Cloud-Based Learning Infrastructure Readiness at a Maritime Academy: A Cross-Group Readiness Index Assessment

Fahmi Umangsangaji [1*]

[1] Maritime Institute, Sekolah Tinggi Ilmu Pelayaran Jakarta, North Jakarta, Indonesia

Keywords
cloud readiness index; cloud-based learning; maritime vocational education; hybrid learning; digital infrastructure

***Correspondence Email:**
Fahmi.umangsangaji@stipmail.ac.id

Abstract
Cloud-based learning infrastructure constitutes an increasingly non-negotiable component of post-pandemic maritime vocational education, yet maritime academies present distinctive infrastructure readiness challenges — including simulation-heavy physical training requirements, high-bandwidth synchronous learning demands, and the need for cloud-accessible content across vessel operations, navigation, and engineering domains — not anticipated by generic higher-education cloud-readiness frameworks. This study develops and validates a maritime-academy-specific Cloud Readiness Index (CRI) and applies it to assess cloud-based learning infrastructure readiness across cadets and lecturers at Sekolah Tinggi Ilmu Pelayaran (STIP) Jakarta. The CRI integrates three dimensions: Infrastructure Access, Digital Cloud Skill, and Institutional Support Perception. Applying the CRI across 60 participants — 30 cadets and 30 lecturers across Port and Shipping Management (PSM), Deck Nautical (DN), and Marine Engineering (ENG) programs — the study documents an overall moderate readiness level (Grand Mean CRI = 3.25/5.00), with Institutional Support Perception as the consistently lowest dimension across all groups (Cadets M = 3.20; Lecturers M = 2.80). Cadets score significantly higher than lecturers on composite CRI ($t(58) = 2.14$, $p = .037$, Cohen's $d = 0.55$), with the lecturer-cadet gap most pronounced on Institutional Support Perception. Between-major ANOVA reveals significant differences ($F(2,57) = 3.82$, $p = .028$) with DN recording lowest readiness across both respondent groups. The study contributes a validated, maritime-academy-specific cloud readiness instrument and institutional diagnostic directly informing STIP Jakarta's hybrid learning infrastructure investment priorities.

1. Introduction

The post-pandemic transformation of Indonesian higher education — accelerated by Ministry of Education and Ministry of Transportation directives mandating hybrid learning infrastructure development across all state vocational institutions — has established cloud-based learning as a structural expectation rather than a pedagogical option for institutions such as Sekolah Tinggi Ilmu Pelayaran Jakarta [1]. Cloud-based learning infrastructure encompasses the technological, institutional, and human capacity conditions necessary for effective cloud-mediated instruction: reliable internet connectivity enabling cloud platform access, institutional adoption of Learning Management Systems and collaborative cloud tools, educator competency in cloud-based instructional design, and the institutional support systems that sustain cloud learning quality across the instructional workforce. At STIP Jakarta specifically, these generic requirements interact with distinctive maritime vocational education characteristics that complicate straightforward cloud adoption: simulation-based STCW training — bridge simulators, engine-room simulators, cargo handling simulators — generates high-bandwidth, synchronous instructional demands that cloud delivery models must accommodate or supplement rather than replace; practical seamanship instruction requires physical campus presence that cloud models must complement rather than displace; and the operational security requirements of navigation and ship management training create data handling considerations not relevant to most non-maritime cloud learning deployments [2].

The cloud computing adoption literature has extensively theorized and empirically examined cloud readiness at organizational and educational institutional levels, identifying infrastructure, skill, and institutional support as the three primary determinant dimensions whose joint adequacy predicts effective cloud adoption [3]. The Technology Acceptance Model [4] and its cloud-specific adaptations [5] have documented that perceived ease of cloud platform use and perceived institutional support are the strongest proximal determinants of individual cloud tool adoption in educational settings — findings directly applicable to the lecturer and cadet adoption behaviors that STIP Jakarta's cloud-based learning infrastructure development must stimulate. However, no cloud readiness assessment instrument has been validated for maritime academy application, where the pedagogical specificity of STCW-aligned simulation training, the professional background diversity of the lecturer community (former practitioners versus academic specialists), and the physical training intensity of maritime vocational education create a readiness landscape that generic higher-education cloud readiness instruments are not designed to capture.

This study addresses this methodological gap by developing and validating a maritime-academy-specific Cloud Readiness Index (CRI) — a three-dimensional composite instrument incorporating Infrastructure Access, Digital Cloud Skill, and Institutional Support Perception dimensions — and applying it to generate the first systematic, cross-group cloud readiness baseline at STIP Jakarta. The cross-group design, comparing cadets and lecturers across three academic programs, enables identification of the specific respondent groups and program contexts requiring most urgent cloud infrastructure investment attention, as well as the dimension-specific readiness profiles that most directly inform the sequencing of STIP Jakarta's hybrid learning development priorities.

1.1 Theoretical Framework

This study draws on the cloud computing adoption and educational technology readiness literature to ground the CRI's dimensional structure in established theoretical foundations. Mell and Grance's [3] NIST cloud computing definition establishes the service model architecture — Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) — within which STIP Jakarta's cloud-based learning adoption occurs, with SaaS Learning Management System adoption as the most immediately relevant deployment model for the academic instructional contexts this study assesses. The Technology Acceptance Model's [4] core constructs — Perceived Usefulness and Perceived Ease of Use — provide the individual-level adoption readiness theoretical basis for the Digital Cloud Skill and Institutional Support Perception dimensions of the CRI, establishing that skill confidence and institutional support are the most proximal determinants of individual cloud platform adoption behavior in educational contexts. Parasuraman's [6] Technology Readiness Index, distinguishing optimism and innovativeness as positive readiness predictors from discomfort and insecurity as negative readiness predictors, provides complementary theoretical grounding for the CRI's cross-dimensional integration, establishing that cloud readiness is not reducible to any single dimension but reflects the balance of enabling and constraining factors across technological, skill, and institutional conditions.

Applied to maritime vocational education specifically, these theoretical frameworks generate the prediction that the most consequential cloud readiness gap at STIP Jakarta is likely to reside in the Institutional Support

Perception dimension — because the physical training infrastructure heritage of maritime academies has historically concentrated institutional investment in simulation and workshop facilities rather than cloud learning platforms — rather than in the Infrastructure Access dimension, where national broadband development has substantially expanded connectivity even in specialized vocational settings. This prediction motivates the CRI's design to weight Institutional Support Perception as a distinct and separately assessed dimension rather than treating institutional support as a background contextual variable subsumed within infrastructure access.

2. Method

This study employed a quantitative cross-sectional survey design using the Cloud Readiness Index instrument, applied to 60 STIP Jakarta stakeholders across two respondent groups and three academic programs from August 2025 to March 2026 as part of the institution's broader Digital Transformation assessment initiative.

The participant population comprised 30 Level 2 cadets (10 per program: PSM, DN, ENG) and 30 active lecturers (10 per program: PSM, DN, ENG), selected through purposive stratified sampling to enable the 3-major × 2-group comparison matrix that the study's comparative design requires. Level 2 cadets were selected for the same reasons as in companion DIGITS studies: they have completed foundational coursework providing context for meaningful cloud learning readiness assessment while remaining in the formal instructional period where infrastructure development would most directly benefit them. All lecturer participants held active course delivery assignments in their respective programs.

The Cloud Readiness Index (CRI) was developed specifically for this study, comprising 15 items across three five-item dimensions. Dimension 1, Infrastructure Access (IA), assessed the availability and reliability of the physical and connectivity infrastructure prerequisites for cloud-based learning: personal device ownership appropriate for cloud platform use, campus Wi-Fi access speed and reliability, home or dormitory internet connectivity, cloud storage access, and mobile data sufficiency for cloud LMS access off-campus. Dimension 2, Digital Cloud Skill (DCS), assessed self-reported competency in cloud-based learning tool use: LMS platform navigation, video conferencing tool use, cloud document collaboration, cloud-based assignment submission, and cloud data storage and retrieval. Dimension 3, Institutional Support Perception (ISP), assessed perceptions of STIP Jakarta's institutional capacity and commitment to cloud-based learning: institutional IT support quality, cloud platform training provision, cloud learning policy clarity, leadership cloud transformation commitment, and technical troubleshooting support availability. All 15 items were scored on a five-point Likert scale (1 = Strongly Disagree / Very Poor to 5 = Strongly Agree / Excellent). The composite CRI score was calculated as the unweighted mean of the three dimension scores. CRI benchmarks: 4.00–5.00 = High Readiness; 3.00–3.99 = Moderate Readiness; 2.00–2.99 = Low Readiness. Instrument reliability was established through pilot testing (n=10 cadets not in main sample): overall $\alpha = 0.82$.

Statistical analyses comprised descriptive statistics by respondent group and program, independent-samples t-tests comparing cadet and lecturer CRI scores, and one-way ANOVA comparing between-major differences for each group, with IBM SPSS Statistics version 26 [7]. Statistical significance was set at $\alpha = .05$.

3. Results and Analysis

3.1 Cloud Readiness Index Scores: Descriptive Results

Table 1 presents CRI dimension scores and composite CRI by program and respondent group, revealing the dimensional and group-level readiness profile that constitutes the study's primary empirical contribution.

Table 1. Cloud Readiness Index Scores by Program and Respondent Group (n = 60)

Group	IA Mean (SD)	DCS Mean (SD)	ISP Mean (SD)	CRI Composite (SD)
Cadets (n=30)				

Group	IA Mean (SD)	DCS Mean (SD)	ISP Mean (SD)	CRI Composite (SD)
PSM Cadets (n=10)	3.82 (0.74)	3.52 (0.81)	3.28 (0.88)	3.54 (0.79)
DN Cadets (n=10)	3.46 (0.88)	3.18 (0.92)	3.12 (0.96)	3.25 (0.91)
ENG Cadets (n=10)	3.61 (0.82)	3.36 (0.87)	3.21 (0.91)	3.39 (0.86)
All Cadets	**3.63 (0.82)**	**3.35 (0.87)**	**3.20 (0.92)**	**3.39 (0.86)**
Lecturers (n=30)				
PSM Lecturers (n=10)	3.64 (0.79)	3.21 (0.89)	2.86 (0.94)	3.24 (0.87)
DN Lecturers (n=10)	3.28 (0.91)	2.94 (0.96)	2.74 (1.02)	3.00 (0.96)
ENG Lecturers (n=10)	3.42 (0.86)	3.08 (0.92)	2.79 (0.98)	3.10 (0.91)
All Lecturers	**3.45 (0.86)**	**3.08 (0.93)**	**2.80 (0.98)**	**3.11 (0.92)**
Grand Mean	**3.54 (0.84)**	**3.22 (0.90)**	**3.00 (0.96)**	**3.25 (0.89)**

CRI benchmarks: 4.00–5.00 = High; 3.00–3.99 = Moderate; 2.00–2.99 = Low

The dimensional profile in Table 1 reveals three analytically important patterns. First, Institutional Support Perception (ISP) is the consistently lowest dimension across all six program-group combinations, with the grand mean of 3.00 sitting exactly at the Moderate-Low boundary — confirming the theoretical prediction that institutional support is the most constrained readiness dimension at STIP Jakarta rather than connectivity or skill. Second, lecturers' ISP scores (All Lecturers M=2.80) fall in the Low Readiness range, while cadets' ISP scores (All Cadets M=3.20) remain in the Moderate range — a 0.40-point group difference indicating that lecturers experience institutional cloud learning support as substantially less adequate than cadets perceive institutional cloud infrastructure. Third, DN lecturers record the lowest CRI composite of any group-program combination (M=3.00), reaching the Moderate threshold precisely without exceeding it, consistent with the companion qualitative finding (DIGITS Paper 2) that DN lecturers exhibit the most constrained digital transformation engagement orientation across the STIP Jakarta academic community.

3.2 Inferential Statistics: Between-Group and Between-Major Comparisons

Table 2 presents the key inferential comparison results, including the cadet-lecturer CRI t-test and between-major ANOVA for each group.

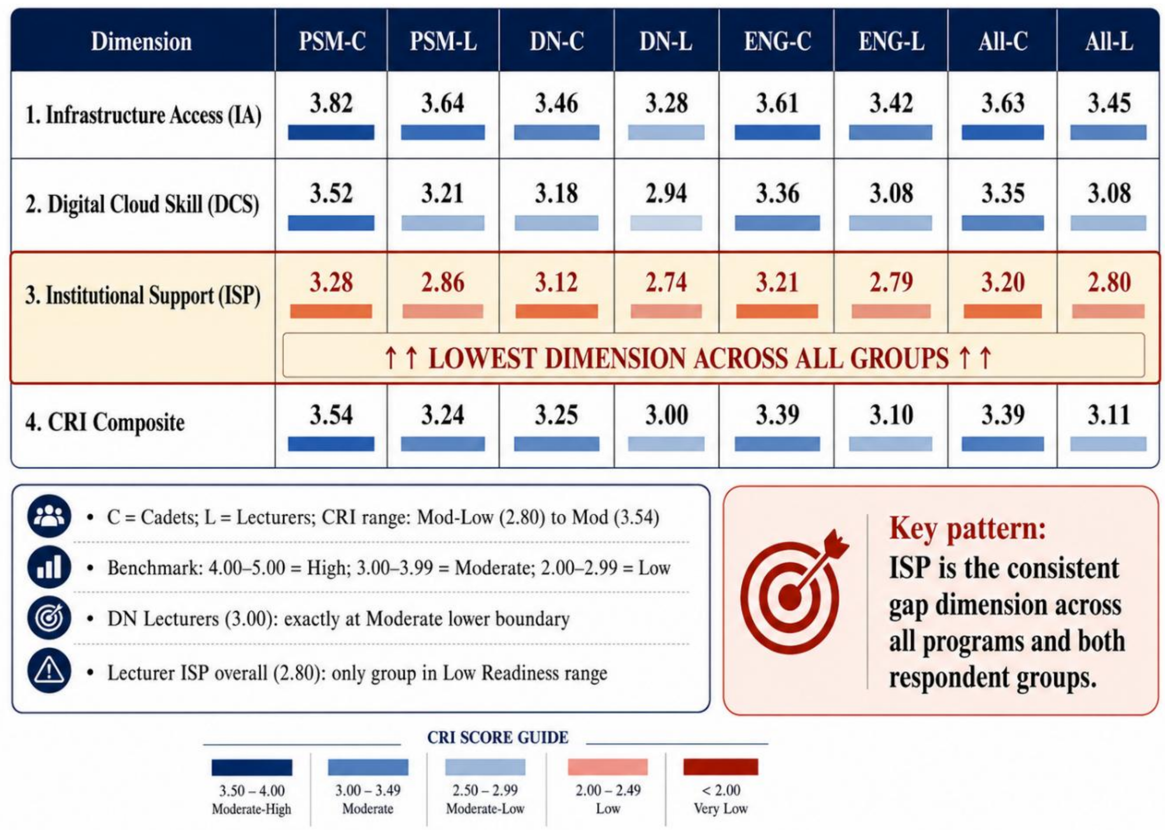
Table 2. Inferential Statistics: CRI Composite Comparisons

Comparison	Statistic	p-value	Effect Size
Cadets vs. Lecturers (overall CRI)	$t(58) = 2.14$	.037*	Cohen's d = 0.55 (Medium)
Between-major ANOVA — Cadets	$F(2,27) = 3.76$	.037*	$\eta^2 = .218$
Between-major ANOVA — Lecturers	$F(2,27) = 3.89$	.033*	$\eta^2 = .224$
Cadets vs. Lecturers on ISP	$t(58) = 2.87$	.006**	Cohen's d = 0.74 (Medium-Large)
Cadets vs. Lecturers on DCS	$t(58) = 1.74$	.087	Cohen's d = 0.45 (Small-Medium)
Cadets vs. Lecturers on IA	$t(58) = 1.12$	.267	Cohen's d = 0.29 (Small)

*$p < .05$; **$p < .01$

The between-group t-test confirms that cadets score significantly higher than lecturers on composite CRI ($t(58)=2.14$, $p=.037$, $d=0.55$), with the most pronounced group difference on Institutional Support Perception ($d=0.74$) and a non-significant difference on Infrastructure Access ($d=0.29$). This dimension-specific group difference pattern is analytically important: the cadet-lecturer readiness gap is not primarily a connectivity gap (where cadets and lecturers are similarly equipped) but an institutional support perception gap, suggesting that lecturers experience STIP Jakarta's cloud learning institutional support as significantly less adequate than cadets perceive the same institutional infrastructure.

Figure 1 presents the CRI dimension profiles for cadets and lecturers across all three programs, visualizing the ISP dimension as the consistent gap area requiring institutional intervention.



Dimension	PSM-C	PSM-L	DN-C	DN-L	ENG-C	ENG-L	All-C	All-L
1. Infrastructure Access (IA)	3.82	3.64	3.46	3.28	3.61	3.42	3.63	3.45
2. Digital Cloud Skill (DCS)	3.52	3.21	3.18	2.94	3.36	3.08	3.35	3.08
3. Institutional Support (ISP)	3.28	2.86	3.12	2.74	3.21	2.79	3.20	2.80
	↑↑ LOWEST DIMENSION ACROSS ALL GROUPS ↑↑							
4. CRI Composite	3.54	3.24	3.25	3.00	3.39	3.10	3.39	3.11

Figure 1. CRI Dimension Profiles by Program and Respondent Group (n = 60)

3.3 Discussion

The study's most consequential finding — that Institutional Support Perception is the lowest CRI dimension across all groups, and that lecturer ISP falls in the Low Readiness range at 2.80 — reframes STIP Jakarta's cloud learning development priority from the infrastructure investment framing that post-pandemic institutional discourse has emphasized toward the institutional governance and faculty support framing that the data more precisely identifies as the critical constraint [8]. The significant cadet-lecturer gap on ISP ($d=0.74$, medium-large effect) is theoretically interpretable through Parasuraman's [6] Technology Readiness framework: cadets, who experience the institutional technology environment primarily as platform users, perceive institutional cloud support as moderate (3.20); lecturers, who experience it as platform designers and instructional architects who require sustained technical support, professional development, and policy clarity to integrate cloud tools into complex STCW-aligned instructional designs, perceive it as inadequate (2.80). The distinction is not between cadets and lecturers as technology users but between their qualitatively different institutional support requirements for cloud learning engagement.

The non-significant cadet-lecturer difference on Infrastructure Access (d=0.29, p=.267) confirms that connectivity equity has been substantially achieved within STIP Jakarta — cadets and lecturers access cloud platforms through roughly equivalent device and connectivity infrastructure — making further connectivity investment the lowest-return institutional cloud readiness priority. Investment in IT infrastructure would address the already-adequate dimension rather than the genuinely constrained dimension. The Digital Cloud Skill difference, while directionally meaningful (d=0.45) but not statistically significant at the α=.05 threshold, suggests a moderate skill gap between cadet and lecturer cloud competency that structured professional development could address without major institutional investment. Together, these three dimensional findings produce a clear investment priority sequence: Institutional Support (most urgent, lowest readiness, most consequential for lecturer adoption), Digital Cloud Skill (second priority, moderate gap, addressable through professional development), and Infrastructure Access (lowest priority, near-adequate, not the binding constraint) [9].

The between-major variation, significant for both cadets (F(2,27)=3.76, p=.037) and lecturers (F(2,27)=3.89, p=.033), with DN recording lowest CRI composite across both groups, confirms the pattern established in companion DIGITS studies: the Deck Nautical program's training environment and professional culture consistently produces the most constrained digital readiness orientation, reflecting not technological unavailability but the training context's navigation-heritage resistance to digital mode shifts that physical seamanship and watchkeeping instruction has historically not required. Addressing DN's below-group cloud readiness will require both targeted infrastructure support — ensuring that bridge simulation complement scenarios are cloud-accessible — and professional development specifically engaging how cloud tools can enhance rather than displace the simulation-based competency development that defines the DN program's core instructional value [2].

4. Conclusion

This study has developed and validated a maritime-academy-specific Cloud Readiness Index and applied it across 60 STIP Jakarta cadets and lecturers, documenting a grand mean CRI of 3.25 (Moderate) with Institutional Support Perception as the lowest and most consequential readiness constraint across all groups. The significant cadet-lecturer gap on composite CRI (d=0.55) and the pronounced lecturer ISP deficit (M=2.80, Low Readiness) identify lecturer institutional support inadequacy rather than infrastructure access limitation as the primary binding constraint on STIP Jakarta's cloud-based learning development. Between-major analysis confirms DN's lowest readiness positioning across both cadets and lecturers, consistent with the navigation-heritage professional formation context that companion DIGITS studies identify as the most constrained digital transformation adoption environment across STIP Jakarta's three programs. These findings provide STIP Jakarta with a validated, dimension-differentiated diagnostic for targeted cloud infrastructure investment prioritization.

5. References

[1] Kementerian Perhubungan Republik Indonesia, "Kebijakan Transformasi Digital Pendidikan Tinggi Vokasi Transportasi," Ministry of Transportation Circular, Jakarta, 2022.

[2] K. Bogusławski, M. Gil, J. Nasur, and K. Wróbel, "Implications of autonomous shipping for maritime education and training: the cadet's perspective," *Marit. Econ. Logist.*, vol. 24, no. 2, pp. 327–343, 2022. DOI: 10.1057/s41278-022-00217-x

[3] P. Mell and T. Grance, "The NIST Definition of Cloud Computing," NIST Special Publication 800-145, National Institute of Standards and Technology, Gaithersburg, MD, 2011.

[4] F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Q.*, vol. 13, no. 3, pp. 319–340, 1989. DOI: 10.2307/249008

[5] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," *MIS Q.*, vol. 27, no. 3, pp. 425–478, 2003. DOI: 10.2307/30036540

[6] A. Parasuraman, "Technology Readiness Index (TRI): A multiple-item scale to measure readiness to embrace new technologies," *J. Serv. Res.*, vol. 2, no. 4, pp. 307–320, 2000. DOI: 10.1177/109467050024001

[7] A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. London: Sage Publications, 2018.

[8] A. Wahid, M. Y. Jinca, T. Rachman, and J. Malisan, "Determination of Indicators of Implementation of Sea Transportation Safety Management System for Traditional Shipping Based on Delphi Approach," *Sustainability*, vol. 15, no. 13, 2023. DOI: 10.3390/su151310080

[9] J. W. Creswell and V. L. Plano Clark, *Designing and Conducting Mixed Methods Research*, 3rd ed. Thousand Oaks, CA: Sage Publications, 2017.

[10] F. Mutohhari, P. Sudira, F. D. Isnantyo, and N. W. A. Majid, "Generic green skills: maturity level of vocational education teachers and students in Indonesia," *Int. J. Eval. Res. Educ.*, vol. 14, no. 1, pp. 179–187, 2025. DOI: 10.11591/ijere.v14i1.29191

[11] L. Widaningsih, S. Rahayu, V. Dwiyanti, and W. Widanengsih, "Analysis and Mapping of Technical Competency Needs for TVET Teachers in the Era of Industry 4.0," *J. Tech. Educ. Train.*, vol. 17, no. 2, pp. 151–164, 2025. DOI: 10.30880/jtet.2025.17.02.011

[12] H. Li, S. I. Khattak, X. Lu, and A. Khan, "Greening the Way Forward: A Qualitative Assessment of Green Technology Integration and Prospects in a Chinese Technical and Vocational Institute," *Sustainability*, vol. 15, no. 6, 2023. DOI: 10.3390/su15065187

[13] A. Hattingh, S. Hodge, and T. Mavin, "Flight instructor perspectives on competency-based education: insights into educator practice within an aviation context," *Int. J. Train. Res.*, vol. 20, no. 3, pp. 264–282, 2022. DOI: 10.1080/14480220.2022.2063155

[14] R. S. Wulandari and T. Cahyadi, "Engineering Technology and Education in Maritime Studies: A Qualitative Examination," *J. Eng. Sci. Technol.*, vol. 20, no. 2, pp. 28–35, 2025.

[15] D. Long and B. Magerko, "What is AI literacy? Competencies and design considerations," in *Proc. CHI Conference on Human Factors in Computing Systems*, New York: ACM, 2020, pp. 1–16. DOI: 10.1145/3313831.3376727