

EXPLORING THE CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING TECHNOLOGY-BASED TRAINING IN TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY

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Abstract

Technology-based training has become a critical strategy for modernizing Technical and Vocational Education and Training (TVET) systems in response to Industry 4.0 and shifting workforce demands. In the Philippines, the Technical Education and Skills Development Authority (TESDA) has advanced flexible learning policies and online initiatives to widen access and sustain training delivery. However, institutional implementation remains uneven, particularly in provincial Technology Institutions (TTIs). This study explored the challenges and opportunities in implementing technology-based training in selected TESDA TTIs in Pangasinan, Philippines, using a qualitative descriptive case study design anchored on Rogers' Diffusion of Innovations Theory. Data were generated through semi-structured interviews and focus group discussions with administrators, trainers, and trainees, supplemented by document review, and analyzed using thematic analysis. Findings indicate that TTIs primarily employ blended learning arrangements, with face-to-face sessions reserved for hands-on competencies and online platforms used for theory instruction, assessment, and coordination. Stakeholders reported notable advantages, including improved access to learning resources, enhanced instructional efficiency, better monitoring, and strengthened workplace-relevant digital skills.

Nevertheless, implementation was constrained by ICT infrastructure deficits, unstable internet connectivity, limited devices, gaps in digital competencies, increased trainer workload, and pronounced equity issues among trainees. Participants also identified opportunities to strengthen technology integration through systematic capacity building, improved infrastructure investments, expanded use of virtual simulations, and the development of sustainability strategies aligned with TESDA's modernization priorities. The study concludes that while technology-based training demonstrates clear value for expanding access and improving training relevance, its sustainability requires coordinated institutional support, equity-oriented interventions, and policy-driven investment to enable deeper diffusion across TTIs.

Keywords: TESDA; technology-based training; TVET; blended learning; Diffusion of Innovations; flexible learning; digital transformation

1. Introduction

The accelerated diffusion of digital technologies across workplaces has redefined the competencies expected of technical workers and, by extension, the mandate of Technical and Vocational Education and Training (TVET) systems. Industry 4.0—characterized by cyber-physical systems, automation, artificial intelligence, and digitally networked production—has intensified the demand for workers who possess not only trade-specific competencies but also transversal digital literacy, adaptive problem-solving, and technology-enabled collaboration. In response, TVET institutions globally have been urged to modernize instructional delivery and assessment practices through technology-based training approaches, including e-learning, blended learning, digital simulations, and mobile learning platforms. Such approaches are increasingly viewed as essential mechanisms for expanding access, improving training flexibility,

enhancing learning engagement, and aligning vocational programs with evolving labor-market requirements.

The urgency of digital transformation in education and workforce development was magnified by the COVID-19 pandemic, which compelled training institutions to adopt remote, flexible delivery models. In many countries, the pandemic acted as a catalyst for the rapid adoption of technology-supported learning systems, exposing both the potential and fragility of digital training infrastructures. International development institutions have documented how technology-enabled vocational initiatives can improve employability and income outcomes when designed to support inclusion and economic mobility. For example, large-scale skills and training programs that integrate digital tools have been associated with improved access to non-farm employment and enhanced earnings, particularly among disadvantaged groups (World Bank, 2021). In parallel, research and policy institutions in Europe have emphasized that the digital transition in TVET requires systemic investments not only in infrastructure but also in trainers' digital competencies and in the modernization of curriculum and assessment systems to avoid reproducing inequities (Cedefop, 2020).

In the Philippine context, digital transformation is a key strategic direction for government and public service modernization. The Department of Information and Communications Technology (DICT) underscores that a national digital strategy aims to improve governance, socioeconomic development, and service delivery by effectively leveraging information and communications technology (ICT) (Digital Watch Observatory, 2022). Such macro-level digital transformation objectives have direct implications for workforce development agencies, particularly TESDA, which is mandated to ensure that technical education remains responsive to labor market conditions and national development priorities. Under Republic Act No. 7796, TESDA is tasked with providing relevant, accessible, and quality technical education and skills development programs for Filipinos, including initiatives that ensure competitiveness in both domestic and global labor markets (Republic Act No. 7796, 1994). As workplaces adopt digital systems and technology-integrated operations, TESDA must ensure that training delivery mechanisms evolve accordingly and that learners acquire digital competencies that complement trade skills.

TESDA's response to these challenges has included the development of technology-based, flexible learning initiatives, most notably the TESDA Online Program (TOP), as well as policy frameworks for flexible learning delivery. TOP is a web-based platform offering free Massive Open Online Courses (MOOCs) intended to expand opportunities for skills development and lifelong learning (TESDA, n.d.-a). Through TOP, learners can access self-paced training modules across multiple sectors, supporting broader participation in workforce education beyond conventional face-to-face training. Complementing TOP, TESDA issued Circular No. 062, series of 2020, which provides guidelines for implementing flexible learning in the delivery of TVET, particularly in response to changing societal conditions and the "new normal" brought about by disruptions such as the pandemic (TESDA, 2020). The circular affirms TESDA's policy direction toward blended, distance, and other flexible delivery approaches to ensure continuity of training while maintaining quality assurance.

Further, TESDA's strategic agenda is articulated in the National Technical Education and Skills Development Plan (NTESDP) 2023–2028, which positions skills development as a mechanism for preparing Filipinos for a rapidly changing economy and highlights the importance of strengthening training systems amid global transformations (TESDA, 2023). While the NTESDP provides a national roadmap, its implementation necessarily depends on the readiness and capacity of TESDA Technology Institutions (TTIs), which serve as frontline delivery hubs of public TVET programs. However, evidence from both local observations and national development analyses indicates that the effectiveness of technology integration in training institutions remains uneven, constrained by persistent gaps in infrastructure, connectivity, and

resource capacity—particularly in rural or non-metropolitan areas where digital access and institutional investments tend to lag (Cedefop, 2020; TESDA, 2020).

This unevenness is especially critical in provinces such as Pangasinan, where TTIs play an important role in providing access to skills development for out-of-school youth, low-income individuals, and underemployed workers. In such settings, technology-based training has strong potential to expand access, improve learning flexibility, and increase employability outcomes, but only if institutional conditions support equitable adoption. In practice, TTIs must simultaneously maintain the integrity of hands-on competency-based training while incorporating digital platforms for theory delivery, assessment, learner support, and administrative monitoring. As reflected in the present study's context, TTIs in Pangasinan have begun adopting blended learning approaches and accessible platforms such as Google Classroom and online communication tools for learning management. However, they face constraints, including limited ICT infrastructure, intermittent internet connectivity, shortages of devices and digital tools, and gaps in the digital capabilities of trainers and learners (Luzadas, 2025).

These realities highlight a central tension in technology-based TVET: while digital systems can enhance efficiency, flexibility, and engagement, they can also intensify inequities when trainees lack devices, affordable data, or supportive learning environments. Moreover, trainers may face additional workload demands and pedagogical challenges when transitioning from traditional to digitized or hybrid instruction. Institutional policy mandates can drive adoption, but if implementation support is inadequate—through insufficient funding, limited IT personnel, or a lack of localized digital content—technology-based training may focus on surface-level digitization rather than transformative learning innovation. The present study is situated within this policy and institutional context, focusing on the lived realities of TTIs' implementation and the perceptions of key stakeholders.

Accordingly, this research sought to explore the challenges and opportunities in implementing technology-based training in TESDA, focusing on TESDA Technology Institutions (TTIs) in Pangasinan. Specifically, it examined: (1) current institutional practices in technology-based training; (2) perceived advantages of technology-based delivery among administrators, trainers, and trainees; (3) challenges encountered by each stakeholder group; (4) perceived opportunities for enhancing technology integration; (5) institutional factors influencing implementation; and (6) a proposed framework for sustainability of technology-based training (Luzadas, 2025).

The study is anchored in Rogers' Diffusion of Innovations (DOI) Theory, which explains how innovations spread across a social system through stages of adoption and varying adopter categories. DOI provides a useful lens for analyzing how institutional stakeholders—administrators, trainers, and trainees—move from awareness and persuasion to implementation and confirmation of technology-based training practices. It also enables examination of how structural barriers (e.g., connectivity, resource constraints, support systems) and enabling factors (e.g., leadership buy-in, policy direction, capacity building) influence adoption trajectories. In the context of TESDA TTIs, DOI is particularly appropriate because technology-based training is not merely a technical upgrade; it represents a systemic shift in pedagogy, institutional culture, and resource allocation.

Ultimately, understanding the institutional realities of technology-based training implementation in TESDA TTIs is crucial to achieving the policy goals of accessible, inclusive, and high-quality TVET. By documenting the challenges and opportunities experienced at the local level, the findings of this study are expected to inform policy refinement, infrastructure planning, trainer upskilling initiatives, and the development of context-sensitive sustainability strategies. In doing so, the study contributes to TESDA's broader modernization agenda and supports national aspirations to develop a globally competitive workforce equipped with both technical and digital competencies.

2. Method

2.1 Research Design

This study adopted a qualitative descriptive case study design to examine the challenges and opportunities in implementing technology-based training in TESDA Technology Institutions (TTIs) in Pangasinan. A qualitative approach was appropriate because the inquiry required an in-depth, context-sensitive understanding of how technology-enhanced training is enacted in real institutional settings, including the meanings and experiences associated with adoption across different stakeholder groups. The case study strategy was selected because it enables systematic investigation of contemporary practices within bounded settings where implementation conditions—such as infrastructure, institutional support, and learner access—are inseparable from the phenomenon being studied.

The case was defined as the institutional implementation of technology-based training within selected TTIs, with emphasis on routine practices, enabling conditions, and constraints affecting delivery. The design was multi-perspectival, incorporating insights from key stakeholders—administrators, trainers, and trainees—to capture differences in perceptions, responsibilities, and access to resources across roles. This stakeholder-inclusive approach deepened interpretation by enabling the study to examine how institutional readiness and technology adoption are experienced across levels of leadership, instruction, and learning.

Data were generated through qualitative techniques, including semi-structured interviews and/or focus group discussions, supplemented by relevant institutional documents where available. Data were analyzed using thematic analysis, allowing patterns and recurring issues to emerge from participant accounts while supporting interpretation through the study's guiding theoretical lens. Rather than seeking statistical generalization, the design prioritized analytical depth and contextual explanation, generating findings that may inform technology integration strategies and sustainability planning within TESDA TTIs and other comparable TVET environments.

2.2 Participants

Participants were selected using purposive sampling, consistent with the qualitative descriptive case study design, to ensure that data were obtained from individuals with direct and sustained involvement in the implementation, delivery, or experience of technology-based training in TESDA Technology Institutions (TTIs) in Pangasinan. The study included three stakeholder groups to capture multi-level perspectives on technology integration: administrators, trainers, and trainees.

The administrator group comprised TESDA personnel with institutional oversight roles, including TESDA administrators, program coordinators, and ICT focal persons. Eligible participants were those currently employed in the TTIs in Pangasinan, actively involved in planning, supervision, or implementation of training programs, and with at least one (1) year of experience managing TESDA-related training delivery.

Trainer participants included TESDA-certified instructors assigned to handle technology-based or ICT-integrated courses within the participating TTIs. Inclusion criteria required trainers to be currently teaching in TESDA TTIs, actively using digital tools, platforms, or blended learning strategies, and to have at least six (6) months of experience conducting technology-integrated training.

Trainees were learners currently enrolled in TESDA programs offered by the TTIs that involve technology use (e.g., Computer Systems Servicing or other courses delivered through blended or technology-supported modules). Participants were required to have completed at least 50% of the training duration, ensuring adequate exposure to the training modality, and to be willing to participate in interviews and/or focus group discussions.

Recruitment continued until data saturation was achieved, meaning additional interviews and discussions yielded no new significant insights or themes.

2.3 Instrumentation

Data were collected using researcher-developed qualitative instruments aligned with the study's descriptive case study design. The primary instruments included a semi-structured interview guide and focus group discussion (FGD) guides, designed to elicit detailed accounts of stakeholders' experiences with the implementation of technology-based training in TESDA Technology Institutions (TTIs) in Pangasinan. These tools were designed to elicit information on institutional practices, perceived benefits, implementation challenges, enabling factors, and opportunities to improve technology integration.

A semi-structured interview guide was used to collect in-depth qualitative data from administrators, trainers, and trainees. The guide consisted of open-ended questions that explored how technology was used in instructional delivery, assessment, and program management; the support systems available (e.g., ICT infrastructure, technical assistance, and digital content); and the challenges and opportunities stakeholders encountered in adopting technology-based training. The instrument was explicitly aligned with the research questions. It was reported to have undergone expert validation by individuals with competencies in TVET and qualitative research, strengthening its content adequacy and appropriateness for the study context.

To capture interactive and collective insights, the study also employed FGD guides for trainers and trainees. The trainer FGD guide focused on routine technology use in teaching, preparation, and delivery; challenges related to connectivity and device access; digital literacy constraints; perceived improvements in engagement and performance; and the adequacy of institutional support and policy mechanisms. The trainee FGD guide explored trainees' lived experiences in technology-mediated learning, including the tools used during training, their attitudes toward technology integration, and problems encountered, such as limited access to devices, internet connectivity, and platform usability.

2.4 Data Analysis

All data generated from semi-structured interviews, focus group discussions (FGDs), and document reviews were subjected to a systematic qualitative analysis. Before formal coding, the dataset was cleaned, organized, and prepared, including the transcription of recorded interviews/FGDs, translation into English where required, and the assignment of unique participant codes to preserve confidentiality. This process ensured that responses were complete, comparable across stakeholder groups, and ready for interpretive analysis.

The study primarily utilized manual thematic analysis to identify recurring patterns and meanings across stakeholder narratives. Coded segments were clustered into categories and themes aligned with the study's research questions, allowing the researcher to structure findings around institutional practices, perceived advantages, challenges, opportunities, and institutional factors affecting technology integration. For the first research question, thematic analysis focused on practices such as the use of digital platforms, blended delivery arrangements, instructional tools, assessment approaches, and trainer preparedness. For subsequent questions, thematic coding and clustering were applied to examine stakeholder perceptions of advantages, challenges, and opportunities, and comparisons were made across administrator, trainer, and trainee groups to surface convergent and divergent patterns.

To strengthen analytic rigor, the study incorporated triangulation by integrating qualitative findings with quantitative or frequency-based indicators where appropriate. Specifically, challenge-related themes were not only identified qualitatively but also supported by frequency analysis, which reflected how frequently particular constraints appeared across respondent groups. The integration of qualitative and quantitative evidence served as a validation

mechanism, enhancing the credibility and reliability of the study's interpretations. Finally, the sustainability framework proposed in the study was developed through the synthesis of the emergent themes across research questions, ensuring that the recommended model was grounded in the empirical realities documented during analysis.

3 Results

The results are organized according to the study's research questions and reflect the thematic findings derived from interviews, focus group discussions, and document analysis. Overall, the findings show that TESDA Technology Institutions (TTIs) in Pangasinan have begun transitioning toward technology-based training. Still, implementation remains uneven and is constrained by infrastructure limitations, capacity gaps, and learner access challenges.

The dominant implementation model across the TTIs is basic blended delivery, where face-to-face sessions are reserved for hands-on competency training. At the same time, online platforms are used for theory-based instruction, quizzes, assignments, and administrative tasks. Google Classroom emerged as the principal learning platform because it is free, accessible, and compatible with mobile devices. In addition, trainers commonly use multimedia presentations (e.g., PowerPoint) during lectures and rely on Google Forms for formative or diagnostic assessments. Institutional program management also demonstrates early digital adoption using cloud storage (shared drives) for e-recordkeeping and messaging platforms (e.g., Facebook Messenger) for announcements and coordination.

However, technology integration is not uniform across programs. Specialized software and more advanced digital applications are concentrated in ICT-related programs (e.g., ICT and animation), while traditional trades continue to rely primarily on conventional, hands-on equipment, with minimal use of simulation tools or advanced digital training resources.

Stakeholders across groups acknowledged the benefits of technology integration, but the emphasis varied by role. Administrators highlighted advantages in efficiency and system compliance, noting that online platforms facilitate reporting, monitoring, and alignment with flexible learning mandates. Trainers perceived technology as enhancing instructional efficiency and pedagogy by allowing theoretical instruction and digital assessment to reduce time spent on routine tasks, enabling greater focus on hands-on practice and targeted remediation. Trainees, in contrast, emphasized benefits related to accessibility and work-readiness, particularly the ability to access learning materials anytime and to develop digital skills increasingly relevant to employment.

Taken together, these results indicate that technology-based training is perceived as useful in expanding access, strengthening learner autonomy, improving administrative monitoring, and building workplace-aligned digital competencies, even when implementation remains modest in scale.

Despite perceived benefits, the study found persistent and multi-layered constraints affecting sustainability and scale-up. Administrators reported a severe resource and capacity gap, characterized by inadequate ICT budgets, weak internet connectivity, limited infrastructure, insufficient IT personnel, and a lack of localized digital learning content. Trainers experienced a digital skills deficit and increased workload, particularly due to the demand for digitizing modules, developing online content, and conducting assessments while lacking adequate institutional support. Trainers also reported challenges in remote monitoring of trainee progress, which often required reliance on personal devices, personal internet subscriptions, and self-funded learning resources.

For trainees, the most prominent barrier was the technology equity gap: many rely primarily on smartphones rather than laptops, experience intermittent connectivity, and struggle with the cost of mobile data. This was compounded by unstable systems that sometimes led to

missed submissions or data loss and created the need for immediate technical support that institutions could not always provide.

Overall, the results show that technology-based training adoption is constrained not only by technology availability but also by institutional readiness, trainer capacity, and inequitable access conditions among learners.

Participants' perceived opportunities were strongly future-oriented and aligned with modernization goals. Administrators framed opportunities in terms of global competitiveness, resource mobilization, systematic quality control, and evidence-based planning, emphasizing the role of technology in aligning training with Industry 4.0 and improving institutional performance through standardized platforms and analytics.

Trainers emphasized instructional opportunities such as access to virtual simulations and advanced learning tools, the ability to deliver personalized instruction through multimedia, and professional development through continuous upskilling. Trainees highlighted opportunities linked to improved job readiness, reinforced skill acquisition through repeatable video demonstrations, increased autonomy in learning, and stronger collaboration through shared documents and online tools.

These findings suggest that although technology-based training is constrained by current limitations, stakeholders view it as a viable pathway for institutional modernization, instructional improvement, and labor-market relevance.

4 Discussion

Consistent with DOI, the adoption of technology-based training in Pangasinan TTIs appears to be a staged, role-dependent process influenced by perceived relative advantage, compatibility with existing training structures, complexity, trialability, and observable outcomes (Rogers, 2003). The results indicate that TTIs are currently operating at an early-to-intermediate adoption stage, where technology is used largely to complement rather than transform competency-based delivery. Most institutions implement basic blended arrangements—face-to-face sessions for hands-on competencies and online platforms for theory, assignments, and coordination—reflecting a pragmatic approach to innovation that minimizes disruption and fits existing training requirements. This pattern is strongly aligned with TESDA's formal policy direction, which promotes flexible learning as an alternative delivery mode to ensure continuity and widen access (TESDA, 2020).

A key finding is that adoption is concentrated around tools with low entry barriers, notably Google Classroom, Google Forms, and basic multimedia presentations. This reflects DOI's expectation that innovations perceived as less complex and more compatible with existing routines diffuse faster than those requiring major technical or pedagogical shifts (Rogers, 2003). In other words, TTIs are selecting technologies that can be rapidly adopted without requiring extensive infrastructure or redesign of instructional systems. This may be viewed as a rational institutional adaptation: trainers and administrators appear to leverage accessible platforms that function adequately under constraints such as intermittent connectivity, limited devices, and uneven digital capabilities among learners.

However, the study also found that adoption is uneven across programs, with more advanced software and deeper integration concentrated in ICT-related areas (e.g., animation, ICT programs). At the same time, other trades remain primarily hands-on with minimal digital augmentation. This highlights the role of innovation compatibility: programs already predisposed to digital tools can more readily integrate technology-based instruction, whereas trade programs rooted in physical equipment and workshop-based training face greater constraints. Importantly, this program-level variation suggests that "technology-based training" in the TTIs currently functions more as supplemental digitization than full instructional transformation—a common trajectory in early adoption environments.

Across administrators, trainers, and trainees, the study documented clear perceived benefits of technology-based training. Administrators emphasized efficiency in monitoring, coordination, and compliance; trainers highlighted instructional convenience and enhanced teaching strategies; trainees emphasized accessibility and digital employability benefits. These perceived advantages are central predictors of diffusion under DOI and help explain why technology-based training is sustained even when institutional conditions remain suboptimal (Rogers, 2003).

From a policy standpoint, these benefits reinforce TESDA's intent in implementing flexible learning approaches. TESDA Circular No. 062 frames flexible learning as a necessary strategy to maintain responsive training delivery amid shifting social conditions and to provide alternative modalities for learners (TESDA, 2020). The study's findings support this policy direction by demonstrating that basic digital platforms can widen access and enable learning continuity, especially for theory content and administrative processes. Moreover, the trainee-reported gains in workplace-relevant digital skills suggest that technology-based training can serve as a "dual function" mechanism: it supports training delivery while simultaneously building transversal competencies required in digitizing labor markets.

Despite perceived value, the most salient discussion point is that technology-based training implementation remains constrained by interrelated barriers: limited infrastructure, weak connectivity, inadequate devices and ICT tools, insufficient digital content, and deficits in skills and support. Administrators emphasized institutional resource gaps and insufficient IT support; trainers reported increased workload and skill development needs; trainees highlighted inequitable access to devices and connectivity, often relying on smartphones and inconsistent data availability. These findings align with global evidence that the digital transition in vocational education depends not only on providing platforms but also on strengthening institutional capacity, trainer preparedness, and inclusion-oriented access structures (Cedefop, 2025).

The observed challenges also closely align with DOI's "complexity" and "compatibility" dimensions. Technology-based training introduces complexity in several ways: it requires trainers to redesign materials, manage dual-mode delivery, monitor learner engagement remotely, and troubleshoot technology barriers. This complexity increases the perceived cost of adoption—mainly when instructors must rely on personal resources or when institutional IT support is limited. The workload burden reported by trainers suggests that diffusion may stagnate unless institutions implement systematic support (e.g., content repositories, instructional design assistance, trainer upskilling pathways, and stronger ICT infrastructure). If such support is absent, technology-based training risks remaining at a shallow level of digitization, where platforms are used merely for compliance or basic logistics rather than to improve learning outcomes and training quality.

For trainees, the equity gap is particularly consequential. When learners lack devices or connectivity, technology-based delivery can unintentionally widen disparities in participation and performance. This outcome is consistent with broader critiques of digital learning implementation, which caution that technology can reinforce exclusion when access is unequal and when training environments assume device ownership and stable internet availability. From an institutional perspective, the results suggest that technology integration cannot be evaluated solely on adoption metrics (e.g., "platform usage"), but must be assessed through equity indicators such as device access, learning continuity, and support availability.

Stakeholders identified opportunities that position technology-based training as a pathway to modernization, Industry 4.0 alignment, and improved employability outcomes, including the use of simulations, improved learner autonomy, enhanced analytics for monitoring, and strengthened collaboration and content sharing. These opportunities align with TESDA's medium-term strategic direction articulated through the National Technical Education and Skills Development Plan (NTESDP) 2023–2028, which emphasizes future-ready skills and system strengthening to ensure workforce competitiveness in a rapidly evolving global economy (TESDA, 2023).

However, translating opportunity into implementation requires a shift from ad hoc adoption to structured institutional scaling. Under DOI, the movement from implementation to confirmation depends on sustained reinforcement, visible positive outcomes, and adopters' ability to normalize the innovation within routine operations (Rogers, 2003). The study's proposed sustainability directions—such as strengthening infrastructure, building digital capability, ensuring equity mechanisms, and formalizing support systems—are therefore not ancillary recommendations but essential requirements for diffusion to mature. Without investment and governance alignment, TTIs may remain in a cycle of partial adoption where technology is used inconsistently, and benefits are not maximized.

The findings have several implications for TESDA and TTIs. First, while TESDA's flexible learning policy enables adoption, policy implementation should be accompanied by structured institutional support and capacity-building to reduce trainer workload and improve instructional quality (TESDA, 2020). Second, TTIs require a more deliberate digitalization framework emphasizing not only platform adoption but also infrastructure upgrades, content development, and digital pedagogy standards—consistent with broader recommendations for strengthening VET's role in the digital transition (Cedefop, 2025). Third, equity mechanisms are critical: ensuring device access, improving connectivity, and providing learner support structures are necessary to prevent technology-based training from excluding marginalized trainees. Finally, in alignment with NTESDP 2023–2028, these institutional improvements can help ensure that TTIs serve as effective public delivery hubs for future-ready and digitally enabled TVET (TESDA, 2023).

In summary, the study demonstrates that technology-based training in Pangasinan TTIs is valued and emerging, but remains constrained by systemic barriers that hinder deeper transformation. Viewed through DOI, the TTIs exhibit early diffusion characterized by adoption of low-complexity tools, stakeholder recognition of relative advantage, and persistent barriers related to complexity and inequity. To advance diffusion toward sustainability and institutional normalization, TESDA and TTIs must strengthen infrastructure, professional development, and equity-oriented support systems so that technology integration becomes not only a response mechanism but a durable strategy for improving TVET quality and labor-market alignment.

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