

Beyond Functional Skills: A Systematic Review of Critical Digital Literacy in Vocational Teacher Education

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Abstract

The convergence of artificial intelligence, digitalization, and social media has exposed the insufficiency of functional digital literacy as an educational outcome, intensifying attention to Critical Digital Literacy (CDL) as a construct concerned with the ideological and structural logics of digital platforms rather than mere operational use. CDL scholarship nonetheless remains fragmented and lacks a stable, shared taxonomy of its dimensions. This study reports a systematic literature review, following the PRISMA 2020 protocol, of CDL in educational contexts. A Scopus search yielded 130 records, narrowed to 73 after automated screening and to 49 after a stringent CDL-focus eligibility criterion. Qualitative designs dominate the corpus (~55%), followed by conceptual work (~31%), while validated quantitative measurement remains rare (four studies). Inductive synthesis identifies eight recurring CDL dimensions, spanning critical-analytical, socio-political, ethical, identity-based, productive, and civic concerns. None of the 49 included studies directly addresses vocational (VET) teacher education, despite vocational teachers' need to combine technical fluency with critical disposition. Five gaps are identified, concerning measurement instruments, the functional-versus-critical divide, affective dimensions, institutional barriers, and generative AI, with future directions proposed. The synthesis is a necessary step toward a dedicated CDL framework for pre-service vocational teachers.

1. Introduction

Over the past decade, formal education has undergone a structural transformation driven by the convergence of artificial intelligence, ubiquitous digitalization, and social media (Ilomäki et al., 2023; Chan & Hu, 2023). Classrooms are increasingly hybrid, algorithmically curated environments in which learners encounter information through search engines, generative AI systems, and social platforms whose underlying logics are rarely transparent to the end user (Baker & Hawn, 2022; Walter, 2024). The proliferation of generative AI (GenAI) tools since late 2022 has intensified this shift: students increasingly encounter GenAI outputs that may be hallucinated, outdated, or fabricated yet presented with confident, authoritative phrasing, raising the bar for the critical evaluative capacities education must cultivate (Chan & Hu, 2023; Walter, 2024).

This acceleration exposes the limits of functional digital literacy, commonly understood as the operational ability to use software and perform basic technical tasks, as an adequate educational outcome (Walter, 2024). Functional competence says little about a learner's capacity to interrogate the provenance of information, recognize algorithmic bias, or understand how platforms structure visibility and voice (Baker & Hawn, 2022). The concern is not hypothetical: Gerlich (2025) reports a significant negative relationship between frequent AI tool use and critical-thinking performance, mediated by a phenomenon the study terms cognitive offloading, and Chan and Hu (2023) document how confidently phrased GenAI outputs can contain fabricated content that under-critical students accept as reliable. Scholars accordingly argue that digital literacy frameworks must move beyond an access-and-skills paradigm toward one that foregrounds interpretation, evaluation, and critique (Ilomäki et al., 2023).

This insufficiency has fueled the consolidation of a more theoretically developed construct: Critical Digital Literacy (CDL), which extends conventional digital literacy with an explicitly critical orientation concerned not only with how digital tools are used but with why they are structured as they are and whose interests they serve. Hinrichsen and Coombs's (2013) five-resource model, spanning decoding, meaning-making, using, analyzing, and persona, remains foundational; Pangrazio (2016) reconceptualizes CDL as "critical digital design," arguing for a shift from consumption to critical production, while Gutiérrez-Ujaque (2024) situates it within a broader

"critical consciousness." Sulzer (2018) and Pötzsch (2019) treat political power and digital capitalism as core, non-negotiable dimensions rather than peripheral concerns. Ilomäki et al. (2023), in a review of 139 sources, find criticality running through multiple adjacent constructs, including e-safety, information literacy, and digital citizenship, rather than forming one bounded skillset, a heterogeneity that continues to characterize the field.

This fragmentation is borne out empirically. Gouseti et al. (2024), in a four-country focus-group study, find that teachers' perceptions of CDL vary considerably across national contexts and diverge from how the construct is operationalized in policy-driven curricula. A recent review of 78 studies on CDL in teacher education similarly identifies inadequate training, limited institutional support, and curricular misalignment as persistent barriers (Syahrudin & Agus, 2026), suggesting the challenge is institutional and pedagogical as much as definitional. The scale of this fragmentation is reflected in the size of the literature itself: a systematic Scopus search for CDL in educational contexts returns a comparatively modest corpus, considerably smaller than the 139 sources drawn on by broader reviews of adjacent constructs such as digital literacy and digital competence (Ilomäki et al., 2023). This scarcity strengthens rather than weakens the case for a rigorous, systematically structured synthesis: the corpus is small enough to review comprehensively, yet rich enough to reveal patterns that individual studies cannot expose on their own.

This mapping carries particular weight for the preparation of pre-service vocational teachers. Vocational education sits at the intersection of industry-driven technical training and the broader civic and ethical formation of learners: vocational teachers must transmit workplace-relevant digital competencies while also cultivating in students the capacity to critically engage with the tools they will use professionally (UNESCO-UNEVOC, 2022). Yet this dual mandate remains under-theorized. A 2025 systematic review of technology adaptability in VET notes that research on vocational teachers' digital competencies remains scarce relative to the general teacher-education literature (Imama et al., 2025), and the existing CDL literature has rarely addressed this population directly, focusing predominantly on general or higher-education contexts. Mapping CDL's dimensions and sub-dimensions is therefore a necessary preliminary step toward a dedicated CDL framework for vocational teacher education.

Building on this rationale, the present study undertakes a systematic literature review to synthesize and critically map scholarship on Critical Digital Literacy in educational contexts, applying a deliberately stringent inclusion criterion requiring CDL, or one of its constituent dimensions, to be the primary object of investigation rather than a peripherally mentioned concept. The review addresses three questions: RQ1, what dimensions and sub-dimensions of CDL are used in educational research; RQ2, what methodologies dominate current CDL scholarship; and RQ3, what research gaps and future directions exist, particularly for teacher preparation. In doing so, it aims to consolidate a fragmented body of knowledge and establish the conceptual foundation for a future, empirically grounded CDL framework for pre-service vocational teachers.

2. Method

2.1. Research Design

This study was conducted as a systematic literature review (SLR), following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement (Page et al., 2021), which supersedes the original 2009 statement and constitutes the current standard for transparent, replicable evidence synthesis. The review was structured around four sequential phases (identification, screening, eligibility, and inclusion), each reported below with its numerical yield, consistent with the emphasis on rigor, transparency, and auditability that distinguishes systematic reviews from narrative reviews (Kitchenham & Charters, 2007; Xiao & Watson, 2019). Critical Digital Literacy (CDL) is a theoretically dense yet empirically dispersed construct that cuts across several adjacent constructs, including e-safety, information literacy, data literacy, and digital citizenship, rather than forming a single bounded skillset (Ilomäki et al., 2023). A systematic, rather than narrative or scoping, review design was therefore adopted to permit a reproducible, criterion-based mapping of the field's dimensions, methodologies, and research gaps while minimizing selection bias.

2.2. Search Strategy and Information Sources

A single bibliographic database, Scopus, was used as the exclusive source of records. Scopus and Web of Science are the two principal databases underpinning contemporary evidence synthesis in education and the social sciences, with broadly overlapping but distinct coverage (Pranckūte, 2021). Scopus was chosen over Web of Science for two reasons. First, Scopus indexes more journals overall than Web of Science, and this advantage is especially pronounced in the social sciences and humanities, the domain in which CDL research is situated (Mongeon & Paul-Hus, 2016), using Scopus alone therefore captures a wider range of relevant education journals than Web of Science would. Second, the two databases overlap heavily, as most journals indexed in Web of Science are also indexed in Scopus (Gavel & Iselid, 2008), so a supplementary Web of Science search would likely add few records relative to the added screening burden. Reliance on a single database is, in any case, methodologically defensible when a review's aim is in-depth, criterion-driven synthesis of a narrowly defined construct rather than exhaustive bibliometric mapping (Xiao & Watson, 2019).

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The search string was "critical digital literac*" AND ("educat*" OR "teacher*" OR "pedagog*" OR "school*"), applied to the title, abstract, and keyword fields. This combines a core conceptual term with a disjunctive cluster of contextual qualifiers, following established guidance on search-string formulation (Kitchenham & Charters, 2007). The wildcard truncation (literac*) captured morphological variants such as "literacy" and "literacies"; the four OR-joined educational qualifiers (educat*, teacher*, pedagog*, school*) ensured that every retrieved record was substantively situated within an educational context, regardless of whether that context was framed around teacher cognition, pedagogical design, or institutional schooling.

The search was executed on 23 March 2025, and no lower publication-year boundary was imposed; records were retrieved up to and including December 2024. Because CDL research remains comparatively sparse relative to broader, more established fields such as general digital literacy (Ilomäki et al., 2023), an arbitrary start date risked excluding foundational work that continues to anchor the field, chief among it Hinrichsen and Coombs's (2013) five-resource model. An unrestricted window therefore captured the construct's full historical trajectory, from its earliest theoretical articulations to its most recent empirical instantiations.

2.3. Inclusion and Exclusion Criteria

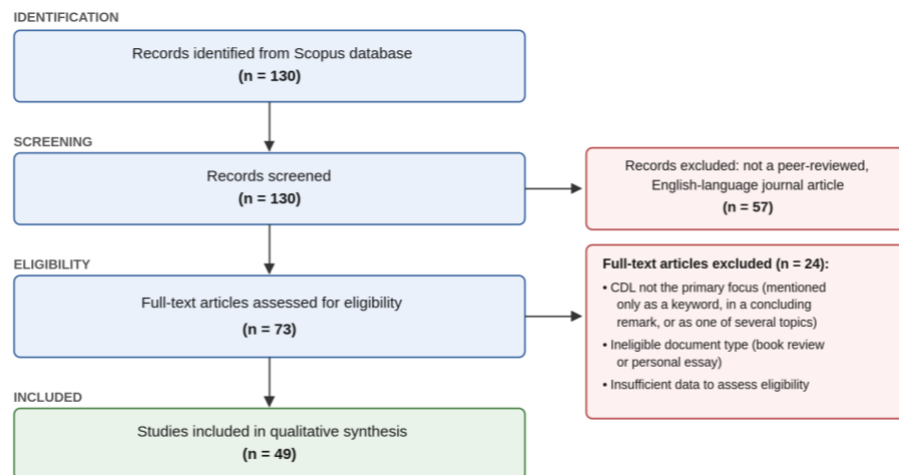
Eligibility was assessed in two stages, consistent with PRISMA guidance that criteria be defined prior to screening and applied consistently (Page et al., 2021): document type and language were checked during automated screening, and substantive content during full-text assessment. The full-text stage was deliberately stringent: a record was retained only if CDL, or a constituent dimension (e.g., critical-analytical thinking, power/ideology awareness, privacy and surveillance, identity and agency, multimodal production, digital citizenship), was the primary object of investigation, that is, substantively examined, measured, developed, or theorized rather than invoked in passing. Table 1 summarizes the full criteria.

Table 1. Inclusion and Exclusion Criteria Applied During Study Selection

Criterion	Inclusion	Exclusion
Document type	Peer-reviewed journal article	Book reviews, conference proceedings, book chapters, editorials without empirical/conceptual content
Language	English	Non-English publications
Publication window	Up to December 2024 (no lower bound)	Records outside the retrieval window
Thematic focus	CDL, or one of its dimensions, is the primary object of study (examined, measured, developed, or theorized)	CDL mentioned only as a keyword, cited in passing in the conclusion/implications, or treated as one of many unrelated topics
Contextual scope	Study situated within an educational/pedagogical context (K–12, higher education, teacher education, or non-formal learning)	Study addresses digital literacy/technology issues entirely outside educational contexts
Data availability	Abstract and full text accessible for review	Abstract unavailable or insufficient data to assess eligibility

2.4. Selection Process and Data Extraction

The selection process followed the four-phase PRISMA sequence (Page et al., 2021). The search string yielded 130 records from Scopus; automated screening for peer-reviewed, English-language journal articles reduced this to 73 records, which formed the basis for full-text eligibility assessment. Each of the 73 was read in full against the thematic-focus criterion above; 24 were excluded, predominantly because CDL was invoked only as a keyword, mentioned in a single concluding sentence, treated as one of several unrelated topics, or because the source was a book review or personal essay rather than a primary study. The remaining 49 records were carried forward for full data extraction and synthesis. Figure 1 summarizes this process.



Note. Adapted from the PRISMA 2020 flow diagram (Page et al., 2021).

Figure 1. PRISMA 2020 Flow Diagram of the Study Selection Process

Data extraction used a structured matrix in Microsoft Excel, following recommended practice for reducing coding inconsistency (Kitchenham & Charters, 2007). Each of the 49 studies was coded for author(s) and year, title, research method, CDL dimensions and sub-dimensions addressed, and research gaps or future directions identified by the authors, mapping directly onto RQ1 (dimensions), RQ2 (methodological orientation), and RQ3 (gaps). Entries were cross-checked against the original abstracts and, where necessary, full texts; independent double-coding by a second reviewer, while desirable (Xiao & Watson, 2019), was not feasible within the scope of a single-researcher study. The resulting matrix is the empirical basis for the synthesis presented in Sections 3 and 4.

One correction to the retained corpus should be noted. A study initially retained at the eligibility stage, Ajeesh and Rukmini (2022), was subsequently found to have been retracted by its publisher for reasons unrelated to this review. Following standard practice for handling post-hoc retractions in evidence synthesis, the study was removed and replaced with the most topically and methodologically comparable eligible study identified through supplementary search, Polizzi (2025), which addresses the same functional-versus-critical distinction within a civic-participation context and satisfies all inclusion criteria in Table 1. This substitution is marked with an asterisk in Table 2.

3. Results and Discussion

This section reports the findings of the review in two parts: the methodological profile of the 49 included studies (addressing RQ2), and the structural dimensions of Critical Digital Literacy that emerged from inductive synthesis (addressing RQ1). Table 2 presents the full extraction matrix for the 49 included studies.

3.1. The Methodological Profile of CDL Research

Analysis of the 49 studies that satisfied the stringent inclusion criteria reveals a methodological profile weighted heavily toward small-N interpretive inquiry, while quantitative measurement remains distinctly minor. Qualitative designs, including case studies, ethnographies, action research, and thematic or discourse analysis, account for approximately 28 of the 49 documents ($\pm 57\%$), making this the dominant methodological orientation in the corpus by a considerable margin (e.g., de los Ríos, 2018; Kwon & de los Ríos, 2019; Noble & Gachago, 2022; Watt, 2019; Polizzi, 2025). Conceptual and theoretical studies form the second-largest cluster, comprising approximately 15 studies ($\pm 31\%$) (e.g., Pötzsch, 2019; Sulzer, 2018; Golden, 2017), while genuinely quantitative studies employing validated instruments number only four (Lo, Wang, & Chen, 2024; Santisteban, Díez-Bedmar, & Castellví, 2020; Castellví, Díez-Bedmar, & Santisteban, 2020), together with one mixed-methods study (Abdelhalim, 2024).

The four quantitative studies operationalize CDL through adapted, small-scale self-report scales (Lo et al., 2024; Santisteban et al., 2020; Castellví et al., 2020), rather than through the kind of cross-nationally validated psychometric instruments found in closely related fields, such as the IEA's International Computer and Information Literacy Study (Frailon & Ržman, 2024).

Table 2. Extraction Matrix of the 49 Included Studies

No.	Author & Year	Research Method (RQ2)	Extracted Dimensions & Sub-dimensions (RQ1)	Research Gaps / Future Directions (RQ3)
2	Tagg & Seargeant (2021)	Qualitative (interviews)	Critical awareness of communicative norms; social/interpersonal literacy; context design	CDL programs in HE should incorporate the social/interpersonal dimension
3	Gutiérrez-Ujaque (2024)	Conceptual (SLR of 40 studies)	Critical consciousness; ethical, social, cultural, and political dimensions	Further research needed on emancipatory CDP praxis for students and instructors
4	Mattock (2022)	Qualitative (case study)	Functional/technical + psychological (computing anxiety) as a barrier to CDL	Psychological barriers remain under-addressed in digital literacy discourse
6	Parlak & Sendurur (2022)	Qualitative (case study)	Digital literacy and CDL frameworks used as observational instruments	Further research needed among disadvantaged groups with limited ICT access
7	Sulzer (2018)	Conceptual	Political power as a core dimension; Web 1.0 vs. 2.0	Digital literacy needs (re)conceptualization that explicitly foregrounds political power
8	Satar, Hauck, & Bilki (2023)	Qualitative (social semiotic analysis)	Multimodal representation; power relations in social semiotics	Further research on multimodal CDL in cross-cultural exchange contexts
9	Knight, Dooly, & Barberà (2023)	Qualitative (conversation analysis)	Agency; awareness of non-human agents (hidden pedagogical agents)	Interface design transparency requires continued investigation
11	Hutchinson & Novotny (2018)	Qualitative/conceptual	Privacy; consent; surveillance as CDL dimensions	Further development of feminist-surveillance-based CDL pedagogy needed
12	Watt (2019)	Qualitative (two-year inquiry)	Multimodal composing; creation/production of digital texts	Integration of video production and CDL in elementary classrooms needs further development
13	Gouseti et al. (2024)	Qualitative (four-country focus groups)	CDL dimensions vary across national contexts (perception vs. practice)	Disjuncture between teachers' perception and practice of CDL warrants cross-national research
15	Castañeda & Villar-Onrubia (2023)	Qualitative (case study)	Critical vs. instrumental competence; emancipation	Lack of concrete examples of critical digital-literacy pedagogical strategies
16	Mata et al. (2021)	Qualitative (narrative analysis)	Critical thinking; values and emotion; anti-democratic ideology/discourse	Integration of the value and emotion dimension into CDL programs is needed
17	Talib (2018)	Conceptual	Multimodal and interdisciplinary approach	—
18	Baroud & Dharamshi (2020)	Qualitative (self-study)	Social, cultural, and ethical issues in digital practice	Teacher-training programs need a greater role
20	Reilly (2021)	Conceptual/qualitative	Privacy; surveillance capitalism; legal advocacy	Long-term privacy law/regulation reform is needed
21*	Polizzi (2025)	Qualitative (semi-structured interviews, think-aloud, diary methods)	Functional vs. critical digital literacy; civic and political participation	Future research should explore the intersection of digital and AI literacies with a focus on participation
22	Lohnes Watulak (2016)	Qualitative (action research)	Critical reflection on one's own digital-literacy practice	The critical-reflective component remains minimal in pre-service teacher training
24	de los Ríos (2018)	Qualitative (ethnography)	Power and privilege; multimodal codemeshing; identity	Empirical studies of the pedagogical affordances of digital tools for CDL remain scarce

No.	Author & Year	Research Method (RQ2)	Extracted Dimensions & Sub-dimensions (RQ1)	Research Gaps / Future Directions (RQ3)
26	Abdelhalim (2024)	Mixed-methods (descriptive cross-sectional)	CDL practices and skills in EFL	Demographic factors influencing CDL warrant further research
29	Hauck (2019)	Qualitative (EVALUATE project report)	Digital pedagogical competence; critical awareness via VE	Gaps remain in maximizing the benefits of VE for CDL
31	Pawluczuk (2020)	Conceptual/qualitative	Functional vs. critical digital literacy; the big-data divide	Youth digital-inclusion programs remain functional rather than critical
32	Garcia, Fernández, & Okonkwo (2020)	Qualitative (narrative analysis, n=390)	Identity; agency; Black feminist epistemology	Broader understanding of CDL that honors marginalized groups is needed
33	Farag, Greeley, & Swindell (2022)	Conceptual (Freire/Foucault)	Critical media literacy; awareness of LMS structures and power	Freire's literacy concept needs modernization for the post-pandemic LMS context
34	Kwon & de los Ríos (2019)	Qualitative (ethnography/practitioner inquiry)	Civic interrogation; civic action via digital tools	CDL is essential for the sustainability of Ethnic Studies curricula
35	Dooly & Darvin (2022)	Conceptual	Awareness of power and ideology online	—
36	Lo, Wang, & Chen (2024)	Quantitative (survey, n=416, PLS-SEM)	CDL as a measurable variable (SLCDL scale); online social capital as mediator	Further studies on other mediating variables of CDL are needed
37	Bilki, Satar, & Sak (2023)	Qualitative (interpretivist, thematic)	Four CDL components: affordances, semiotic/interactional, inclusivity, socio-political	Facilitators need to guide reflection across the four CDL themes
39	Villar-Onrubia et al. (2022)	Conceptual (review of 24 competence frameworks)	Digital citizenship; teachers' digital competence	How teachers' CDL supports students' construction of digital citizenship remains unexamined
40	Beck et al. (2021)	Conceptual/qualitative	Privacy; surveillance; practical tactics of response	—
41	Martinez (2019)	Qualitative (20 interviews)	Source criticism; critical awareness of internet advertising	Variation in teachers' approaches calls for standardization of the CDL approach
43	Aguilera & Pandya (2021)	Conceptual (editorial)	Critical computing; education politics; design and imagination	Call for further CDL research across K-12-HE, teacher education, and affinity spaces
44	Santisteban, Díez-Bedmar, & Castellví (2020)	Quantitative (survey, n=322)	Critical discourse construction (controversial issues)	Most pre-service teachers struggle to construct critical discourse
45	Mun & Luu (2023)	Qualitative/conceptual (case study)	Five-resource CDL model (Hinrichsen & Coombs) applied	—
46	Castellví, Díez-Bedmar, & Santisteban (2020)	Quantitative (survey, n=322)	CDL attitudes and skills toward social issues	A minority of pre-service teachers can critically analyze — intervention research is needed
49	Pöttsch (2019)	Conceptual	Structural awareness; digital capitalism; commodification	—
50	Hinrichsen & Coombs (2013)	Conceptual (theoretical framework)	Core framework: decoding, meaning-making, using, analyzing + persona	Implications for institutional practice require further development
53	Maiorana et al. (2023)	Qualitative (participatory action research)	Information literacy; data literacy; digital citizenship; computational thinking	Assessment of key design factors for learning resources is needed
55	Brocca, Masia, & Garassino (2024)	Qualitative (interviews, n=10 teachers)	Analysis of presupposition/implicit content extraction (ICE)	Ability to analyze implicit textual strategies remains low
56	G. Stewart et al. (2021)	Qualitative (scalar analysis/self-study)	Control, bureaucracy, isolation as 'sites of struggle'	Systemic understanding of structural barriers to

No.	Author & Year	Research Method (RQ2)	Extracted Dimensions & Sub-dimensions (RQ1)	Research Gaps / Future Directions (RQ3)
				CDL implementation is needed
58	Noble & Gachago (2022)	Qualitative (case study, multimodal)	Counter-storytelling; critical race theory; multimodal	—
59	McNicol (2016)	Conceptual	Critical awareness of controversial/radicalizing content	Pedagogical, not merely technical (filtering), solutions are needed
60	Hosek & Handsfield (2020)	Qualitative (case study)	Dialogic pedagogy; the 'missing C' (critical) in TPACK	PD linking critical pedagogy with teachers' technology practice is needed
61	Fernández-de-Castro et al. (2023)	Conceptual (SLR, 2015–2019)	Digital citizenship; CDL competencies for social inclusion	A CDL-based 'digital youth work' proposal needs further development
63	Molin & Godhe (2020)	Qualitative (group discussion analysis)	Critical awareness of multimodal text construction	Greater instructional attention to the role of mode in multimodal texts is needed
66	Ketzer-Nöltge & Markovic (2022)	Qualitative (exploratory)	Credibility of online sources; information evaluation	—
67	Leaning (2019)	Conceptual	Argues information literacy has yet to develop a critical approach	Integration of media- and information-literacy traditions toward a critical orientation is needed
69	Pangrazio (2016)	Conceptual	'Critical digital design' — shift from consumption to critical production	Three explicit challenges (ideology vs. affect; collective vs. individual; critical disposition vs. technical proficiency)
72	Bacalja, Beavis, & O'Brien (2022)	Conceptual	Data literacies; digital citizenship; platformization, AI, algorithms	A pedagogical framework responsive to contemporary digital forces is needed
73	Golden (2017)	Conceptual (scalar analysis)	Ideology in algorithms/software; 'beneath the screen'	Call for further generative CDL research based on scalar analysis

3.2. The Structural Dimensions of Critical Digital Literacy

Inductive synthesis of the 49 included studies surfaces eight recurring, empirically grounded dimensions of CDL, each operationalized somewhat differently across studies yet converging on a shared critical orientation.

3.2.1. Critical-Analytical/Cognitive Dimension

This dimension concerns the capacity to interrogate the credibility, bias, and presuppositional content of digital texts: for instance, students' ability to detect implicit ideological framing in digital news or social-media content (Mata et al., 2021; Brocca, Masia, & Garassino, 2024), or pre-service teachers' capacity to construct critical discourse around contested socio-political issues encountered online (Santisteban et al., 2020; Castellví et al., 2020). This dimension aligns closely with what Ng, Leung, Chu, and Qiao (2021), in the adjacent AI-literacy literature, describe as the evaluative component of literacy: the capacity to critically appraise machine-generated or algorithmically curated content rather than accepting it uncritically.

3.2.2. Power/Ideology and Socio-Political Awareness

A substantial cluster of studies treats CDL as fundamentally concerned with exposing how digital platforms encode and reproduce power structures. Sulzer (2018) frames political power as a non-negotiable core dimension of digital literacy requiring explicit reconceptualization; Pötzsch (2019) extends this toward structural awareness of digital capitalism and the commodification of educational technology; Golden (2017) and Kwon and de los Ríos (2019) similarly center civic interrogation and ideological analysis embedded "beneath the screen." This attention connects to the broader critical educational-technology literature documenting how platforms increasingly govern educational practice through opaque, data-driven logics rarely legible to end users (Williamson, Bayne, & Shay, 2020).

3.2.3. Ethical Awareness, Privacy, and Surveillance

Several studies center informational self-determination and resistance to datafication as a standalone CDL competency: Hutchinson and Novotny (2018) examine wearable technology through a lens of consent and surveillance; Reilly (2021) explicitly connects CDL to privacy advocacy and legal literacy; Beck et al. (2021) propose CDL as a pedagogical method for teaching practical tactics of response to online surveillance.

3.2.4. Identity and Agency

This dimension foregrounds how learners use digital tools to construct, perform, and sustain identity, particularly among marginalized groups. Garcia, Fernández, and Okonkwo (2020) document how Black girls enact CDL for social change through narrative-based digital production; de los Ríos (2018) examines bilingual multimodal composition as a space for negotiating identity and resisting oppressive discourse; Noble and Gachago (2022) apply counter-storytelling and critical race theory to digital storytelling pedagogy.

3.2.5. Multimodal Literacy and Critical Production

Moving beyond passive consumption, this dimension emphasizes critical, reflective production of multimodal digital texts. Watt (2019) and Talib (2018) examine video- and social-media-based composition as CDL practices; Pangrazio's (2016) notion of "critical digital design" explicitly theorizes the shift from consumption toward critically informed production as a hallmark of mature CDL orientation.

3.2.6. Digital Citizenship

A cluster of studies situates CDL within a broader frame of civic participation and social inclusion. Villar-Onrubia et al. (2022) position CDL as a prerequisite for "(post)digital citizenship"; Maiorana et al. (2023) and Fernández-de-Castro et al. (2023) respectively connect CDL to active citizenship and digital youth work; Bacalja, Beavis, and O'Brien (2022) extend it toward data literacies and platformized civic participation.

3.2.7. Structured Models and Frameworks

Beyond these thematic dimensions, several studies contribute integrative frameworks: the five-resource model comprising decoding, meaning-making, using, analyzing, and persona (Hinrichsen & Coombs, 2013), subsequently applied in curriculum redesign (Mun & Luu, 2023); the four-component virtual-exchange model encompassing affordances, semiotic/interactional awareness, inclusivity, and socio-political dimensions (Bilki, Satar, & Sak, 2023); and the critique of "the missing C" in TPACK, which argues that existing technology-integration frameworks systematically neglect critical pedagogy (Hosek & Handsfield, 2020).

3.2.8. Functional-Versus-Critical Contrast

Finally, a recurring, almost programmatic, pattern across the corpus is the explicit contrast drawn between functional digital literacy (operational, tool-based competence) and critical digital literacy (interpretive, power-aware competence). Parlak and Sendurur (2022), Polizzi (2025), and Pawluczuk (2020) each document contexts in which functional competence is prioritized in practice while critical competence remains aspirational, pointing to a persistent implementation gap between rhetoric and pedagogy.

3.3. Discussion

3.3.1. Synthesizing the Dimensions of CDL in Educational Contexts

The methodological profile of this corpus, dominated by qualitative and conceptual work and largely thin on validated quantitative measurement, is not simply a matter of researcher preference. It reflects where CDL currently sits as a construct: still being defined and still overlapping with adjacent literacy ecosystems such as information literacy, data literacy, digital citizenship, and e-safety, without a stable, psychometrically ready operational definition (Ilomäki et al., 2023). When a construct's boundaries remain contested, qualitative and conceptual modes of inquiry tend to suit the task better than premature measurement: they let researchers surface dimensions inductively and produce context-sensitive description of how a critical disposition plays out in situated practice. A comparable pattern appears in the broader critical educational-technology literature, where Selwyn (2022) argues that each new wave of educational technology triggers a cycle of conceptual reassessment before it becomes mature enough for systematic measurement. Read this way, the field's conceptual richness and empirical thinness are two sides of the same developmental stage: intellectually generative but still limiting its capacity to demonstrate impact or benchmark progress across institutional and national contexts.

The synthesis presented here does not merely follow but also complements Ilomäki et al.'s (2023) review of adjacent constructs. In their analysis of 139 sources, the critical dimension of digital literacy is found dispersed across concepts such as e-safety, information literacy, and digital citizenship, without a clearly bounded skillset. By applying a stricter inclusion criterion, by contrast, the present review yields a more clearly

defined and internally coherent eight-dimension structure. This indicates that the fragmentation Ilomäki et al. observe may not be an inherent characteristic of Critical Digital Literacy (CDL) itself, but is instead partly attributable to construct overlap and conflation across prior studies.

The eight substantive dimensions synthesized above are not merely a descriptive taxonomy. Read together, they form a coherent argument for why a critical disposition has become a non-negotiable part of digital participation within today's information ecosystem. The convergence of the critical-analytical, power/ideology, and privacy/surveillance dimensions matters most in an era when algorithmically mediated platforms, often invisibly, structure what learners see, believe, and are permitted to produce (Williamson, Bayne, & Shay, 2020). Functional competence alone, narrowly understood as operational proficiency in using software interfaces, reaches only the procedural surface of digital participation; it offers little purchase on learners' capacity to ask why a platform is designed the way it is, whose commercial or political interests it serves, or how its underlying logics distribute visibility and voice (Selwyn, 2022).

Cognitive-offloading and misinformation risks associated with generative AI (Gerlich, 2025; Chan & Hu, 2023) sharpen this picture further. In the AI-literacy literature specifically, scholars increasingly favor multidimensional conceptualizations of literacy that combine technical understanding with critical evaluative capacity and ethical judgment, rather than treating literacy as synonymous with technical proficiency alone (Ng et al., 2021). The recurring functional-versus-critical contrast within the CDL corpus (Parlak & Sendurur, 2022; Polizzi, 2025; Pawluczuk, 2020) is therefore not simply a holdover from earlier digital-literacy debates. If anything, it is a more urgent fault line in the generative-AI era, where the gap between knowing how to use a tool and knowing how to interrogate it carries direct consequences for what learners come to believe is true.

At the same time, the identity/agency and digital-citizenship dimensions show that CDL cannot be reduced to a set of cognitive or evaluative skills alone. Scholars working from critical-race and feminist epistemological traditions (Garcia et al., 2020; Noble & Gachago, 2022; de los Ríos, 2018) argue that critical digital engagement cannot be separated from questions of whose knowledge, voice, and lived experience are validated or marginalized in digital spaces. This concern echoes broader calls in the digital-skills literature for outcome-oriented models of literacy that explicitly attend to equity and rights realization, rather than treating skill acquisition as an end in itself (Livingstone et al., 2023). The synthesis presented here therefore supports a multidimensional, rather than unidimensional, conception of CDL, in which cognitive-evaluative, socio-political, ethical, identity-based, productive, and civic dimensions operate as interconnected and mutually reinforcing components rather than a simple linear sequence of discrete skills.

3.3.2. Implications for Pre-Service Vocational Teacher Education

The near-total absence of CDL research in vocational education settings sits uneasily with the institutional vision UNESCO-UNEVOC (2022) sets out, which positions vocational teacher education as a space integrating technical training with critical and civic engagement. That vision implicitly presupposes an adequate body of CDL scholarship on which vocational education can draw. The present review's findings suggest this presupposition is not yet supported by empirical evidence, at least not within the vocational context specifically. This gap is consistent with Imama et al.'s (2025) finding that research on vocational teachers' digital competence remains limited relative to general teacher education; the present review extends that finding by showing that even where CDL scholarship has developed substantially in general education contexts, it has not been meaningfully adapted or applied to vocational education. This points to a misalignment between policy aspirations and the actual state of research and underscores the urgency of developing Critical Digital Literacy scholarship within vocational teacher education.

The existing literature on vocational teachers' digital competence overwhelmingly emphasizes multidisciplinary but predominantly functional competence domains, such as attitudes toward digitalization, information literacy, digital security procedures, virtual collaboration, and problem-solving in digitally connected work situations (Roll & Ifenthaler, 2021), with comparatively limited attention to the critical, ideology-aware, or power-aware dimensions that dominate the general educational CDL literature synthesized in this review. Empirical assessment of practicing vocational teachers' digital competence further indicates that proficiency levels generally sit at a moderate level, and that institutional support for developing more advanced, reflective digital competence often remains underdeveloped (Cattaneo, Antonietti, & Rauseo, 2022). Similarly, studies on pre-service vocational teachers' digital-competence development in distance-education contexts show that available training resources tend to prioritize procedural, subject-specific digital skills over cultivating a critical disposition toward the socio-political dimensions of digital tools (Deschênes, Dionne, & Parent, 2024).

Mapping the eight CDL dimensions identified in this review onto the vocational teacher-education context reveals several concrete points of leverage for the future development of a Vocational Critical Digital Literacy Framework. First, the power/ideology dimension and the functional-versus-critical contrast speak directly to the realities of industrial automation and AI-driven workplace transformation: vocational teachers need

operational fluency with industry software, but they also need the critical capacity to question how algorithmic systems in the workplace, such as automated scheduling, AI-assisted quality control, and surveillance-based productivity monitoring, redistribute power and autonomy on the shop floor. This concern aligns with broader worries about algorithmic governance already documented in general education contexts (Williamson, Bayne, & Shay, 2020). Second, the ethics/privacy/surveillance dimension bears directly on the data-ethics obligations vocational teachers face when students interact with proprietary industry platforms, workplace-monitoring systems, or client data during work-based learning placements. Third, the digital-citizenship and identity/agency dimensions imply that vocational CDL must move beyond a narrow employability-skills framing toward cultivating students' capacity to act as critically reflective professionals and civic agents within a digitalizing industry, a reframing consistent with calls in the VET literature for digital-competence frameworks built specifically to connect school-based training and workplace practice, rather than borrowed wholesale from general education (Roll & Ifenthaler, 2021). Treating this dual mandate as an explicit design principle, rather than an incidental by-product of technical training, is the central conceptual bridge this review seeks to build toward future framework development.

3.3.3. Directions for Future Research

Five interrelated gaps emerge from this review. First, validated, cross-nationally comparable instruments for measuring CDL directly remain scarce: most studies attempting to quantify adjacent constructs were excluded because CDL itself was not the measured variable, leaving the four quantitative studies retained here (Lo et al., 2024; Santisteban et al., 2020; Castellví et al., 2020) as isolated exceptions rather than a cumulative tradition, a thinness that extends to CDL-specific assessment design more broadly. Second, the functional-versus-critical divide documented across several studies (Parlak & Sendurur, 2022; Polizzi, 2025; Pawluczuk, 2020) still lacks intervention-based research testing which pedagogical designs actually bridge it. Third, the affective and value-based register of CDL remains under-theorized, with programs addressing controversial digital content rarely engaging learners' emotional responses alongside cognitive-critical skills (Mata et al., 2021). Fourth, structural and institutional barriers, including limited organizational readiness (Baroud & Dharamshi, 2020) and the control, bureaucracy, and professional isolation identified by G. Stewart et al. (2021), are well documented but rarely addressed through institutional-design research. Fifth, and most relevant to this review's aim, CDL research engaging generative AI is almost entirely absent from the corpus, even though the field's attention to power and ideology is arguably more urgent in a generative-AI-saturated environment (Gerlich, 2025; Chan & Hu, 2023).

Read alongside persistent structural barriers to CDL integration documented in teacher education more broadly (Syahrudin & Agus, 2026) and the relative scarcity of research on vocational teachers' digital competencies specifically (Imama, Ismara, Sudira, & Maryadi, 2025), these gaps point to five priorities for future research: cross-national validation of CDL-specific measurement instruments rigorous enough to be comparable to large-scale assessments such as ICILS (Fraillon & Ržman, 2024); intervention studies embedding CDL pedagogy into vocational teacher-education curricula without displacing technical training, building on existing multidisciplinary competence models (Roll & Ifenthaler, 2021); pedagogical and institutional design research addressing, respectively, the affective register identified by Mata et al. (2021) and the structural barriers identified by Baroud and Dharamshi (2020) and G. Stewart et al. (2021); longitudinal research on how vocational teachers' own CDL orientation shapes their modeling of critical digital engagement during work-based learning; and, most urgently, empirical investigation of CDL within generative-AI contexts specific to vocational and technical education. Collectively, these priorities chart a path from a literature that is conceptually rich but empirically thin toward a research agenda that is more measurable, more professionally differentiated, and more attentive to AI.

3.4. Implications

The review's most consequential finding is an absence rather than a presence: none of the 49 included studies takes up vocational (VET) teacher education directly, even though vocational teachers need exactly this combination of technical fluency and critical disposition. Together with the gaps identified above, this absence is the starting point for a dedicated CDL framework for pre-service vocational teachers, one that treats technical competence and critical disposition as a single design problem rather than separate training tracks.

3.5. Limitations

Three limitations should inform how these findings are read. Reliance on a single database (Scopus) and English-language records may have excluded relevant work published elsewhere or in other languages. The stringent thematic-focus criterion, while necessary to ensure genuine engagement with CDL, excluded borderline studies on adjacent constructs such as general digital literacy and digital assessment; readers seeking a broader literacy landscape may consult Ilomäki et al. (2023). Data extraction was cross-checked against original sources but not independently double-coded by a second reviewer, a common constraint in single-researcher reviews.

4. Conclusion

This review set out to synthesize a theoretically dense but empirically fragmented body of scholarship on Critical Digital Literacy (CDL) in education, guided by three research questions concerning the dimensions and sub-dimensions through which CDL is conceptualized (RQ1), the methodologies dominating current scholarship (RQ2), and the research gaps and future directions the field presents (RQ3). Applying a stringent PRISMA 2020 protocol to 73 Scopus-indexed records, it retained 49 studies in which CDL was the primary object of investigation. Addressing RQ1, these studies converge on eight substantive dimensions spanning cognitive, socio-political, ethical, identity-based, productive, and civic concerns, a convergence that is the strongest evidence CDL names something real and worth building on, despite the construct still being defined and argued over. On RQ2, the corpus is dominated by qualitative and conceptual work, a methodological profile that reflects the construct's immaturity rather than a lack of validated measurement tools per se. As for RQ3, the review surfaces five interrelated gaps, from the scarcity of validated CDL-specific measurement instruments to the near-total absence of research on CDL in vocational (VET) teacher education, charting a path toward a research agenda that is more measurable, more professionally differentiated, and more attentive to generative AI. Taken together, these findings offer a consolidated map of CDL's dimensions, methods, and gaps, and lay the groundwork for a dedicated Critical Digital Literacy framework for pre-service vocational teacher education.

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Data Availability

The datasets generated during and/ or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration on AI Use

The authors declare that no artificial intelligence (AI) or AI-assisted tools were used in the preparation of this manuscript.

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