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Infrastructure Readiness for Blended Learning in Vocational Higher Education: A Case Study from the Faculty of Engineering, Universitas Negeri Padang

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ABSTRACT

The evolution of technology and the COVID-19 pandemic have accelerated the adoption of blended learning in higher education, including in vocational institutions. However, infrastructure readiness plays a pivotal role in the success of this implementation, especially in practice-based technical education. This study aims to assess the level of infrastructure readiness for supporting blended learning at the Faculty of Engineering, Universitas Negeri Padang, and to identify supporting and hindering factors. A quantitative descriptive survey method was used, with data collected through observations, interviews, and document analysis. The results showed that the infrastructure readiness level reached 65.11%, indicating moderate compliance with national standards as outlined in the Ministry of Education Regulation No. 3/2020. The main challenges identified include mismatches between equipment procurement and space availability, limited internet connectivity, and underutilized e-learning applications. Supporting factors included increased digital devices, provision of internet data for students and lecturers, and improvements in e-learning platforms. These findings highlight the need for continuous reinforcement of digital infrastructure to ensure the effectiveness of blended learning in the post-pandemic era.

Keywords: *Blended Learning; Infrastructure Readiness; Vocational Education; Industry 4.0; COVID-19.*

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INTRODUCTION

The rapid advancement of the Fourth Industrial Revolution (Industry 4.0) has significantly impacted higher education, prompting the transformation of teaching methods towards more flexible, adaptive digital learning models [1], [2]. Simultaneously, the COVID-19 pandemic forced universities to embrace blended learning as a sustainable solution for remote instruction [3], [4]. For vocational education—where hands-on skills are essential—the successful implementation of blended learning hinges critically on the availability and quality of infrastructure [5], [6].

Prior research has mainly focused on pedagogical models, digital adaptation, and stakeholder perceptions in online learning, but few studies have thoroughly assessed infrastructure readiness, particularly in the Indonesian vocational context [7], [8]. Essential infrastructure such as internet connectivity, hardware and software, and appropriate learning spacesplays a decisive role in delivering effective blended education.

Digital disparities across regions and campuses exacerbate inequality in access, especially for students from rural areas or underprivileged backgrounds. These students often struggle with limited internet, insufficient personal devices, and low digital literacy, while lecturers may face similar challenges [9], [10].

In response, the Indonesian Ministry of Education issued Regulation No. 3 of 2020 outlining national standards for learning facilities, covering ICT devices, labs, media, and blended-learning-compatible classrooms [11]. However, institutional implementation varies, with many vocational programs falling short.

The Faculty of Engineering at Universitas Negeri Padang bears significant responsibility in ensuring infrastructure readiness, especially with reliance on platforms like elearning2.unp.ac.id, Zoom, and Google Meet. This involves not only hardware availability but also digital skill enhancement for both educators and students.

This study aims to fill the identified gap by evaluating the readiness of blended learning infrastructure in the Civil Engineering Department. Beyond measuring compliance with national standards, this research also examines the supporting and inhibiting factors, offering insight into developing sustainable digital learning infrastructure.

METHOD

A quantitative descriptive research design was used to assess infrastructure readiness at the Civil Engineering Department, Faculty of Engineering, Universitas Negeri Padang. This approach provides a systematic and objective picture of current infrastructure conditions.

The study focused on the Building Materials course, selected for its practical nature and reliance on laboratory facilities, representing the hands-on characteristics of vocational learning.

The study's population consisted of all physical and digital infrastructure components supporting the blended learning format in the course, including lab spaces, tools, supporting furniture, IT equipment, and internet access. Due to the limited scope, total sampling was applied. Data were gathered through direct observation of learning spaces, in-depth interviews with course instructors and lab managers, and document analysis (syllabi, lab sheets, instructional guides). Observation checklists and validated Likert-scale instruments assessed the functionality, suitability, and utilization of each component.

Percentage-based scoring was applied to measure compliance with standards, with results categorized as high (>=75%), moderate (50-74%), or low (<50%) based on national (Permendikbud No. 3/2020) and university benchmarks. Qualitative insights from interviews were analyzed thematically to provide context and uncover key challenges and opportunities, reinforcing the validity of the quantitative findings.

RESULTS AND DISCUSSION

The infrastructure readiness score was 65.11%, indicating a moderate level of compliance. This suggests that while core facilities are present, some components still fall short of optimal standards.

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Five key components were assessed: laboratory space, practical tools, supporting furniture, IT systems, and internet access. The Building Materials Laboratory met spatial and functional standards, but limitations in equipment quantity and aging tools reduced its effectiveness.

While some supporting infrastructure like storage and visual aids had been upgraded for blended use, their integration into digital learning systems remained incomplete. Furthermore, the availability and quality of tech-based teaching media were limited.

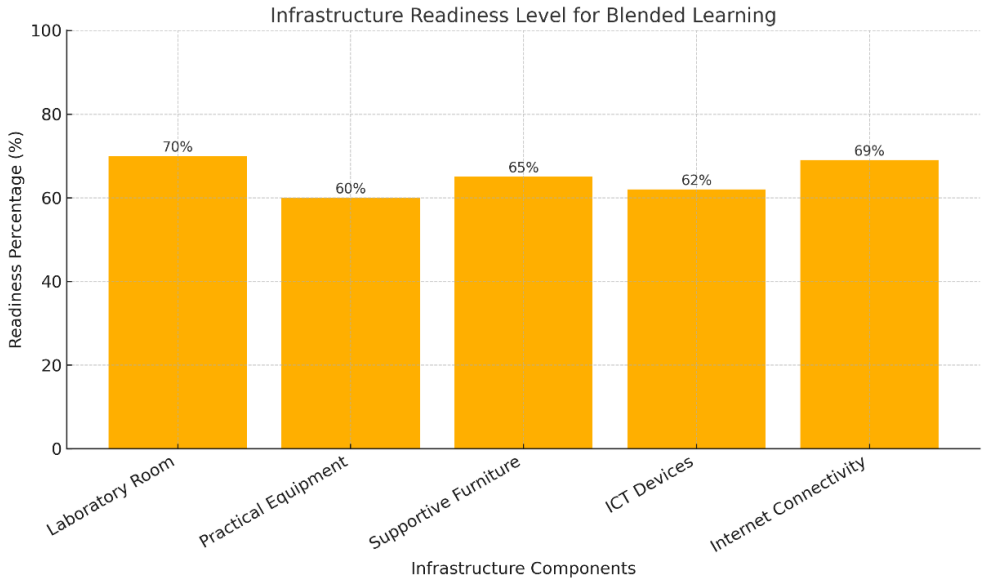

Figure 1: Infrastructure Readiness by Component

Students—particularly early-year cohorts—faced challenges due to limited access to personal devices and unreliable campus internet. The university's e-learning platform also lacked capacity for large multimedia content, limiting instructional delivery.

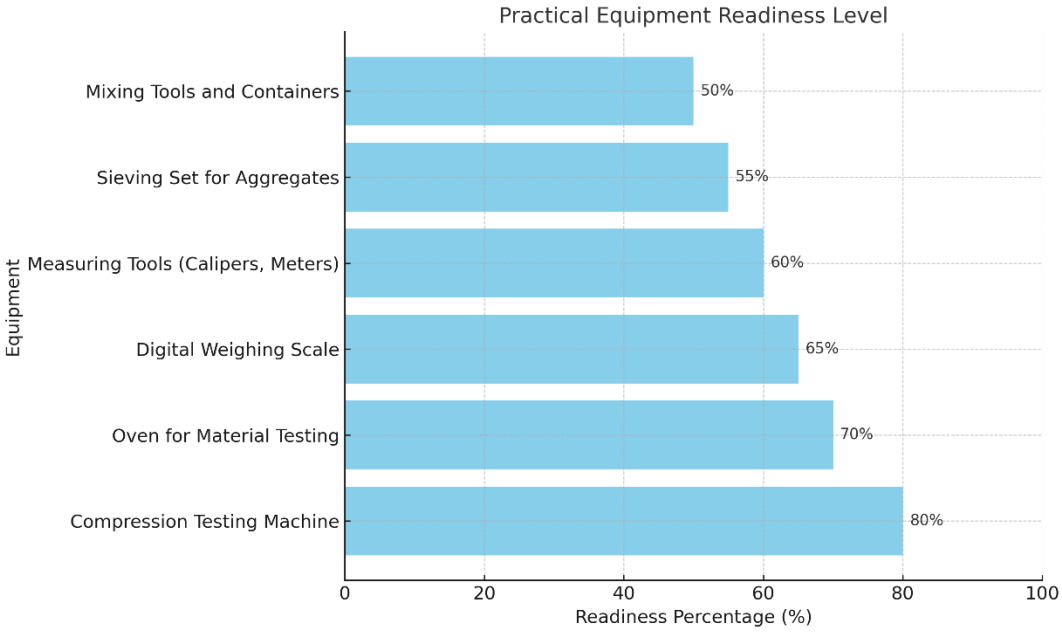

Figure 2: Table of Practical Equipment Readiness Scores

Interviews revealed supportive measures such as additional lab computers, internet quota subsidies, and LMS training workshops. However, challenges remained in syncing tool procurement with spatial needs and in addressing varying digital competencies among faculty.

Overall, the findings indicate steady progress but also highlight critical areas for improvement to ensure equitable and effective blended learning implementation in vocational settings.

The 65.11% readiness score reflects a moderate yet significant step toward achieving digital transformation in vocational education. Although national benchmarks are partially met, the limited integration of systems and inconsistent facility upgrades remain obstacles.

Comparative studies also show that infrastructure gaps hinder learning outcomes, especially in vocational institutions where hands-on practice is essential [6], [9]. This underscores the urgency for investment in both physical and digital infrastructure. Observations confirm that spatial planning and procurement processes must be better synchronized to avoid inefficiencies. Weak internet and underpowered LMS platforms further disrupt learning continuity, particularly when handling large video or interactive materials [10], [13].

Encouragingly, institutional initiatives like internet support, device provision, and digital training for instructors signal a shift toward a more digitally resilient education system. Long-term strategies should focus on scaling infrastructure capacity, digital literacy enhancement, and institutional policy alignment to sustain blended learning in post-pandemic, Industry 4.0-driven contexts.

CONCLUSION

This study concludes that the infrastructure readiness for blended learning at the Civil Engineering Department, Faculty of Engineering, Universitas Negeri Padang, is moderately adequate at 65.11%. While basic requirements are met particularly in lab spaces and equipment—challenges persist in internet quality, device availability, and digital platform functionality.

Supporting factors include device augmentation, institutional data support, and instructor training. However, to ensure consistent and effective blended learning delivery in vocational education, systematic and sustained infrastructure development is essential. These findings offer valuable insights for education policymakers and institutional leaders seeking to strengthen blended learning ecosystems aligned with national standards and global digital education trends.

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