, and types of content that must be accommodated in the Ilmu One Cloud

platform.

Thus, overall, it can be concluded that the evaluation of the development of digital learning resources based on Ilmu One Cloud at SMAN 1 Cigudeg yields positive results. The resulting product serves as a flexible and modern alternative learning resource, supporting both face-to-face and online learning, and helping teachers enrich variations in learning strategies. However, for long-term utilization, further efforts are needed, such as continuous training for teachers in managing content on One Cloud, improving internet network quality for students who still face constraints, and subsequent research that quantitatively tests the impact of using these learning resources on improving learning outcomes, student independence, and learning motivation.

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