Research Paper

Digital Transformation in Nursing Education: Evaluating a Video-Supported PBL Model on Clinical Competency and Critical Thinking

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Abstract

This study engages with the ongoing theoretical debate between the technological solutionism prevalent in digital education (Morozov, 2013) and critical pedagogical perspectives that question the socio-technical implications of technology integration (Fenwick et al., 2015). In nursing education, this manifests as a tension between evidence-based advocacy for digital tools, such as instructional videos, and the imperative to foster pedagogical depth that cultivates critical thinking and clinical reasoning. However, scant research has systematically examined how the structured fusion of a robust pedagogical model such as Problem-Based Learning (PBL) with video-based scaffolding reconfigures the learning ecology, thereby affecting both procedural competency and learner agency. This article addresses this gap by asking: How does a systematically developed Video-Supported PBL model influence nursing students' clinical skill acquisition and critical thinking? Using a design-based research (DBR) approach, the study developed, validated, and empirically tested the "MEDIFA" model, integrating expert validation and pretest/posttest analyses with 30 students. The findings demonstrate significant quantitative gains in clinical competency (N-Gain = 0.76) and reveal a qualitative shift toward self-regulated learning, in which students strategically used on-demand videos for mastery while engaging in collaborative problem-solving. The analysis further shows a reconfiguration of the instructor's role from primary demonstrator to facilitator of reasoning, mediated by the digital scaffold. The article argues that this integration creates a synergistic learning system where cognitive load management via video enables deeper participation in situated, practice-based communities (Lave & Wenger, 1991), thereby bridging a key conceptual divide in the literature. It contributes a validated instructional model and a refined theoretical synthesis, offering a more nuanced framework for designing and evaluating technology-enhanced learning in competency-based professional education.

Keywords *Nursing Education, Problem-Based Learning, Instructional Video, Clinical Competency, Critical Thinking, Digital Learning Design, Pedagogical Integration*

INTRODUCTION

The digital transformation of higher education has sparked a critical debate at the intersection of pedagogical innovation and technology integration. In nursing education, this is reflected in two competing perspectives: one that champions technological solutionism—viewing digital tools as straightforward enhancers of efficiency and skill acquisition (Morozov, 2013)—and another rooted in critical pedagogy, which interrogates how technology reshapes power dynamics, epistemic authority, and the socio-material realities of clinical training (Freire, 2000; Friesen, 2017). This tension is particularly salient in competency-based fields such as nursing, where the need to develop safe, critical-thinking practitioners must be balanced against the rapid adoption of digital learning aids.

Recent scholarship (2020–2025) reveals divergent research clusters. One cluster,

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represented by scholars such as Rodríguez et al. (2020) and Rezkiki et al. (2021), strongly advocates digital interventions—particularly instructional videos—demonstrating significant improvements in nursing students' skill performance and knowledge retention compared with traditional methods. These studies often align with a cognitive-behavioral paradigm, framing video as an efficient medium for modeling procedures and enhancing psychomotor replication (Chen et al., 2018; Habes et al., 2020).

In contrast, a critical cluster of research urges caution. Scholars such as Hilleren et al. (2022) and Sommerhoff et al. (2022) highlight methodological inconsistencies and a narrow focus on technical skills, often at the expense of complex competencies, including clinical judgment, communication, and collaboration. They warn that poorly integrated digital tools may promote superficial learning and dependency, failing to address the underlying reasoning behind clinical actions—a concern underscored by persistent medication errors linked to inadequate training (Pramesona et al., 2025). A third, emerging cluster seeks to bridge these views by embedding digital tools within established pedagogical frameworks such as Problem-Based Learning (PBL). Scholars like Atherton (2023) and Moust et al. (2021) argue that technology should facilitate inquiry, collaboration, and self-direction rather than merely deliver content.

Despite these advances, a clear research gap remains. While evidence exists on the isolated effectiveness of PBL or instructional videos, there is a scarcity of theoretically grounded, systematically developed hybrid models that integrate both approaches. Most studies treat technology as an adjunct rather than a core component of pedagogical design (Fatimah, 2026). Consequently, key questions remain unanswered: How does the structured fusion of PBL's problem orientation with accessible video demonstrations reshape the learning environment? Can such a model enhance both procedural competence and the critical thinking required for real-world clinical decision-making, particularly for complex skills such as physical assessment and sterile technique (Budihardjo, 2017; Setiarta et al., 2020)? The field lacks a cohesive instructional model that intentionally designs video resources as integral scaffolding within the PBL cycle.

This study addresses this gap by developing, validating, and empirically evaluating a novel Video-Supported Problem-Based Learning (VS-PBL) model named "MEDIFA" for core nursing skills education. Methodologically, it employs a design-based research approach, synthesizing instructional design principles (Dick et al., 2015) with PBL pedagogy (Tan, 2003) to create video resources tailored to common student difficulties. Interpretively, it examines how pedagogically orchestrated video can shift learning from instructor-led demonstration to student-centered, self-regulated practice.

The study is guided by the following research question: How does the VS-PBL model affect nursing students' clinical skill competency in complex procedures? How does engagement with the model influence students' perceived readiness for critical thinking and self-directed learning? To what extent is the integrated model perceived as feasible and effective by expert validators and students? The remainder of this paper is structured as follows: the methodology outlines the development and testing process; the results present validation and learning-outcome data; the discussion interprets the findings in light of debates on digital pedagogy; and the conclusion suggests implications for practice and future research.

LITERATURE REVIEW

The academic discourse on digital technology in nursing education is primarily shaped by two competing conceptual approaches. The first, which can be termed the evidence-based techno-optimist approach, is grounded in cognitive-behavioral paradigms and quantitative educational research. Scholars within this cluster, such as Rodríguez et al. (2020) and Rezkiki et al. (2021), present empirical evidence that digital tools—particularly instructional videos—significantly

enhance skill acquisition, knowledge retention, and procedural accuracy compared to traditional methods. Their studies, often employing controlled trials and pre-test/post-test designs, demonstrate measurable gains in competencies such as medication administration and wound care (Chen et al., 2018; Habes et al., 2020).

The underlying premise is that technology serves as a neutral delivery medium that optimizes learning efficiency by providing consistent, repeatable visual models, thereby reducing the cognitive load associated with translating textual protocols into action (Sweller et al., 2019). This approach aligns with institutional demands for scalable, standardized training solutions with quantifiable outcomes. However, a key limitation is its frequent marginalization of socio-cultural and pedagogical context. By focusing predominantly on replicating technical skills, it often neglects how digital tools integrate into—or potentially disrupt—complex processes such as clinical reasoning, collaborative problem-solving, and professional identity formation (Hilleren et al., 2022). Its implicit assumption of technological neutrality also overlooks how video design embeds specific perspectives on nursing practice, potentially prioritizing procedural fidelity over adaptive critical thinking.

In contrast, the critical socio-material and pedagogical approach interrogates the foundational ways in which technology mediates learning and professional development. Emerging from critical pedagogy (Freire, 2000) and socio-material theory (Fenwick et al., 2015), scholars such as Hilleren et al. (2022) and Sommerhoff et al. (2022) argue that the heterogeneity of digital interventions and a narrow focus on measurable technical skills have obscured an understanding of the actual learning process. They question whether technology, when implemented without deep pedagogical integration, might inadvertently foster dependency, dilute hands-on apprenticeship, or fail to address the "hidden curriculum" of nursing, including therapeutic communication and ethical judgment. This perspective emphasizes that learning is not merely the transfer of information but a situated, participatory activity within a community of practice (Lave & Wenger, 1991). From this viewpoint, a video is not merely a tool but an actor in a network that reconfigures relationships among students, instructors, patients, and knowledge.

A limitation of this critical approach, however, is that it often remains at the level of critique, offering fewer concrete, scalable design principles or actionable models for educators seeking to practically harness technology's benefits while mitigating its risks. This creates a persistent gap between high-level pedagogical theory and the pragmatic needs of curriculum development in resource-constrained environments. To navigate and bridge these divergent discourses, this study engages with core learning theories. Cognitive Load Theory (CLT) (Sweller et al., 2019) provides a crucial lens for understanding the challenges nursing students face when learning complex, multi-step procedures such as physical assessment or sterile wound dressing, which can overwhelm working memory. CLT posits that learning is hindered when intrinsic load (complexity of the material) and extraneous load (poorly designed instruction) exceed cognitive capacity. Strategically designed instructional videos can manage extraneous load by offloading visual-spatial information and enabling self-paced review, thereby freeing cognitive resources for germane load—the mental effort devoted to constructing schemas and deep understanding.

However, CLT offers an individualistic, cognitive perspective. To address the collaborative and contextual nature of nursing practice, this study also draws on Situated Learning Theory and the concept of legitimate peripheral participation (Lave & Wenger, 1991). This theory challenges the notion of decontextualized skill acquisition, positing that learning is integral to social practice. In this research, the PBL component creates a simulated "community of practice" in which students, through collaborative problem-solving around authentic clinical scenarios, move from peripheral observation (aided by video demonstrations) toward more central participation in nursing discourse and reasoning. Video resources thus act as boundary objects that facilitate shared

understanding and scaffold participation. Furthermore, Self-Determination Theory (SDT) (Deci & Ryan, 2000) frames motivational aspects. SDT argues that intrinsic motivation flourishes when needs for autonomy, competence, and relatedness are supported. A well-designed video-supported PBL model can enhance autonomy through self-paced, repeated access to resources; competence through skill mastery; and relatedness through collaborative problem-solving.

Synthesizing these perspectives, this study articulates an integrative Pedagogically-Integrated Socio-Technical (PIST) Framework for evaluating digital learning models in competency-based education. This framework comprises three analytical lenses derived from the preceding synthesis:

1. Cognitive-Scaffolding Lens: Informed by CLT and instructional design theory (Dick et al., 2015), this lens examines how the design of video tutorials (e.g., through segmentation and signaling) reduces extraneous cognitive load and provides procedural scaffolding.
2. Situated-Participation Lens: Grounded in Situated Learning Theory, this lens analyzes how the PBL context and the use of video as a boundary object foster legitimate peripheral participation in a community of nursing practice, facilitating the development of both skill and professional identity.
3. Motivational-Agency Lens: Drawing on SDT, this lens investigates how the integrated model supports or undermines students' perceived autonomy, competence, and relatedness, thereby influencing engagement and self-directed learning.

The PIST Framework enables this research to move beyond the binary debate of "technology as effective tool" versus "technology as problematic disruptor." Instead, it provides a structured approach to investigate *how* the specific integration of video within a PBL pedagogy—the "MEDIFA" model—mediates the interrelated cognitive, social, and motivational dimensions of learning complex nursing competencies. It facilitates a holistic evaluation that asks not only "Does it work?" but also "How does it work, for whom, and under what conditions?"

RESEARCH METHOD

This study employed a Design-Based Research (DBR) approach to systematically develop, validate, and evaluate the Video-Supported Problem-Based Learning (VS-PBL) "MEDIFA" model. The research was pragmatically grounded, focusing on solving the practical problem of low clinical competency in nursing education through iterative design cycles.

Participants included two groups: (1) Expert validators (n=5) comprising nursing subject matter experts, instructional designers, and media specialists; and (2) Nursing students (n=30) enrolled in a Basic Nursing Skills course at As-Syafi'iyah Islamic University, Indonesia.

Instruments comprised: (1) a validated knowledge and skill competency test for pre-post assessment, (2) expert validation rubrics using 5-point Likert scales with open-ended feedback, and (3) student perception questionnaires with quantitative scales and qualitative open-ended items. The procedure followed two main phases:

1. Development and Validation: The MEDIFA model and video prototypes were created based on needs analysis and theoretical frameworks (Systematic Instructional Design, PBL theory, Cognitive Load Theory). These underwent expert validation and were revised based on feedback.
2. Empirical Testing: The revised model was implemented in a field test with 30 students using a quasi-experimental pre-test/post-test design. The intervention consisted of structured VS-PBL cycles incorporating video-supported problem scenarios for complex nursing skills.

Furthermore, the data analysis employed mixed methods by following this analysis process:

a. Quantitative analysis included descriptive statistics, paired-sample t-tests, and normalized gain (N-Gain) calculations for competency scores.
b. Qualitative data from expert feedback and student perceptions were analyzed thematically.
c. Validation strategies included triangulation, peer debriefing, audit trails, and thick description to ensure trustworthiness.

The study received ethical approval, with informed consent obtained from all participants, and employed several strategies to address limitations, including a single-institution context and potential social desirability bias in self-reported data.

FINDINGS AND DISCUSSION

Results: Development, Validation, and Efficacy of the MEDIFA Model

The systematic design-based research process resulted in the development of the "MEDIFA" model, a structured Video-Supported Problem-Based Learning (VS-PBL) intervention comprising nine instructional syntaxes specifically designed for basic nursing skills training. The model's validity was rigorously established through a multi-stage expert validation process involving three distinct panels of experts.

Table 1. Expert Validation Results for the MEDIFA Model

Expert Panel	Number of Experts	Average Validation Score (5-Point Scale)	Key Qualitative Feedback
Nursing Subject Matter Experts	2	4.84	Integration of Standard Operational Procedures within problem contexts moves beyond rote mimicry, prompting understanding of clinical rationale.
Instructional Design Experts	2	4.50	Video segments are well-chunked and focused, effectively managing cognitive load for complex procedures.
Instructional Media Experts	1	4.62	Technical production quality supports clear communication of procedural steps.

The field implementation of the MEDIFA model with 30 nursing students yielded significant quantitative evidence of its effectiveness. Pre-test analysis revealed a baseline mean competency score of 76.80 (SD = 6.42), indicating the cohort's initial proficiency level. Following the completion of the video-supported PBL cycles, the post-test mean score increased substantially to 94.43 (SD = 3.21).

Statistical analysis using a paired-samples t-test confirmed that this improvement was highly significant ($t(29) = 24.22$, $p < 0.001$), decisively rejecting the null hypothesis of no difference between pre- and post-intervention performance. The magnitude of learning gain was further quantified through the normalized gain score (N-Gain = 0.76), which, according to established educational research benchmarks (Hake, 1998), falls within the "high effectiveness" category.

Qualitative analysis of student perception surveys and observational data revealed three interconnected thematic findings:

Enhanced Self-Regulated Learning

Students consistently reported strategic use of on-demand video resources for mastery learning. One participant explained: "Before lab sessions, I would repeatedly watch the injection

technique video, pausing and rewinding specific segments about landmark identification until I achieved confidence in my understanding." This self-directed approach contrasted markedly with the prior reliance on limited live demonstrations and textual materials.

Transformative Engagement through PBL Integration

The problem-based learning component fundamentally altered students' orientation toward skill acquisition. As articulated by one student: "The clinical case scenario about potential infection transformed a sterile dressing from a checklist procedure into a meaningful, urgent clinical intervention. We engaged in substantive discussions about the rationale behind each aseptic step rather than merely following instructions."

Reconfiguration of Pedagogical Roles

Implementation of the MEDIFA model precipitated a discernible shift in classroom dynamics. The instructor's role evolved from primary demonstrator to facilitator of clinical reasoning. Students noted this transformation: "Our lecturer increasingly focused on questioning our clinical judgment during PBL sessions, while directing us to specific video timestamps for procedural refinement during practice." This reconfiguration leveraged video as a stable reference point, enabling more sophisticated coaching interactions.

Discussion: Theoretical Integration and Practical Implications

These findings collectively demonstrate that the systematically developed MEDIFA model represents a potent intervention for enhancing both clinical competency and self-regulated learning in nursing education. The results engage directly with ongoing theoretical debates between techno-optimist and critical pedagogical perspectives in health education technology.

The significant quantitative gains (N-Gain = 0.76) provide empirical support for the evidence-based techno-optimist position championed by scholars such as Rodríguez et al. (2020), affirming that well-designed digital resources can substantially improve skill acquisition outcomes. However, this study complicates this narrative by demonstrating that efficacy is not inherent in the video medium itself but rather emerges from its strategic integration into the PBL pedagogical framework. This aligns with and provides empirical specificity to critical perspectives advanced by scholars such as Hilleren et al. (2022), who caution against technology-centric interventions that neglect the pedagogical process. The MEDIFA model directly addresses this critique by embedding video resources within authentic problem scenarios that necessitate clinical reasoning and collaborative problem-solving.

Theoretically, this research advances a synthesis model that bridges Cognitive Load Theory (CLT) and Situated Learning Theory. Student-reported strategies of segmenting complex procedures through repeated video viewing operationalize CLT principles by enabling learners to manage intrinsic cognitive load while reducing extraneous processing demands (Sweller et al., 2019). Simultaneously, the PBL context creates an authentic community of practice where videos function as boundary objects (Star & Griesemer, 1989) that scaffold legitimate peripheral participation (Lave & Wenger, 1991). This theoretical integration resolves a persistent tension in the literature between individual cognitive processing and social learning paradigms, offering a coherent framework for designing digitally-enhanced professional education.

The practical implications for nursing education are substantial. The evolved instructor role—from content deliverer to facilitator of clinical reasoning—highlights necessary shifts in faculty development priorities. Professional training should increasingly focus on designing integrative learning experiences that leverage digital scaffolds to foster learner autonomy rather than merely adopting technological tools. For curriculum designers and institutional policymakers,

these findings argue for investment in the development of pedagogical models rather than in the procurement of generic digital content libraries. Competency-based programs, such as nursing education, would benefit from curricular frameworks that explicitly link technology use to the development of critical thinking and clinical judgment, as exemplified by the MEDIFA model's integrated structure.

CONCLUSIONS

This study successfully developed, validated, and empirically tested the Video-Supported Problem-Based Learning (VS-PBL) "MEDIFA" model, demonstrating that pedagogical integration—rather than technology per se—is the decisive factor in enhancing nursing education. The research bridges a critical gap between isolated advocacy for digital tools and the imperative to develop complex clinical competencies and critical thinking. The MEDIFA model transforms the learning ecology from instructor-dependent demonstration to a student-centered system where digital scaffolds support self-regulated mastery and problem-based scenarios foster clinical reasoning within a collaborative community of practice.

The study makes dual contributions: conceptually, it offers a theoretical synthesis that shows how Cognitive Load Theory and Situated Learning Theory can be synergistically operationalized in digital learning design; and practically, it provides a validated instructional blueprint that reconfigures the educator's role from information deliverer to facilitator of reasoning.

LIMITATIONS & FURTHER RESEARCH

This study has several limitations that should be considered when interpreting the findings. First, the intervention was implemented in a single nursing institution in Indonesia, which may limit transferability to settings with different cultural norms, curricular structures, or resource availability. Second, although the quasi-experimental pre-test/post-test approach provides solid evidence of short-term learning gains, it cannot rule out all confounding influences to the same extent as a randomized controlled design. Third, the study drew substantially on self-reported perceptions; despite triangulation with performance indicators, these data remain vulnerable to response and social desirability biases. Finally, the evaluation emphasized simulated skill performance and immediate outcomes, leaving open the question of how well skills are retained over time and applied in authentic clinical environments.

Future Research Directions

1. **Contextual replication and comparison:** Conduct multi-site and cross-national comparative studies to identify how institutional, cultural, and resource conditions shape the effectiveness of the VS-PBL/MEDIFA model.
2. **Durability and transfer of learning:** Use longitudinal designs to track skill retention and examine whether learning transfers to real clinical practice, including workplace performance and patient-safety–relevant behaviors.
3. **Mechanism-focused process studies:** Apply micro-analytic methods (e.g., video-based interaction analysis, learning analytics, eye-tracking) to explain how learners integrate video-mediated procedures during collaborative problem-solving and clinical reasoning.
4. **Implementation and scalability research:** Investigate the requirements for scaling beyond a pilot, including faculty development, instructional coaching, infrastructure readiness, and institutional policies that support sustainable curricular integration.

By pursuing these research avenues, the field can advance toward a more sophisticated,

evidence-based understanding of digital transformation that consistently places pedagogical integrity and holistic clinical competence at the center of technological innovation in nursing education.

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