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Information literacy training for university students in a digital learning resources environment: Experience from Digital Center - Thai Nguyen University, Vietnam

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ABSTRACT: *This study examines information literacy training for university students in a digital learning resources environment, drawing on the experience of the Digital Center at Thai Nguyen University, Vietnam. Using a mixed-methods design, the research integrates survey data from 168 students with qualitative interviews involving 27 participants to capture both learning outcomes and student experiences. The findings indicate that training activities effectively enhance students' abilities to access and navigate academic digital resources, while higher-order competencies such as critical evaluation and information synthesis develop less consistently. Qualitative evidence reveals emerging awareness of academic information quality alongside persistent uncertainty in assessing unfamiliar digital content. The study highlights the role of institutional design and pedagogical coherence in shaping sustainable information literacy development and contributes context-specific insights to discussions on digital transformation in Vietnamese higher education.*

Keywords: *Information literacy; digital learning resources; higher education; digital transformation; Vietnam*

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I. INTRODUCTION

The accelerated digital transformation of higher education has profoundly reshaped the ways knowledge is produced, accessed, and utilized within universities. Digital learning resources, ranging from institutional repositories and licensed databases to open educational resources and algorithm-driven search platforms, have become integral to academic teaching and research practices. While these developments have expanded access to information at an unprecedented scale, they have simultaneously intensified the complexity of the information environment, raising critical questions about students' capacity to navigate, evaluate, and ethically use information in digital contexts [1], [2]. Within this landscape, information literacy has emerged not merely as a supplementary academic skill but as a foundational competence underpinning effective learning, research engagement, and lifelong education.

Information literacy, as conceptualized in contemporary scholarship, extends beyond technical abilities related to information retrieval. It encompasses a constellation of cognitive, critical, and ethical capacities that enable individuals to recognize information needs, assess the credibility and relevance of sources, synthesize information meaningfully, and apply it responsibly within specific academic and social contexts [1], [3]. Empirical studies have consistently demonstrated that information literacy is closely associated with learning quality, academic performance, and research readiness among university students [4], [5]. In digitally mediated learning environments, this relationship becomes even more pronounced, as students are increasingly exposed to algorithmic filtering, fragmented information flows, and varying levels of source reliability [2], [6].

Despite a growing body of international research addressing information literacy in higher education, existing studies largely concentrate on competency frameworks, assessment models, or learner outcomes at a general level [4], [6], [6]. Comparatively limited attention has been paid to the institutional mechanisms through which information literacy training is systematically designed, implemented, and sustained within digital learning infrastructures. In particular, the role of university libraries and emerging digital centers as active pedagogical actors—rather than passive information providers—remains underexplored, especially in developing and transitional higher education systems [8], [9]. This gap is notable given that digital centers increasingly function as hubs integrating learning resources, digital services, and academic support.

In the Vietnamese context, the urgency of information literacy education has been reinforced by recent national policy orientations emphasizing digital competence and technology-enhanced learning in higher education. Regulatory frameworks issued by the Ministry of Education and Training explicitly underscore the responsibility of higher education institutions to strengthen learners' digital and information competencies in response to the demands of online and blended education models [10], [11]. However, translating these policy directions into effective institutional practices presents significant challenges, particularly in terms of

curriculum integration, instructional design, and cross-unit coordination between academic faculties and information service providers [13].

Against this backdrop, this study examines the experience of the Thai Nguyen University Digital Center in organizing and delivering information literacy training for undergraduate and postgraduate students within a digital learning resources environment. Rather than approaching information literacy as an abstract skill set, the article situates training practices within the operational realities of a digital center serving a multi-disciplinary university system. By documenting training objectives, content structures, delivery modalities, and implementation conditions, this study seeks to contribute empirically grounded insights into how information literacy education can be institutionalized in alignment with digital transformation agendas in higher education. In this study, the digital learning resources environment is understood as an integrated institutional ecosystem comprising digital collections, access platforms, instructional support, and learning practices that jointly mediate students' information literacy development. In doing so, the article aims to enrich ongoing scholarly discussions on information literacy education by foregrounding the practical role of digital centers in bridging policy intentions, pedagogical strategies, and student learning needs.

II. LITERATURE REVIEW

2.1. information literacy as a conceptual and educational construct in digital contexts

Information literacy has undergone significant conceptual evolution alongside transformations in information environments. Early formulations emphasized functional abilities related to locating and using information; however, contemporary scholarship increasingly frames information literacy as a complex, context-dependent competence embedded within broader learning ecosystems. Markless and Streatfield conceptualize information literacy in digital environments as an integrative construct combining cognitive judgment, contextual awareness, and reflective engagement with information practices rather than a fixed set of technical skills [1]. This perspective aligns with the ACRL Framework, which positions information literacy as a set of threshold concepts shaping learners' epistemic dispositions and scholarly identities [3].

Within higher education, this conceptual shift has been reinforced by systematic reviews demonstrating that information literacy competencies are multidimensional and discipline-sensitive. Pinto et al. highlight that effective information literacy education must transcend procedural training and address critical evaluation, ethical use, and knowledge construction processes [4]. Similarly, Bawden and Robinson situate information literacy within the broader domain of information science, arguing that digital abundance necessitates heightened analytical and interpretive capacities rather than mere access-oriented skills [12]. These perspectives collectively suggest that information literacy training in universities must be grounded in robust conceptual frameworks capable of responding to the epistemological challenges posed by digital learning resources.

2.2. Digital learning resources and the reconfiguration of information practices

The proliferation of digital learning resources has fundamentally altered students' information-seeking behaviors and learning trajectories. Digital repositories, licensed databases, learning management systems, and open-access platforms now coexist with algorithm-driven search engines and social information channels. Head's empirical work on students' experiences with digital information reveals that algorithmic mediation significantly shapes how learners encounter, prioritize, and trust information, often in ways that remain opaque to them [2]. This raises concerns regarding superficial engagement, overreliance on convenience, and diminished critical scrutiny in academic contexts.

From a broader institutional perspective, Bond et al.'s systematic review of digital transformation in higher education underscores that technological integration alone does not guarantee pedagogical effectiveness [8]. Instead, meaningful learning outcomes depend on how digital infrastructures are aligned with educational goals and learner support mechanisms. Within this landscape, information literacy functions as a mediating competence that enables students to navigate digital learning resources strategically and critically. Empirical evidence from Park and Kim further confirms that information literacy is positively associated with digital learning outcomes, suggesting that students' capacity to engage productively with digital resources is contingent upon their information literacy proficiency [5].

2.3. Information literacy, digital competence, and student learning outcomes

The relationship between information literacy and broader digital competence has attracted increasing scholarly attention. Sánchez-Caballé et al. identify digital competence as an umbrella construct encompassing information, communication, content creation, and problem-solving dimensions, within which information literacy plays a central role [7]. Their mapping study indicates that deficiencies in information literacy often undermine students' overall digital competence, particularly in academic research and knowledge production tasks.

Empirical studies consistently demonstrate that students with stronger information literacy skills exhibit higher levels of academic engagement, research preparedness, and self-directed learning. Beile and Boote, although focusing on dissertation preparation, emphasize that information literacy underpins scholarly thinking and research readiness long before advanced academic stages [14]. Foo et al. further argue that evidence-based information literacy education contributes not only to immediate academic performance but also to the development of lifelong learning capacities essential in digitally saturated societies [6]. Collectively, these studies suggest that information literacy training should be strategically embedded within digital learning environments to maximize its educational impact.

2.4. Institutional roles in information literacy education: Libraries and digital centers

While a substantial body of literature addresses information literacy competencies and learner outcomes, comparatively fewer studies interrogate the institutional arrangements through which information literacy education is operationalized. Traditional university libraries have long been recognized as key actors in information literacy instruction; however, the emergence of digital centers has reconfigured institutional responsibilities. Phan et al. document how Vietnamese university libraries are increasingly transitioning toward digital resource development and user support, reflecting broader shifts in information service models [9].

International literature similarly points to the need for institutional frameworks that integrate information literacy training with digital infrastructures and academic curricula. Foo et al. emphasize that sustainable information literacy education requires organizational commitment, cross-unit collaboration, and adaptive instructional models aligned with evolving information environments [6]. In the Vietnamese context, Ngan and Ha's assessment of students' information literacy in digital learning environments highlights persistent gaps between students' access to digital resources and their capacity to use them effectively, underscoring the necessity of structured institutional interventions [13].

Recent national policy frameworks further reinforce the institutional dimension of information literacy education. The Ministry of Education and Training's regulations on online higher education and digital competence explicitly call for systematic approaches to developing learners' information and digital skills [10], [11]. These policy orientations implicitly position digital centers as pivotal sites for translating national strategies into concrete educational practices within universities.

2.5. Research gaps and implications for the present study

Despite extensive scholarship on information literacy concepts, competencies, and outcomes, several gaps remain evident. First, much of the existing literature privileges learner-centered assessments while offering limited insight into the organizational and pedagogical processes underpinning information literacy training in digital environments. Second, empirical studies documenting institutional experiences from non-Western higher education systems remain underrepresented, particularly in relation to emerging digital centers. Third, there is a lack of practice-based analyses examining how information literacy training is embedded within digital learning resource ecosystems rather than treated as stand-alone instructional activities.

Addressing these gaps, the present study situates information literacy training within the operational context of the Thai Nguyen University Digital Center. By examining institutional practices, training designs, and implementation conditions, the study contributes to a more nuanced understanding of how information literacy education can be effectively organized in digital learning environments, thereby extending existing theoretical and empirical discussions in the field..

III. RESEARCH CONTEXT AND METHODOLOGY

3.1. Research context

This study is situated within Thai Nguyen University (TNU), a multi-disciplinary public university system in Vietnam undergoing an accelerated process of digital transformation in teaching, learning, and academic support services. In alignment with national policies on digital competence development in higher education, TNU established the Digital Center as a centralized unit responsible for managing digital learning resources and organizing information literacy training for students.

The Digital Center functions as an integrated academic support hub, combining access to digital collections, licensed academic databases, institutional repositories, and structured training activities. Information literacy training is implemented through orientation programs, short courses, thematic workshops, and guided practice sessions, targeting both undergraduate and postgraduate students. This institutional setting provides a relevant context for examining how information literacy training is operationalized within a digital learning resources environment..

3.2. Research design

The study adopts a case study design employing a mixed-methods approach, integrating quantitative and qualitative data to capture both patterns of student information literacy development and the institutional practices shaping training implementation. This design is appropriate for investigating information literacy education as a situated practice embedded within a specific organizational and policy context.

The mixed-methods strategy follows a convergent explanatory logic, in which quantitative findings offer an overview of students' perceived information literacy competencies, while qualitative data provide contextualized explanations of training design, delivery, and implementation conditions. The study does not seek statistical generalization; rather, it aims to generate analytically grounded insights into information literacy training practices within a university digital center..

3.3. Research questions

The study addresses the following research questions:

RQ1. How is information literacy training conceptualized and organized at the Digital Center of Thai Nguyen University within a digital learning resources environment?

RQ2. What are students' perceived information literacy competencies after participating in information literacy training programs provided by the Digital Center?

RQ3. How do institutional training practices shape students' experiences of information literacy learning in a digital environment?

RQ4. What challenges and enabling factors influence the implementation of information literacy training at the Digital Center?

3.4. Participants and data sources

Quantitative data were collected from 168 students (n = 168) who had participated in information literacy training activities organized by the Digital Center. The participants included undergraduate students from different academic disciplines and years of study, as well as a smaller number of postgraduate students engaged in research-oriented training sessions. A purposive sampling strategy was employed to ensure that respondents had direct experience with the training programs under investigation.

Qualitative data were obtained from 27 participants (N = 27) through semi-structured interviews and institutional document analysis. The interview participants consisted of Digital Center staff members involved in training design and delivery, along with student participants representing different levels of study and training needs. Selection of qualitative participants followed a purposeful and information-rich sampling logic, allowing for in-depth exploration of training practices and learner experiences.

Institutional documents analyzed in the study included training curricula, instructional materials, internal guidelines, and reports related to information literacy education at the Digital Center..

3.5. Data collection procedures

Quantitative data were collected using a structured questionnaire designed to capture students' self-assessed competencies related to identifying information needs, accessing digital learning resources, evaluating information quality, and using information ethically in academic contexts. The questionnaire was administered after students' participation in information literacy training activities.

Qualitative data were collected through semi-structured interviews guided by open-ended questions focusing on training objectives, pedagogical approaches, learning experiences, and implementation challenges. Document analysis complemented interview data by providing institutional perspectives on training organization and content..

3.6. Analytic logic

Quantitative data were analyzed using descriptive statistical techniques to identify general patterns in students' perceived information literacy competencies. The results served as a contextual baseline for interpreting qualitative findings.

Qualitative data were analyzed thematically through an iterative coding process, focusing on institutional training design, pedagogical strategies, student engagement, and contextual constraints. Integration of quantitative and qualitative findings occurred at the interpretation stage, where results were examined in relation to the research questions to construct a coherent account of information literacy training at the Digital Center.

3.7. Ethical considerations

Participation in the study was voluntary, and informed consent was obtained from all participants. Data were anonymized to ensure confidentiality, and the study adhered to ethical principles governing educational research.

IV. RESULTS AND DISCUSSION

4.1. Information literacy outcomes among students in a digital learning resources environment

To examine the effectiveness of information literacy training implemented at the Digital Center of Thai Nguyen University, this study first analyzes students' learning outcomes across key information literacy competency domains. Drawing on quantitative survey data (n = 168), the findings reveal a differentiated competency profile shaped by the combined influence of digital learning resources availability and the pedagogical orientation of the training program delivered by the Digital Center.

Overall, students demonstrated relatively strong competencies in accessing and navigating digital academic resources, particularly in locating licensed databases, institutional repositories, and full-text scholarly materials provided by the university. With a mean score of 4.12, the competency related to accessing digital academic resources reflects the effectiveness of the Center's introductory and orientation-level training, which emphasizes familiarization with library services, digital collections, and institutional platforms. This outcome is consistent with the training objectives outlined in the Digital Center's instructional framework, which prioritizes enabling students - especially first-year cohorts - to confidently operate within a digital learning environment.

Similarly, competencies related to searching specialized databases (mean = 3.98) indicate that students have acquired foundational procedural skills for information retrieval, including keyword searching, subject-based queries, and the use of OPAC and subscribed databases. These results suggest that the training has succeeded in reducing initial barriers to information access, a challenge commonly faced by students transitioning into digitally mediated higher education environments.

- However, as students progress from access-oriented tasks to more cognitively demanding activities, a clear decline in reported competency levels becomes evident. Skills related to managing references and citations (mean = 3.74) were assessed at a moderate level, indicating partial familiarity with academic conventions such as citation styles, reference management tools, and issues of academic integrity. While the Digital Center's training includes explicit instruction on citation practices and plagiarism prevention - as documented in the training content described in the institutional materials - the results suggest that these skills require repeated application and contextual reinforcement beyond standalone instructional sessions.

More pronounced limitations emerge in competencies associated with evaluating the credibility of information (mean = 3.41) and synthesizing information for academic tasks (mean = 3.36). These domains correspond to higher-order information literacy skills that involve critical judgment, comparison of sources, and the integration of information into coherent academic arguments. The comparatively lower scores in these areas point to an uneven development across information literacy dimensions, where technical and procedural competencies outpace evaluative and analytical capacities. To provide a systematic overview of these patterns, Table 1 summarizes students' self-assessed information literacy competencies..

Table 1. Self-assessed information literacy competencies of students (n = 168)

Competency Domain	Mean Score	SD
Accessing digital academic resources	4.12	0.58
Searching specialized databases	3.98	0.64
Managing references and citations	3.74	0.71
Evaluating credibility of information	3.41	0.76
Synthesizing information for academic tasks	3.36	0.79

Note: Likert scale (1 = very low; 5 = very high).

Source: Author's survey and analysis, 2025.

From an interpretive perspective, this distribution of competencies aligns with earlier conceptualizations of information literacy as a progressive construct in which operational and technical skills tend to precede higher-order cognitive capacities [1], [3]. In digitally rich environments such as Thai Nguyen University, the relative ease of information access - facilitated by digital platforms, licensed databases, and centralized support services - may accelerate functional engagement with information. At the same time, this ease of access can obscure the epistemic challenges inherent in evaluating source credibility, assessing relevance, and synthesizing information across multiple domains [2], [5].

Importantly, these findings must be understood within the specific institutional context of the Digital Center. At this level, the training places strong emphasis on familiarizing students with academic information sources, search techniques, and responsible information use. This pedagogical focus reflects the Digital Center's training design, which prioritizes foundational access and procedural competencies as an entry point to information literacy development in a digital learning resources environment. While these components are essential, the results suggest that the cultivation of critical and reflective information practices remains contingent on sustained engagement and integration into disciplinary learning activities.

Taken together, the findings in this section indicate that information literacy training at the Digital Center has been effective in establishing a solid foundation for digital information access and use. Nevertheless, the moderate development of evaluative and synthetic competencies highlights the need for a more continuous and context-embedded approach to information literacy education - one that extends beyond initial training sessions and is reinforced through academic coursework and research-oriented learning tasks.

4.2. Institutional design of information literacy training at the digital center

Beyond individual learning outcomes, the effectiveness of information literacy education is closely shaped by institutional design and pedagogical organization. In this regard, qualitative evidence drawn from interviews, internal documents, and observational data (N = 27) indicates that the Digital Center at Thai Nguyen University has deliberately structured information literacy training as a coherent, multi-level learning pathway, rather than a fragmented or ad hoc set of instructional activities.

Unlike short-term skills workshops that focus narrowly on tool usage, the Digital Center's training model reflects an institutional commitment to positioning information literacy as a developmental process aligned with students' academic progression. Training activities are systematically organized into three interconnected stages. The first stage focuses on orientation to digital learning resources, where students are introduced to the university's digital library ecosystem, including institutional repositories, subscribed databases, and online learning platforms. This stage plays a foundational role in reducing informational barriers and supporting students' initial transition into a digitally mediated academic environment.

The second stage emphasizes applied information searching and academic integrity practices, shifting the instructional focus from access to responsible and effective use of information. At this stage, the training is intentionally structured to support students' academic learning processes, with particular attention to information use in coursework and written assignments. This pedagogical orientation reflects the Digital Center's emphasis on aligning information literacy instruction with concrete academic tasks in a digital learning resources environment. Rather than responding to formally measured learning difficulties, the training reflects the Digital Center's institutional recognition of common challenges faced by students when engaging with academic information in a digital environment.

The third stage advances toward research-oriented information literacy skills aligned with disciplinary learning, where students engage more deeply with information evaluation, synthesis, and scholarly communication practices. This stage is typically implemented through targeted workshops or collaborative sessions with academic departments, reflecting an attempt to contextualize information literacy within specific fields of study. Such alignment underscores the Center's recognition that higher-order information literacy competencies cannot be developed in isolation from disciplinary epistemologies.

This progression is illustrated in Figure 1, which captures the internal logic of the information literacy training model implemented at Thai Nguyen University..

Figure 1. Structure of information literacy training at the digital center

Source: Author's survey and analysis, 2025.

Such a staged approach reflects evidence-based recommendations that information literacy education should be embedded within students' academic trajectories rather than delivered as a one-time skills workshop [6], [12]. However, interview data also reveal structural constraints, including limited instructional time and uneven integration across faculties. These constraints suggest that while the Digital Center plays a pivotal enabling role, the sustainability of advanced information literacy development ultimately depends on broader curricular alignment.

4.3. Student learning experiences and cognitive shifts

While quantitative results provide an overview of students' self-assessed information literacy competencies, students' lived learning experiences offer a more nuanced understanding of how information literacy training reshapes academic practices within a digital learning resources environment. Qualitative evidence from semi-structured interviews (N = 27) indicates that participation in training activities at the Digital Center has contributed to discernible cognitive shifts in students' perceptions of academic information and their own information practices.

A recurrent theme across interviews is an increased awareness of academic information quality, particularly students' growing ability to distinguish between general web-based information and peer-reviewed scholarly sources. Many participants described a heightened sensitivity to source legitimacy, publication context, and authorship, which they associated with training sessions that introduced academic databases and institutional digital collections. This shift suggests that information literacy training has played an important role in recalibrating students' initial assumptions about information equivalence in digital environments, where authoritative and non-authoritative sources often coexist side by side.

Alongside this growing awareness, students reported increased confidence in navigating digital information systems, including databases, library platforms, and search interfaces. Familiarity with these systems was frequently framed not only as a technical gain but also as a reduction in anxiety when engaging with academic information tasks. In this sense, the training appears to function as an enabling mechanism that lowers cognitive and affective barriers to participation in digitally mediated learning.

However, these positive developments coexist with persistent challenges. A dominant concern expressed by students relates to difficulty in critically evaluating unfamiliar digital content, particularly when dealing with interdisciplinary topics or emerging fields where authoritative boundaries are less clearly defined. Despite being able to retrieve relevant sources, many students indicated uncertainty in assessing credibility, bias, and relevance without explicit guidance. This difficulty points to a gap between procedural competence and evaluative judgment, underscoring the complexity of information literacy development beyond surface-level skills.

Furthermore, students frequently articulated a need for ongoing and contextualized guidance, emphasizing that one-off training sessions were insufficient for internalizing critical information practices. Several participants highlighted that evaluative skills became meaningful only when applied repeatedly within specific academic contexts, such as coursework, projects, or research assignments. This perception reinforces the view that information literacy learning unfolds through iterative engagement rather than discrete instructional interventions. To systematize these experiential patterns, Table 2 summarizes the major themes emerging from qualitative analysis.

Table 2. Themes emerging from student interviews (N = 27)

Theme	Primary Learning Dimension	Implication for Information Literacy Training
Awareness of academic information quality	Cognitive (recognition of authority and source legitimacy)	Need to strengthen conceptual understanding of scholarly communication and information authority
Confidence in digital navigation	Behavioral (operational engagement with digital systems)	Confirms effectiveness of hands-on training focused on databases and digital platforms
Difficulty in critical evaluation	Metacognitive (judgment, reflection, and critical appraisal)	Indicates a gap between procedural skills and higher-order evaluative competencies
Need for ongoing guidance	Pedagogical (dependence on instructional scaffolding)	Suggests the necessity of sustained, curriculum-integrated information literacy support

Source: Author's survey and analysis, 2025.

Together, the findings presented in Table 2 illustrate the transitional nature of students' information literacy development within a digital learning resources environment. While training initiatives at the Digital Center effectively raise awareness and enhance technical navigation skills, they do not automatically translate into sustained critical evaluation capacities. This tension between increased awareness and limited evaluative

confidence reflects a broader pattern observed in studies of student information behavior in algorithmically mediated information landscapes [2], [4].

From an interpretive standpoint, these findings support the argument that information literacy development is iterative, context-dependent, and closely tied to disciplinary learning practices, rather than a linear progression from novice to expert [13]. Students' expressed need for continued guidance suggests that centralized information literacy training, while necessary, must be complemented by opportunities for application and reinforcement within academic curricula. In the context of Thai Nguyen University, this underscores the importance of linking the Digital Center's training initiatives with teaching and learning activities across faculties to foster deeper and more durable information literacy outcomes..

4.4. Integrating quantitative and qualitative evidence

The mixed-methods design adopted in this study enables a systematic integration of quantitative learning outcomes and qualitative experiential insights, thereby strengthening the analytical depth of the findings. Rather than treating survey data and interview narratives as parallel strands, this approach allows for triangulation that clarifies how observed competency patterns are produced and sustained within a digital learning resources environment.

Quantitative results demonstrate that students have achieved tangible gains in competencies related to digital access and navigation, particularly in locating academic resources and engaging with institutional platforms. These outcomes provide empirical confirmation that information literacy training delivered by the Digital Center effectively supports students' functional engagement with digital learning resources. However, quantitative measures alone offer limited explanatory power with regard to why certain competencies develop more strongly than others.

Qualitative findings complement and extend these results by illuminating the pedagogical and cognitive mechanisms underlying observed competency patterns. Interview data reveal that structured exposure to digital resources, guided practice, and institutional support play a crucial role in shaping students' confidence and familiarity with academic information systems. At the same time, students' accounts help explain the comparatively moderate development of critical evaluation and synthesis skills, which require sustained cognitive engagement and contextual reinforcement beyond initial training interventions.

To integrate these strands analytically, Figure 2 conceptualizes the relationship between training design, competency development, and sustained academic practice within the Digital Center model.

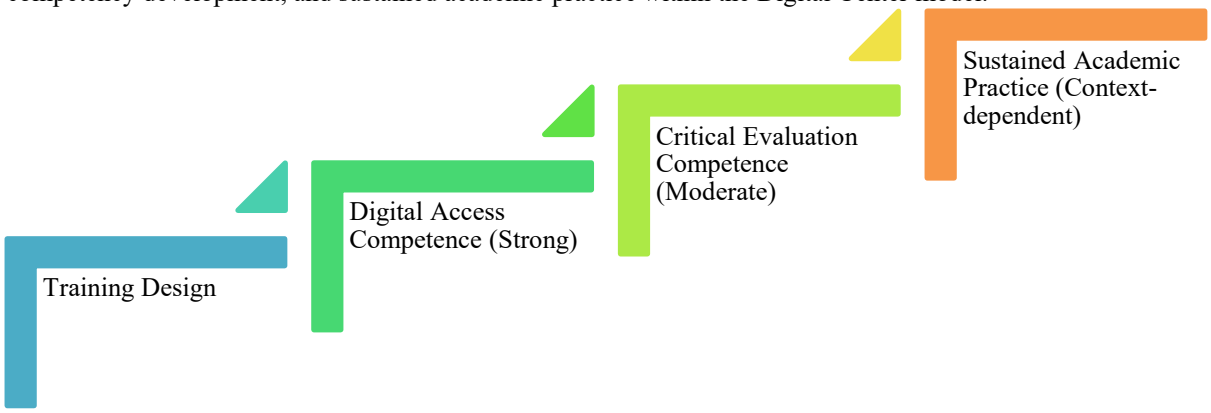

Figure 2. Integration of information literacy outcomes

Source: Author's survey and analysis, 2025.

As illustrated in Figure 2, information literacy outcomes emerge from the interaction between institutional training design, students' engagement with digital learning resources, and opportunities for application within academic contexts. The model underscores that competency development is not a linear outcome of training participation but a dynamic process mediated by pedagogical coherence and learning context. In this sense, quantitative gains in access-related skills represent necessary but insufficient conditions for deeper information literacy development. This integrative perspective highlights that information literacy outcomes are shaped not only by individual effort or motivation but also by the institutional conditions under which learning takes place. The Digital Center's role as a centralized support unit enables consistent access to resources and foundational training, yet the sustainability of advanced competencies depends on how information literacy practices are reinforced through coursework, assessment, and disciplinary learning activities.

In line with the ACRL Framework for Information Literacy for Higher Education, the findings suggest that threshold concepts—such as authority as constructed and contextual, information value, and scholarly

communication as a process—cannot be fully internalized through isolated instructional sessions [3]. Instead, these concepts require repeated engagement across learning contexts, guided reflection, and curricular continuity. The integration of quantitative and qualitative evidence thus reinforces the argument that information literacy training in digital environments must be understood as an ongoing institutional endeavor rather than a discrete educational intervention.

4.5. Implications within the Vietnamese higher education context

Situated within Vietnam's higher education reform agenda, the experience of the Digital Center at Thai Nguyen Situated within Vietnam's ongoing higher education reform agenda, the experience of the Digital Center at Thai Nguyen University provides a contextually grounded illustration of how centralized digital support units can operationalize national policy orientations on digital competence and technology-enhanced learning [10], [11]. In recent years, these policy frameworks have emphasized not only the expansion of digital infrastructure but also the development of learners' competencies to effectively engage with digital information and learning environments. The Digital Center model demonstrates how such policy objectives can be translated into concrete institutional practices through structured information literacy training.

At the same time, the findings of this study caution against equating infrastructural readiness with pedagogical effectiveness. While investments in digital platforms, databases, and learning management systems are necessary preconditions for digital transformation, the results indicate that access alone does not guarantee meaningful learning outcomes. Students' uneven development of higher-order information literacy competencies suggests that the pedagogical dimension of digital transformation remains a critical challenge within Vietnamese higher education institutions.

Without systematic integration of information literacy training into teaching and learning practices at the faculty level, such initiatives risk remaining peripheral rather than transformative. The case of Thai Nguyen University illustrates that centralized units like the Digital Center can effectively provide foundational training and institutional coordination; however, the consolidation of critical and reflective information practices depends on sustained reinforcement within disciplinary curricula, assessment tasks, and academic supervision. This finding is particularly relevant in the Vietnamese context, where curricular structures are often content-heavy and leave limited space for transversal competencies such as information literacy.

More broadly, the study contributes empirically grounded evidence to ongoing discussions on digital transformation in higher education, particularly in developing and transitional educational contexts [8]. It highlights the need to move beyond a technology-centered understanding of digital transformation toward a more pedagogically integrated approach, in which information literacy is recognized as a core academic competence rather than a supplementary skill. In this regard, the experience of the Digital Center at Thai Nguyen University underscores the importance of institutional coordination between digital support units, academic departments, and policy frameworks to ensure that digital transformation efforts lead to sustainable educational change.

V. CONCLUSION AND IMPLICATIONS

5.1. Conclusions

This study examined information literacy training for university students within a digital learning resources environment, drawing on the case of the Digital Center at Thai Nguyen University, Vietnam. By adopting a mixed-methods approach, the study provides empirically grounded insights into how institutional training design, student learning experiences, and digital infrastructures interact to shape information literacy outcomes. The findings indicate that information literacy training implemented through a centralized digital support unit can effectively strengthen students' competencies in accessing and navigating academic digital resources. Quantitative results confirm tangible gains in procedural and access-oriented skills, while qualitative evidence reveals meaningful cognitive shifts in students' awareness of academic information quality. However, the study also demonstrates that the development of higher-order competencies - particularly critical evaluation and information synthesis - remains uneven and context-dependent.

Taken together, the results underscore that information literacy development in digital learning environments is not a linear progression from access to mastery. Rather, it is a gradual and iterative process mediated by pedagogical design, institutional coordination, and opportunities for contextualized application. The experience of the Digital Center at Thai Nguyen University illustrates both the potential and the limitations of centralized information literacy training when it is not systematically embedded within disciplinary teaching and learning practices.

5.2. Theoretical implications

From a theoretical perspective, this study reinforces conceptualizations of information literacy as a multidimensional and developmental construct rather than a fixed set of technical skills. The findings lend empirical support to frameworks that emphasize the progression from operational engagement with information systems toward metacognitive and epistemic judgment, particularly within digitally mediated learning contexts [1], [3].

Importantly, the integration of quantitative and qualitative evidence highlights the role of institutional context in shaping how information literacy competencies are acquired and sustained. While digital environments lower barriers to access and facilitate procedural learning, they simultaneously intensify the cognitive demands associated with evaluating information authority, credibility, and relevance. This duality suggests that information literacy theories must continue to account for the tension between technological affordances and epistemic challenges in contemporary higher education settings.

By situating information literacy development within a digital learning resources environment, the study contributes to ongoing scholarly discussions on how digital transformation reshapes learning processes, student agency, and academic practices. It underscores the need for theoretical models that move beyond individual skill acquisition to incorporate institutional design, pedagogical coherence, and learning trajectories over time.

5.3. Institutional Implications

At the institutional level, the findings point to the strategic role of digital centers as enabling mechanisms for information literacy education. The Digital Center at Thai Nguyen University demonstrates how centralized units can coordinate access to digital resources, deliver foundational training, and support students' initial engagement with academic information practices. Such units are particularly valuable in large and multi-disciplinary universities, where students' information needs vary widely.

However, the study also highlights the limitations of relying solely on centralized training models. Without systematic integration into faculty-level teaching, assessment, and supervision, information literacy training risks remaining peripheral rather than transformative. The uneven development of evaluative and synthetic competencies observed in this study suggests that higher-order information literacy skills require sustained reinforcement within disciplinary contexts.

Accordingly, universities should consider institutional strategies that promote closer collaboration between digital centers, academic departments, and teaching staff. Embedding information literacy objectives into curricula, aligning training activities with course assignments, and incorporating information evaluation criteria into assessment practices may enhance the durability and depth of learning outcomes. Such integration would allow centralized training initiatives to function not as isolated interventions but as integral components of the academic learning ecosystem.

5.4. Policy Implications

At the policy level, the findings carry important implications for higher education systems undergoing digital transformation, particularly in developing and transitional contexts such as Vietnam. National policies increasingly emphasize digital competence and the application of information technology in higher education [10], [13]. The case of Thai Nguyen University illustrates how these policy orientations can be operationalized through institutional mechanisms such as digital centers and structured information literacy training programs.

Nevertheless, the study cautions against policy approaches that prioritize infrastructural investment without parallel attention to pedagogical integration. Digital platforms, databases, and learning management systems constitute necessary conditions for transformation, but they do not in themselves ensure meaningful learning outcomes. Policymakers should therefore consider frameworks that explicitly recognize information literacy as a core academic competence, supported by curricular guidance, professional development for educators, and institutional incentives for interdisciplinary collaboration.

By grounding policy discussions in empirical evidence from institutional practice, this study contributes to a more nuanced understanding of digital transformation in higher education. It suggests that sustainable progress depends not only on technological readiness but also on coherent alignment between policy objectives, institutional design, and pedagogical practice.

5.5. Limitations and directions for future research

While this study offers in-depth insights into information literacy training within a specific institutional context, it is not without limitations. The case study design, while analytically rich, limits the generalizability of findings to other institutional settings. In addition, reliance on self-reported competency measures may not fully capture students' actual performance in complex information tasks. Future research could extend this work by incorporating longitudinal designs to examine how information literacy competencies evolve over time, as well as performance-based assessments to complement self-reported data. Comparative studies across institutions or

national contexts would also contribute to a deeper understanding of how different models of information literacy training operate within diverse digital learning environments.

Overall, the experience of the Digital Center at Thai Nguyen University demonstrates how information literacy training, when situated within a coherent digital learning resources environment, can support university students' academic engagement while revealing the pedagogical conditions required for sustainable competency development.

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