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Research Article

Gender-Responsive Digital Deep Learning Management in Indonesian Vocational Schools

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Abstract

Digital transformation in vocational high schools should not be evaluated only through infrastructure availability, but also through its capacity to deepen learning, protect student well-being, and widen equitable school-to-work opportunities. This study evaluates the management of digital-based deep learning in four public vocational high schools in Pesawaran Regency, Indonesia, using a qualitative document-evaluation design. The data corpus comprised 2025 Education Report Cards, school vision and mission statements, school profiles, annual work plans, principal work programs, and follow-up planning documents from SMKN 1 Gedong Tataan, SMKN 1 Tegineneng, SMKN 1 Negeri Katon, and SMKN Padang Cermin. The documents were analyzed through thematic synthesis informed by open-systems theory, CIPP evaluation, continuous quality improvement, TPACK, project-based vocational pedagogy, and a gender-responsive welfare lens. The findings show that the schools have strong strategic commitments to character formation, digital learning, industry partnership, project learning, and vocational relevance. However, the Education Report Cards reveal an important management paradox: ICT facilities were consistently strong, while resource allocation for quality improvement remained weak and instructional quality was unstable in several schools. The study proposes a PPEPP-CIPP model for gender-responsive digital deep learning management, linking standard setting, implementation, evaluation, control, and improvement with context, input, process, and product evidence. The model positions digital learning as a human-centered and welfare-sensitive strategy for improving vocational learning quality, student participation, and transition readiness.

Keywords: Deep Learning; Gender-Responsive Vocational Education; School Welfare; CIPP Evaluation.

INTRODUCTION

Vocational high schools occupy a strategic position between schooling, technological change, local development, and social mobility. In Indonesia, vocational high schools (Sekolah Menengah Kejuruan, SMK) are expected to prepare students for work, further study, and entrepreneurship. Digital learning has become central to this mission because contemporary workplaces increasingly require digital communication, data interpretation, design, documentation, and technology-mediated collaboration. However, digital transformation does not automatically produce high-quality learning. A school may possess devices, internet access, and digital platforms while still failing to provide learning experiences that are meaningful, equitable, reflective, and connected to real occupational practices.

This issue is particularly relevant to the focus of Women, Education, and Social Welfare because digital vocational education is not only a pedagogical matter but also a welfare, equity, and human-centered systems issue. When digital learning is poorly managed, it can reproduce unequal access, increase task burden, weaken psychosocial support, and leave students with portfolios that are disconnected from labor-market expectations. Conversely, when digital learning is managed through inclusive and welfare-sensitive principles, it can expand participation for girls and boys, strengthen confidence, document competencies, support school-to-work transition, and improve the social value of vocational education.

The international literature increasingly recognizes that digital competence in vocational education depends on more than technical proficiency. Teachers need an integrated understanding of content, pedagogy, and technology [1], [2], while institutions need professional learning, curriculum support, and leadership conditions that allow technology to be used for authentic learning rather than administrative substitution [3], [4]. Studies in vocational education show that teacher digital competence, attitudes toward technology, and school context are associated with technology acceptance and learning design [5], [6], [7]. Other studies emphasize that e-learning and project-based vocational pedagogy can support employability and twenty-first-century skills when integrated with authentic tasks, assessment, and industry collaboration [8], [9], [10].

Despite these developments, a practical gap remains. Many studies examine digital competence, project-based learning, or teaching factory implementation separately, while fewer studies evaluate how school management systems convert digital infrastructure into deep learning quality, student welfare, and equitable transition outcomes. This gap matters because vocational schools are open systems: they receive inputs from policy, students, teachers, digital resources, local culture, funding, and industry partners; they transform these inputs through curriculum, learning, assessment, supervision, and partnerships; and they are accountable for outputs and outcomes such as literacy, numeracy, character, vocational competence, employment alignment, and community benefit [11].

Pesawaran Regency provides a relevant context for such evaluation. The documents analyzed in this study indicate that public vocational high schools in the regency already articulate commitments to faith-based character, safe and healthy school culture, innovation, digital learning, industry partnership, project-based learning, and quality management. At the same time, the 2025 Education Report Cards reveal a recurring paradox: ICT facilities were rated strongly across the four schools, but the proportion of resources used for quality

improvement remained weak, and the quality of learning declined in several schools. This pattern suggests that the central issue is not simply digital access but the management of digital learning quality.

This study aims to evaluate digital-based deep learning management in four public vocational high schools in Pesawaran Regency through a document-based CIPP and PPEPP analysis. Specifically, it examines institutional orientation, learning management strategies, Education Report Card patterns, quality-control gaps, and improvement priorities. The novelty of the study lies in integrating CIPP evaluation with the Indonesian PPEPP quality cycle and a gender-responsive welfare lens. In doing so, the article reframes digital deep learning as a management strategy that should be accountable to learning quality, student dignity, safe participation, and school-to-work welfare outcomes rather than to technology use alone.

METHODS

Research Design

This study employed a qualitative document-evaluation design to examine how digital-based deep learning is managed in four public vocational high schools in Pesawaran Regency, Indonesia. The design was selected because the study focused on institutional evidence recorded in official school documents rather than on individual perceptions or classroom experiments. The evaluation combined the CIPP model - context, input, process, and product - with the PPEPP quality cycle - standard setting, implementation, evaluation, control, and improvement - so that the analysis could move from descriptive interpretation to actionable quality-management recommendations [12], [13], [14].

Participants and Sampling

This study did not involve human participants in the form of interviews, questionnaires, or classroom observations. The units of analysis were four public vocational high schools: SMKN 1 Gedong Tataan, SMKN 1 Tegineneng, SMKN 1 Negeri Katon, and SMKN Padang Cermin. The schools were selected purposively because they are public vocational schools in Pesawaran Regency and because their Education Report Cards, school profiles, vision and mission statements, annual work plans, principal programs, and follow-up planning documents were available for document evaluation. The sampling was therefore institutional, criterion-based, and document-oriented.

Operational Definitions of Variables

Because this is a qualitative evaluative study, the term variables is used operationally to refer to the main constructs analyzed in the documents. Digital deep learning management refers to the planning, implementation, supervision, and improvement of digital learning practices that support authentic vocational tasks, reflection, collaboration, technical literacy, numeracy, and portfolio-based evidence. Gender-responsive vocational education refers to the extent to which digital learning, project work, mentoring, safety, and school-to-work transition are framed as inclusive and equitable for female and male students. CIPP evaluation refers to the analysis of school context, inputs, processes, and products. PPEPP refers to the continuous quality cycle of standard setting, implementation, evaluation, control, and improvement. School welfare

refers to the protection of student dignity, psychosocial safety, learning confidence, and equitable transition opportunities.

Hypotheses Development

The study did not test statistical hypotheses because it used secondary documents and qualitative synthesis. However, four evaluative propositions guided the analysis. H1: Strong ICT facilities do not automatically generate strong instructional quality unless schools also allocate sufficient resources for quality improvement. H2: Schools with explicit digital, project-based, and DUDIKA-oriented strategic commitments are more likely to show stronger foundations for digital deep learning management. H3: The integration of CIPP and PPEPP can reveal whether digital readiness is translated into implementation, control, and improvement. H4: A gender-responsive welfare lens can broaden digital learning evaluation from infrastructure readiness to safe participation, equitable mentoring, student confidence, and school-to-work transition.

Data Collection Procedure

Data were collected through a structured document review. First, the authors compiled the 2025 Education Report Cards of the four schools. Second, institutional documents were organized, including vision and mission statements, school profiles, annual work plans, principal work programs, and follow-up planning documents. Third, each document was screened for evidence related to digital learning, instructional quality, teacher reflection, link and match, ICT facilities, resource allocation, project-based learning, teaching factory practices, partnerships, and student welfare. Fourth, relevant excerpts and indicators were transferred into an extraction matrix for cross-school comparison.

Data Analysis

Data analysis followed four stages of qualitative document analysis. The first stage extracted key Education Report Card indicators, including literacy, numeracy, instructional quality, teacher reflection, link and match, ICT facilities, and resource allocation for quality improvement. The second stage coded school documents into themes of strategic orientation, digital learning planning, project and teaching factory learning, supervision, partnerships, and improvement programs. The third stage mapped the coded evidence onto CIPP dimensions and PPEPP actions. The fourth stage synthesized the cross-case patterns into a gender-responsive digital deep learning management model for vocational schools.

Validity and Reliability Results

Validity and reliability were addressed through qualitative trustworthiness procedures rather than through psychometric coefficients. Content validity was strengthened by aligning the extraction matrix with the study objectives, CIPP dimensions, PPEPP stages, and the indicators available in the Education Report Cards. Triangulation was conducted across four categories of documents: report cards, school profiles, work plans, and scholarly literature. Reliability was supported by using the same extraction categories for all four schools and by checking the consistency of interpretations across indicators and documents. No Cronbach alpha, factor

loading, or inter-rater kappa is reported because the study did not use a survey instrument or independent quantitative coding.

Ethical Considerations

The study used institutional documents and secondary school-level indicators. It did not collect personal information from students, teachers, parents, or school leaders. The analysis therefore avoided student-level identification and did not make claims about individual learning outcomes, gender-specific experiences, or classroom behavior. School names are reported because the documents were treated as institutional evidence for educational improvement. All interpretations were written cautiously to avoid stigmatizing any school and to position the findings as quality-improvement input rather than as punitive evaluation.

RESULTS AND DISCUSSION

Results

Institutional Orientation Toward Human-Centered Digital Vocational Education

The document analysis shows that the four vocational schools share a broadly compatible strategic direction. SMKN 1 Gedong Tataan emphasizes the BARIS identity: faithful, safe, friendly, innovative, and healthy. This orientation is important because digital learning in vocational schools can become overly technical if it is separated from safety, psychosocial climate, ethical technology use, and care for student dignity. From a welfare perspective, the school's identity provides a normative basis for ensuring that digital learning is safe, inclusive, and supportive rather than merely platform-based.

SMKN 1 Tegineneng articulates a stronger explicit digital orientation through quality learning services, cross-subject project learning, creative entrepreneurship, and partnerships with government, higher education, and the world of business, industry, and work (DUDIKA). Its profile identifies five expertise concentrations: Computer and Network Engineering, Office Management, Accounting, Light Vehicle Engineering, and Visual Communication Design. These concentrations create opportunities for portfolio-based digital learning, especially when students are guided to produce authentic evidence such as design products, administrative documents, service records, accounting simulations, automotive reports, or multimedia outputs.

SMKN Padang Cermin emphasizes graduates who are intelligent, skilled, creative, and independent, grounded in faith and piety. Its mission includes twenty-first-century learning, vocational education for work, further study, and entrepreneurship, creative projects, extracurricular development, industry cooperation, facilities, learning quality management, and teacher capacity improvement. SMKN 1 Negeri Katon emphasizes planning, professional educators, empowerment of school members, communication, control, accountability, and innovative learning models. These orientations indicate that the schools already have a strategic foundation for deep learning management, but the implementation requires evidence-based control and quality improvement [15], [16], [17].

Table 1. Strategic Orientation of The Four Vocational Schools

School	Key Strategic Orientation	Relevance To Digital Deep Learning	Management Implication
SMKN 1 Gedong Tataan	Faith, safety, friendliness, innovation, health	Links digital learning with ethical climate, psychosocial safety, creativity, and care.	Strengthen safe digital culture, anti-bullying practices, project innovation, and healthy learning environments.
SMKN 1 Tegineneng	Digital learning, cross-subject projects, entrepreneurship, DUDIKA partnership	Supports authentic learning, productive skills, and digital portfolios.	Develop industry-based curriculum, teaching factory projects, portfolio assessment, and creative studio outputs.
SMKN 1 Negeri Katon	Professionalism, independence, accountability, innovative learning	Positions leadership and supervision as drivers of learning quality.	Use coaching, monitoring, and peer learning to improve digital pedagogy and assessment.
SMKN Padang Cermin	Twenty-first-century learning, vocational relevance, BMW orientation, quality management	Connects learning with work, further study, entrepreneurship, and school quality targets.	Build a PPEPP-based dashboard linking projects, MoU, tracer study, teacher development, and budget priorities.

Education Report Card Patterns and Management Meaning

The 2025 Education Report Cards reveal mixed quality patterns. Literacy was moderate in SMKN 1 Gedong Tataan, SMKN 1 Tegineneng, and SMKN Padang Cermin, and good in SMKN 1 Negeri Katon. Numeracy was also moderate to good but fluctuated across schools. This pattern suggests that digital deep learning should not be reduced to the use of learning platforms; it must also strengthen vocational literacy and numeracy, such as reading technical procedures, interpreting customer needs, analyzing production data, calculating costs, reading graphs, and evaluating the quality of products or services.

Instructional quality was mostly categorized as good, although several schools experienced score declines. Teacher reflection was generally good, which indicates a promising foundation for professional learning communities. However, the coexistence of teacher reflection and declining instructional quality suggests that reflection alone is insufficient unless it is connected to lesson redesign, peer observation, digital portfolio assessment, and support for teachers in project-based pedagogy. Digital transformation therefore requires pedagogical leadership, not only device provision [18], [19], [20].

The strongest paradox concerns ICT facilities and quality-oriented resource allocation. ICT facilities were rated good, with a score of 100 across the four schools, but the proportion of resources allocated for quality improvement was weak in all schools. This is the main managerial finding of the study. Schools may be digitally equipped, yet the core budgetary and

professional support for learning quality may remain underdeveloped. From a welfare-sensitive perspective, this gap matters because students, including girls in male-dominated vocational fields, need not only access to devices but also safe mentoring, authentic projects, feedback, and meaningful transition support.

Table 2`. Education Report Card Patterns and Management Meaning

Indicator	Comparative Pattern in the Four Schools	Management Meaning
Literacy	Moderate to good: Gedong Tataan 66.67%; Tegineneng 73.33%; Negeri Katon 80%; Padang Cermin 68.89%.	Strengthen vocational reading: manuals, procedures, customer briefs, safety texts, technical reports, and digital information.
Numeracy	Moderate to good but fluctuating: 68.89%; 66.67%; 80%; 62.22% across the four schools.	Embed numeracy in production data, measurements, cost estimation, graphs, quality control, and entrepreneurship tasks.
Instructional quality	Mostly good, but several schools experienced score declines; Gedong Tataan remained moderate.	Use humanistic supervision, lesson study, LMS evidence, and digital portfolio review to redesign learning.
Teacher reflection	Generally good across the schools.	Convert reflection into collaborative products: modules, jobsheets, rubrics, and project assessment instruments.
Link and match	Generally good, although employment-field alignment remains uneven.	Move DUDIKA partnership into curriculum validation, project mentoring, portfolio assessment, and tracer-study follow-up.
Resources for quality improvement	Weak across all four schools: 5.34; 13.01; 5.59; and 10.69.	Prioritize quality-oriented budgeting for teacher learning, software, TIK maintenance, portfolios, and industry-linked projects.
ICT facilities	Good, with a score of 100 in all schools.	Transform infrastructure readiness into pedagogical depth, equity, safety, and welfare-sensitive learning outcomes.

Discussion

The results show a central governance problem: digital infrastructure has reached a relatively strong level, but the quality cycle that converts infrastructure into deep, inclusive, and vocationally relevant learning remains inconsistent. This pattern confirms that digital transformation in vocational schools should not be interpreted as device availability alone. It requires pedagogical leadership, quality-oriented budgeting, teacher professional learning, authentic assessment, student safeguarding, and systematic school-industry collaboration. In the CIPP perspective, the main gap is located in the conversion of input into process and

product quality. In the PPEPP perspective, the gap shows the need to strengthen the movement from evaluation to control and improvement.

CIPP Interpretation of Digital Deep Learning Management

The context evaluation indicates that the schools need digital learning management that is aligned with vocational relevance, character formation, safe participation, and local development. The context is not limited to school documents; it includes the labor market, DUDIKA expectations, student diversity, gendered participation patterns in vocational fields, and the psychosocial risks of technology-mediated learning. Therefore, the context dimension requires schools to formulate digital learning standards that include equity, safety, learning depth, and transition readiness.

The input evaluation shows strong ICT readiness but weaker evidence of systematic investment in quality improvement. This means that digital inputs should be expanded beyond devices and connectivity to include teacher digital competence, project rubrics, authentic assessment tools, industry mentors, digital portfolios, LMS analytics, software access, and safeguarding protocols. Recent vocational education research supports this interpretation by showing that teacher digital competence is shaped by attitudes, training, workload, leadership, curriculum support, and school context [5],[7].

The process evaluation indicates that project-based learning and teaching factory approaches are present in planning documents, but schools need stronger documentation of how these approaches operate in classrooms, laboratories, workshops, and digital platforms. Process quality should be evidenced through modules, jobsheets, block schedules, student portfolios, peer review, LMS logs, supervision notes, DUDIKA feedback, and student reflection. The product evaluation indicates that literacy, numeracy, instructional quality, link and match, graduate absorption, and employment alignment should be read together. A high absorption rate does not necessarily mean strong alignment if graduates work outside their field of expertise [21], [22].

A PPEPP-CIPP Model for Gender-Responsive Digital Deep Learning

The proposed model integrates PPEPP with CIPP to make evaluation actionable. In the standard-setting stage, schools should define what counts as digital deep learning in vocational contexts: authentic tasks, gender-safe participation, technical literacy and numeracy, ethical digital behavior, portfolio evidence, and industry feedback. In the implementation stage, teachers translate these standards into project modules, jobsheets, teaching factory activities, LMS-supported learning, and formative assessment. In the evaluation stage, schools combine Education Report Card indicators, portfolio evidence, student reflection, DUDIKA input, and tracer-study data.

In the control stage, school leaders use supervision and coaching to correct gaps between standards and practice. Control should be humanistic rather than punitive; it should help teachers redesign learning and help students experience technology as a medium of empowerment[12], [23]. In the improvement stage, schools institutionalize good practices through professional learning communities, curriculum revision, quality-oriented budgeting, active industry partnerships, and gender-disaggregated monitoring. This final point is crucial

for journal fit: future evaluations should examine whether girls and boys experience equal access to digital tools, project leadership, mentorship, safety, and school-to-work opportunities.

Table 3. PPEPP-CIPP Model for Gender-Responsive Digital Deep Learning Management

PPEPP Stage	CIPP Focus	Core Evaluative Question	Evidence to Collect	Gender-Responsive Welfare Action
Standard setting	Context and input	What standards define digital deep learning for vocational education?	Vision, mission, curriculum, RKAS, DUDIKA needs, student profile	Include safe participation, accessibility, portfolio evidence, and equal opportunities for girls and boys.
Implementation	Process	Are project, teaching factory, and digital learning activities implemented as planned?	Modules, jobsheets, LMS logs, project documentation, supervision notes	Ensure inclusive grouping, fair access to tools, psychosocial safety, and mentoring.
Evaluation	Process and product	What do report-card indicators, authentic assessment, and portfolios show?	Education Report Card, rubrics, portfolios, reflection journals, DUDIKA feedback	Use gender-disaggregated evidence where possible and examine confidence, safety, and transition readiness.
Control	Input and process	What gaps exist between standards, resources, and practice?	Budget reports, observation notes, community-of-practice records, tracer data	Use non-punitive coaching and address barriers faced by vulnerable or underrepresented students.
Improvement	Product and outcome	Which good practices should be institutionalized and scaled?	Revised SOPs, active MoU, student products, certification, employment alignment	Create school dashboards for learning quality, welfare, participation, and school-to-work outcomes.

Implications for Education, Welfare, and School-to-Work Transition

The findings have three practical implications. First, school leaders need to transform ICT facilities into learning-quality investment. Budgeting should prioritize teacher training, software access, equipment maintenance, digital portfolios, authentic assessment, learning analytics, and school-industry mentoring. Second, teachers need professional learning communities that focus on real pedagogical problems: how to integrate vocational literacy and

numeracy into projects, how to assess process and product quality, how to support students who lack confidence, and how to ensure safe participation in digital spaces.

Third, DUDIKA partnerships should move from administrative cooperation to co-designed learning. Industry partners can help validate rubrics, provide authentic problems, mentor student projects, assess digital portfolios, and strengthen work-placement alignment. Such partnerships are particularly important for gender-responsive vocational education because girls may face stereotypes, limited role models, or weaker access to networks in some vocational fields. A human-centered digital learning system should therefore make participation, safety, confidence, and transition support visible in the school's quality dashboard.

CONCLUSION

This study concludes that public vocational high schools in Pesawaran Regency have a strong strategic foundation for digital deep learning through their commitments to character formation, digital services, project-based learning, teaching factory, industry partnership, and quality management. Nevertheless, the 2025 Education Report Cards reveal that digital readiness has not yet been fully converted into stable instructional quality because ICT facilities were strong while quality-oriented resource allocation remained weak. The proposed PPEPP-CIPP model offers a practical way to transform digital learning management from infrastructure-centered adoption into evidence-informed, human-centered, and welfare-sensitive improvement. By linking standard setting, implementation, evaluation, control, and improvement with context, input, process, and product evidence, the model helps schools strengthen vocational literacy and numeracy, authentic projects, teacher professional learning, portfolio assessment, DUDIKA collaboration, and school-to-work transition. Its gender-responsive orientation also reminds schools that future digital vocational management should monitor equitable access, safety, confidence, mentoring, and employment alignment for all students, including girls in vocational fields where participation and transition may remain socially constrained.

LIMITATIONS

This study is limited by its reliance on secondary documents and Education Report Card indicators. It does not include interviews, classroom or workshop observations, LMS analytics, student portfolio assessment, or gender-disaggregated student-level data. Therefore, the findings should be interpreted as a document-based evaluative synthesis rather than a direct measurement of classroom practice or student experience. Future studies should validate the proposed model through fieldwork involving school leaders, productive-subject teachers, students, alumni, parents, and DUDIKA partners. Future research should also include gender-disaggregated analysis, psychosocial safety indicators, digital access mapping, and tracer-study evidence to examine whether digital deep learning management improves not only learning quality but also equitable welfare and school-to-work outcomes.

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AUTHOR CONTRIBUTION

J. conceptualized the study, organized the document corpus, and drafted the initial manuscript. J. contributed to document extraction, translation, and contextual interpretation of school programs. S. strengthened the evaluation framework and reviewed the interpretation of Islamic education management and school quality assurance. T. S. contributed to methodological refinement, policy interpretation, and critical revision of the manuscript. K. reviewed the integration of digital pedagogy, vocational learning, and institutional quality improvement. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST

"The authors declare no conflict of interest."

DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors used AI-assisted language editing to improve clarity, grammar, and formatting. The authors reviewed, verified, and approved all content and remain fully responsible for the accuracy, integrity, and originality of the manuscript.

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