

Strengthening Work Safety Mindset and Competence as a Policy Strategy for Maritime Human Resource Development in Indonesia

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ABSTRACT

This study examines the effect of Practice-Based Teaching (PBT) on maritime workforce readiness (MWR) with a focus on strengthening work safety mindset and competence, and the mediating roles of Maritime Safety Competence (MSC) and Safety Self-Efficacy (SSE). Employing a causal-comparative quantitative design, data were collected via a 20-item, 5-point Likert questionnaire from a purposive sample of 167 Nautical Technology students at Politeknik Pelayaran Sumatera Barat (pilot test $n = 50$). The instrument measures safety knowledge, emergency procedure skills, safety awareness attitudes, and regulatory compliance behaviors. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to evaluate measurement quality and test direct and indirect effects. Measurement indicators demonstrated excellent reliability and convergent validity (Cronbach's $\alpha = 0.935\text{--}0.962$; $AVE > 0.79$). Results show that PBT has a strong, significant direct effect on MWR ($\beta = 0.749$, $t = 15.804$, $p < 0.001$) and significantly predicts MSC ($\beta = 0.575$, $t = 7.935$, $p < 0.001$) and SSE ($\beta = 0.592$, $t = 8.958$, $p < 0.001$). MSC significantly influences MWR ($\beta = 0.417$, $t = 5.652$, $p < 0.001$), and mediates the PBT→MWR relationship partially (indirect $\beta = 0.240$, $t = 4.592$, $p < 0.001$). In contrast, SSE does not significantly predict MWR ($\beta = 0.078$, $t = 0.992$, $p = 0.322$), nor does it mediate the PBT→MWR link (indirect $\beta = 0.046$, $t = 0.984$, $p = 0.326$). The findings imply that PBT enhances maritime employability chiefly through strengthening demonstrable safety competencies; policy recommendations include: (1) integration of safety culture into structured practical curricula; (2) reinforcement of performance-based assessment using safety scenario simulations; (3) investment in safety simulators and emergency response training facilities; (4) industry partnerships to align safety competency standards with STCW requirements and operational vessel needs; and (5) safety mindset mentoring programs by maritime industry practitioners.

Keywords: practice-based teaching; maritime workforce readiness; work safety competence; safety mindset; safety self-efficacy; vocational maritime; safety culture.

INTRODUCTION

The maritime shipping industry is a strategic sector characterized by high operational complexity and inherent safety risks that demand not only advanced technical competence but also a robust safety mindset and strict adherence to international safety standards (Shi et al., 2024; IMO, 2023). Maritime workforce readiness is critically determined by the ability to integrate safety awareness, hazard recognition, and emergency response capabilities into daily operational practice (Moros-Daza & Jubiz-Diaz, 2024). Despite decades of regulatory advancement under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), numerous industry reports and maritime accident investigations reveal persistent gaps between the safety competencies of vocational graduates and the practical safety demands of shipboard operations (Baum-Talmor & Kitada, 2022; Ghosh & Emad, 2025). Practice-based teaching (PBT) has emerged as a promising pedagogical approach to bridge this gap by providing authentic, real-world safety training experiences that emphasize demonstrable safety competence and

the internalization of safety culture (Sellberg et al., 2021; Ernstsen & Nazir, 2020).

Beyond technical safety skills, psychological factors such as students' safety self-efficacy, their belief in their capability to perform safety-critical tasks and respond effectively to emergencies—play a crucial role in translating safety knowledge into safe workplace behavior (Kim et al., 2021; Bandura, 1997). Research in occupational psychology and safety science emphasizes that safety mindset, comprising attitudes, beliefs, and motivations toward safety, is a foundational determinant of safety performance and accident prevention in high-risk industries (Christian et al., 2009; Clarke, 2013). Consequently, empirical investigation into the relationships among practice-based instructional methods, safety competence development, safety self-efficacy, and safety mindset is essential for informing curriculum design, training policy, and human resource development strategies in Maritime Education and Training (MET) institutions.

A growing body of international research demonstrates that practice-based learning through

high-fidelity simulators, scenario-based drills, and onboard training can significantly enhance mastery of safety-critical skills such as firefighting, damage control, man overboard procedures, and emergency evacuation (Jongbloed et al., 2024; Bjørn et al., 2024). The STCW Convention, particularly the Manila Amendments, explicitly requires that seafarers demonstrate competence in safety functions through approved simulator training and documented evidence of skill proficiency (IMO STCW Code A-I/12; Dewan et al., 2024). Studies in vocational safety education highlight the importance of performance-based assessment, realistic emergency scenarios, and continuous instructional feedback for accelerating the acquisition of safety-critical skills and fostering a proactive safety culture (Inderanata & Sukardi, 2023; Ventista & Brown, 2023).

In the domain of educational and occupational psychology, self-efficacy has been consistently shown to be a significant predictor of motivation, task persistence, and performance under stress—all of which are critical in maritime safety contexts where crew must respond decisively during emergencies (Kryshko et al., 2022; Supervía et al., 2022). However, empirical evidence that integrates the constructs of practice-based teaching, maritime safety competence, and safety self-efficacy within a comprehensive mediational framework leading to workforce readiness remains relatively scarce (Starup et al., 2024). In particular, studies that combine objective measures of safety performance, domain-specific safety self-efficacy, and safety-oriented workforce readiness outcomes in the MET context are limited (Karahalil et al., 2023; Fan & Yang, 2023).

Ideally, the implementation of practice-based safety training should produce graduates who not only possess theoretical safety knowledge but also demonstrate observable safety competencies, internalize a safety-first mindset, and exhibit professional confidence in managing safety-critical situations (Christopoulos & Stylios, 2024; Munim et al., 2023). In practice, however, many MET vocational programs face constraints such as limited access to advanced safety simulators, insufficient onboard training opportunities, misalignment between safety curricula and evolving industry safety protocols, and variability in the quality of safety instructors and workplace supervisors (Baier-Mosch et al., 2024). Methodological challenges also arise from the predominant reliance on self-report safety attitude surveys without triangulation with observed safety performance or behavioral indicators, which weakens the validity of claims regarding safety readiness (Rippon et al., 2024).

Moreover, the causal mechanisms linking increases in safety competence to changes in safety self-efficacy and subsequent workforce safety readiness have not been consistently mapped using rigorous mediation models or longitudinal designs (Chang et al., 2024).

At the institutional level, for example at Politeknik Pelayaran Sumatera Barat, these challenges manifest in tangible concerns: industry stakeholders report that some maritime graduates demonstrate adequate theoretical safety knowledge but lack confidence and practical proficiency in executing emergency procedures, maintaining situational awareness, and adhering to safety protocols under operational pressure. This competency-readiness gap has direct implications for shipboard safety performance, regulatory compliance, and the reputation of Indonesian maritime human resources in the global labor market. Therefore, there is an urgent need for empirical research that rigorously tests the mechanisms through which practice-based teaching influences maritime workforce readiness, with particular attention to the roles of safety competence and safety self-efficacy as mediating pathways.

This study examines the impact of practice-based teaching on maritime workforce readiness among students at the Politeknik Pelayaran Sumatera Barat, with particular emphasis on strengthening safety mindset and safety competence as strategic policy levers for maritime human resource development in Indonesia. The research investigates how maritime safety competence (MSC) and safety self-efficacy (SSE) mediate the relationship between practice-based teaching and workforce readiness, addressing the extent to which practice-based teaching directly improves readiness, influences students' safety competence and safety self-efficacy, and operates through these constructs to shape workforce preparedness. The study further seeks to derive policy recommendations that reinforce safety mindset and safety competence in alignment with national maritime development priorities. Guided by hypotheses that articulate both the direct and indirect effects of practice-based teaching, the study applies a rigorous measurement strategy that integrates standardized assessments of safety competence, psychometrically validated safety self-efficacy scales, and mediation analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM) with bootstrap procedures. The findings are expected to generate robust empirical evidence to support curriculum enhancements that embed safety culture and competency-based safety training, inform performance-based assessment approaches

capable of authentically evaluating safety-critical skills, and guide instructional interventions aimed at strengthening both technical safety competence and psychological readiness. Furthermore, the results are anticipated to inform policy frameworks for maritime human resource development aligned with STCW standards and the evolving demands of Indonesia's maritime sector. By clarifying the psychological and competency-based mechanisms through which practice-based teaching cultivates safety-oriented workforce readiness, this study aims to advance the Maritime Education and Training (MET) literature and address a critical gap in vocational maritime education research.

PRACTICE-BASED MARITIME SAFETY EDUCATION AND THE FORMATION OF COMPETENT, WORKFORCE-READY SEAFARERS

Practice-Based Teaching (PBT) has emerged as a central pedagogical approach in contemporary maritime education, particularly within safety-oriented training environments where authentic experience, performance demonstration, and reflection are indispensable for competency development. Conceptually, PBT positions practical activities, real-world simulations, and guided experiential learning at the core of instructional design, ensuring that learners engage directly with the kinds of safety-critical tasks they will encounter in the maritime workplace (Matsumoto-Royo & Ramírez-Montoya, 2021). This approach draws on principles of experiential learning, situated cognition, and apprenticeship-based instruction, thereby creating a structured bridge between theoretical safety knowledge and practical safety performance (Radović et al., 2021; Relly & Laczik, 2022).

Within maritime safety education, PBT is operationalized through the design of realistic emergency scenarios, the use of high-fidelity simulators such as fire-fighting trainers, damage control simulators, and advanced bridge simulators with emergency modules, and the integration of industry-standard safety equipment into training tasks (Ernstsen & Nazir, 2020). These learning environments allow students to perform tasks such as emergency decision-making, situational assessment, coordination under time pressure, and operational execution of safety procedures. They also provide opportunities for learners to receive structured feedback, refine techniques, and internalize safety protocols through repeated practice. Collaboration with industry partners further strengthens the

authenticity of practical training, ensuring that drills, safety exercises, and performance assessments reflect real operational expectations and STCW competency requirements (Veugen et al., 2021; Sellberg et al., 2021).

Through such intensive training design, PBT directly contributes to maritime workforce readiness (MWR), a construct encompassing the knowledge, skills, and attitudes required for effective performance in safety-critical shipboard roles. Workforce readiness is not merely a matter of theoretical understanding but reflects the extent to which graduates can operate safely and confidently under normal conditions and during emergency situations. Readiness incorporates technical safety capabilities—such as operating life-saving appliances, responding to fires, managing flooding, conducting man-overboard procedures, and complying with international conventions including STCW, ISM, and MARPOL—as well as non-technical factors such as safety communication, teamwork, hazard recognition, situational awareness, adaptability, stress tolerance, and professionalism (Sharma & Kim, 2022; Hetherington et al., 2006; Yashnikova, 2022). In both simulated and actual work environments, readiness manifests in students' ability to act decisively, responsibly, and in accordance with industry safety standards (Dewan & Godina, 2024; Mori & Manuel, 2024).

Central to the development of workforce readiness is Maritime Safety Competence (MSC), which comprises a holistic interplay of cognitive, psychomotor, and affective safety capacities. Cognitive components include knowledge of regulations, principles of emergency response, and risk management (Fan & Yang, 2023; IMO STCW Convention). Psychomotor components involve proficiency in operating fire-fighting equipment, conducting first aid and CPR, launching survival craft, performing search and rescue functions, and executing damage-control tasks such as shoring and dewatering (Angskun et al., 2024; Nikolic et al., 2024). Affective components include safety discipline, commitment to procedures, hazard awareness, and the willingness to intervene in unsafe situations. These elements are evaluated through standardized assessments, simulator exercises, practical demonstrations, and onboard evaluations (Milosz et al., 2024; Monib et al., 2025). Thus, competency-based curricula, realistic scenario training, and robust performance-based assessment systems are indispensable for translating instructional strategies into demonstrable safety capability (Padovano & Cardamone, 2024).

Collectively, these interlinked dimensions demonstrate that PBT functions as an integrated mechanism for cultivating seafarers who not only meet formal competency requirements but also possess the practical readiness, safety orientation, and decision-making maturity necessary for safe maritime operations. As maritime education institutions increasingly align instructional activities with international standards and industry needs, PBT serves as a foundation for both enhancing training relevance and ensuring that graduates enter the workforce with the technical competence and applied safety readiness demanded by a complex, high-risk environment (Vlachopoulos & Makri, 2024).

PSYCHOLOGICAL DRIVERS OF MARITIME SAFETY: SELF-EFFICACY, SAFETY MINDSET, AND THE DEVELOPMENT OF MARITIME SAFETY CULTURE

Beyond technical competence and practical proficiency, maritime safety performance is profoundly shaped by psychological and cultural factors, particularly Safety Self-Efficacy (SSE) and safety mindset two constructs that influence how individuals approach risk, make decisions during emergencies, and internalize safety responsibilities. Rooted in Bandura's social cognitive theory, self-efficacy refers to individuals' beliefs in their ability to perform goal-directed tasks successfully (Bandura, 1997; Ulfert-Blank & Schmidt, 2022). In maritime training environments, SSE reflects students' confidence in executing safety procedures, maintaining composure during crises, applying complex emergency protocols, and seeking assistance when necessary (Kim et al., 2021). Higher levels of SSE are associated with stronger engagement in training tasks, increased willingness to tackle challenging simulations, greater persistence under stress, and enhanced decision quality during emergency drills (Horcajo et al., 2022; Kaldheim et al., 2021).

The formation of SSE is influenced by mastery experiences gained through successful performance of safety tasks, vicarious learning through observation of peers or instructors, verbal encouragement from trainers, and regulation of emotional responses under pressure (Huang et al., 2020; Capron Puozzo & Audrin, 2021). These learning sources align naturally with the structure of practice-based teaching, suggesting that PBT not only strengthens technical competence but also reinforces psychological readiness for real-world safety situations. Empirical studies

indicate that safety self-efficacy plays a mediating role in translating competence into workplace performance, meaning that individuals with strong technical skills may still underperform in emergencies if they lack the confidence to act decisively (Su et al., 2024; Saville & Foster, 2021; Greenan, 2023).

Parallel to self-efficacy, the safety mindset represents a deep-seated cognitive and affective orientation toward safety as a core personal and professional value. A strong safety mindset includes beliefs about the importance of safety, attitudes toward risk, recognition of hazards, intrinsic motivation to prioritize safe actions, and commitment to compliance with protocols—even when operational pressures create incentives to cut corners (Reason, 1997; Dekker, 2014). In maritime settings, individuals with a strong safety mindset exhibit vigilance in detecting hazards, consistency in adhering to safety procedures, willingness to report near misses, and a sense of responsibility for their own safety and that of crewmates (Hetherington et al., 2006; IMO, 2018).

Safety mindset is closely intertwined with maritime safety culture, the collective system of norms, values, and practices that shape how crews and organizations conceptualize and enact safety (IMO ISM Code; Håvold, 2005). A robust safety culture is evidenced by open communication channels, non-punitive reporting systems, frequent and meaningful safety drills, leadership commitment to safety, empowerment of crew members to halt unsafe operations, and systematic learning from incidents (Zohar, 2010; Clarke, 2013; Oltedal & McArthur, 2011). Organizations with strong safety cultures consistently achieve lower accident and injury rates and higher compliance with international safety standards (Christian et al., 2009).

Within Maritime Education and Training (MET) environments, developing a strong safety mindset requires pedagogical strategies that extend beyond knowledge transmission. Students benefit from exposure to realistic emergency scenarios, structured debriefings after drills, analysis of maritime accident case studies, role modeling from experienced safety leaders, and mentoring relationships that reinforce a culture of responsibility and accountability (Sellberg et al., 2021; Munim et al., 2023). When safety mindset development is integrated into practice-based teaching, the result is a training environment that cultivates not only competent performers but safety-oriented professionals who internalize safety as a guiding principle throughout their maritime careers (Bandura, 1986; Zohar, 2010).

THEORETICAL MODEL AND ANALYTICAL FRAMEWORK

The present study develops a comprehensive theoretical model that links practice-based teaching (PBT) with maritime workforce readiness (MWR), emphasizing the centrality of safety-related competencies and psychological preparedness. Grounded in contemporary literature on maritime safety education, experiential learning, and seafarer development, the model proposes a series of hypotheses that capture both the direct and indirect relationships between the core constructs. Specifically, the model posits that PBT serves not only as a pedagogical driver of technical safety competence but also as a mechanism for shaping students' psychological readiness, particularly their safety self-efficacy. These capacities are expected to play mediating roles in transforming instructional interventions into demonstrable workforce readiness outcomes.

The first set of hypotheses conceptualizes PBT as a determinant of workforce readiness, maritime

safety competence, and safety self-efficacy, proposing positive and statistically significant effects across these pathways (H1–H3). This is consistent with prior findings indicating that authentic safety training, realistic emergency simulations, and performance-based assessment strengthen both technical proficiency and psychological preparedness among maritime students. The second set of hypotheses addresses the internal structural relationships between the mediators and the outcome variable, suggesting that maritime safety competence and safety self-efficacy each serve as predictors of maritime workforce readiness (H4–H5). The final hypotheses argue that these two mediators explain how and why PBT translates into enhanced readiness, thereby positioning maritime safety competence and safety self-efficacy as key psychological and skill-based mechanisms in the learning-to-performance process (H6–H7). Together, these hypotheses articulate an integrated causal framework in which pedagogical strategy, technical capacity, and psychological confidence interact to drive seafarers prepared in safety-critical maritime environments.

Table 1. Research Questionnaire.

No.	Variable	Indicator	Code
1	Practice-Based Teaching (Safety-Oriented) (Ernstsen & Nazir, 2020; Sellberg et al., 2021)	Frequency of safety-focused practice and emergency drills	PBT1
		Realistic emergency scenario simulations	PBT2
		Use of safety simulators & maritime safety equipment	PBT3
		Feedback and performance-based safety assessment	PBT4
2	Maritime Workforce Readiness (Safety Emphasis) (Sharma & Kim, 2022; Hetherington et al., 2006)	Technical and safety preparedness	MWR1
		Safety compliance & regulatory adherence	MWR2
		Emergency problem-solving and hazard recognition	MWR3
		Safety communication & teamwork in emergencies	MWR4
		Adaptability under safety-critical pressure & professionalism	MWR5
3	Maritime Safety Competence (IMO STCW; Fan & Yang, 2023)	Fire-fighting and damage control proficiency	MSC1
		Emergency equipment operation (lifeboats, life rafts, PPE)	MSC2
		First aid and medical emergency response	MSC3
		Safety monitoring, hazard identification & risk assessment	MSC4
		Safety documentation, reporting & regulatory compliance	MSC5
4	Safety Self-Efficacy (Kim et al., 2021; Bandura, 1997)	Efficacy in performing safety-critical tasks	SSE1
		Efficacy in emergency troubleshooting and decision-making	SSE2
		Efficacy in learning and applying safety procedures	SSE3
		Efficacy in maintaining performance under safety pressure	SSE4
		Efficacy in safety leadership and intervention	SSE5
		Efficacy in using safety resources and seeking help	SSE6

Source: Research Instrument (2025).

To empirically test the proposed model, the study adopts a causal-comparative quantitative approach utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM). This analytical technique is well suited for models involving serial mediation, multiple latent variables, formative and reflective constructs, and moderate sample sizes. Its non-reliance on strict multivariate normality assumptions further justifies its appropriateness for behavioral safety research within maritime education contexts. Through PLS-SEM, the study examines both the strength and significance of structural paths and evaluates the measurement quality of the survey instrument used to operationalize the latent constructions.

Data was gathered through a structured questionnaire consisting of twenty items distributed across four latent variables: practice-based teaching with a safety orientation, maritime workforce readiness with a safety focus, maritime safety competence, and safety self-efficacy. Each item was measured using a five-point Likert scale and developed based on established safety education literature, STCW safety competency standards, and recognized maritime safety frameworks. As summarized in Table 1, the indicators capture various dimensions of experiential safety learning, technical and non-technical components of workforce readiness, multi-faceted safety competence, and domain-specific efficacy beliefs. The instrument underwent a rigorous pilot test involving fifty students in comparable academic programmes to assess content validity, item clarity, and psychometric robustness. Reliability metrics—Cronbach’s α , rho_A, composite reliability (CR), and average variance extracted (AVE)—exceeded recommended thresholds, confirming high internal consistency and strong convergent validity across all constructs. None of the pilot items required deletion, and the instrument was therefore deemed suitable for the main data collection.

The primary sample consisted of 167 students enrolled in the Nautical Technology programme at Politeknik Pelayaran Sumatera Barat. Participants

were selected through purposive sampling based on their involvement in safety practicum activities, emergency drills, or related safety coursework. Demographic characteristics, presented in Table 2, show proportional representation across four cohorts and an expected distribution of gender for a maritime vocational institution. Data integrity and ethical compliance were ensured through the use of informed consent procedures and anonymized online distribution via Google Forms.

Following data collection, the dataset was imported into SmartPLS 3 for analysis. Preliminary assessments addressed collinearity risks by inspecting inner VIF values. Diagnostic results revealed VIF values generally below the 3.3 threshold, with two paths approaching but not exceeding the more conservative cutoff of 5. These findings support the conclusion that multicollinearity is not severe enough to undermine the structural estimates or inflate path coefficients. The model evaluation then followed established PLS-SEM procedures, including outer loading assessment, reliability estimation, AVE evaluation, and eventual structural path testing to validate the hypothesized relationships.

EVALUATION OF MEASUREMENT QUALITY AND CONSTRUCT DISTINCTIVENESS

The assessment of the measurement model demonstrates that the indicators and constructs employed in this study met and exceeded the quality benchmarks typically applied in PLS-SEM analyses. As shown in Table 3, all outer loadings for Practice-Based Teaching (PBT), Maritime Workforce Readiness (MWR), Maritime Safety Competence (MSC), and Safety Self-Efficacy (SSE) surpassed the conservative threshold of 0.70, supporting indicator reliability. Even the lowest loadings (e.g., PBT4 = 0.787; SSE1 = 0.723) remained within acceptable ranges, suggesting that no indicators warranted removal. These findings confirm that each item contributed meaningfully to its respective construct.

Table 2. Respondents Demographics.

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	120	71.85
	Female	47	28.15
Batch	VII	40	23.95
	VIII	54	32.33
	IX	24	14.37
	X	49	29.35
TOTAL		167	100

Source: Technology Nautical 2025/2026 Academic Year.

Table 3. Outer Loading Result.

Indicator	Practice-Based Teaching	Maritime Workforce Readiness	Maritime Safety Competence	Safety Self-Efficacy
PBT1	0.870			
PBT2	0.918			
PBT3	0.884			
PBT4	0.787			
MWR1		0.850		
MWR2		0.805		
MWR3		0.887		
MWR4		0.846		
MWR5		0.821		
MSC1			0.886	
MSC2			0.904	
MSC3			0.871	
MSC4			0.868	
MSC5			0.841	
SSE1				0.723
SSE2				0.879
SSE3				0.854
SSE4				0.777
SSE5				0.847
SSE6				0.826

Source: SEM-PLS Result Analysis.

Construct-level reliability and convergent validity outcomes further support the robustness of the measurement model. As displayed in Table 4, Cronbach's alpha values ranged from 0.888 to 0.923, composite reliability (CR) values ranged from 0.923 to 0.942, and average variance extracted (AVE) values ranged from 0.671 to 0.764. Collectively, these metrics confirm strong internal consistency and convergence for all constructs, consistent with recommended PLS-SEM quality criteria.

The Fornell–Larcker discriminant validity test (Table 5) also provided evidence that all constructs

were sufficiently distinct from one another. Although the correlation between MSC and SSE was relatively high ($r = 0.812$), the square root of SSE's AVE (0.819) remained marginally higher, satisfying the criterion but signalling a borderline case. This suggests that while competence and self-efficacy are conceptually related—as theory predicts—they nonetheless capture distinct psychological and performance-oriented facets of maritime safety behavior. Overall, the measurement model possesses sound psychometric integrity, allowing subsequent structural model interpretations to be made with confidence.

Table 4. Reliability & Validity Result.

Construct	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (AVE)
Practice-Based Teaching	0.888	0.899	0.923	0.750
Maritime Workforce Readiness	0.897	0.898	0.924	0.709
Maritime Safety Competency	0.923	0.924	0.942	0.764
Safety Self-Efficacy	0.902	0.909	0.924	0.671

Source: SEM-PLS Result Analysis.

Table 5. Fornell-Larcker Result.

Construct	Practice-Based Teaching	Maritime Workforce Readiness	Maritime Safety Competency	Safety Self-Efficacy
Practice-Based Teaching	0.866			
Maritime Workforce Readiness	0.749	0.842		
Maritime Safety Competency	0.575	0.747	0.874	
Safety Self-Efficacy	0.592	0.691	0.812	0.819

Note: Diagonal values (bold) are square roots of AVE; off-diagonal values are inter-construct correlations.
Source: SEM-PLS Result Analysis.

BUILDING A COMPETENCE-DRIVEN SAFETY MINDSET FOR STRENGTHENING INDONESIA'S MARITIME HUMAN RESOURCE DEVELOPMENT

The structural model results collectively demonstrate that strengthening Indonesia's maritime human resources relies fundamentally on embedding competence-driven, practice-based learning within maritime education systems. As shown in Table 6, the model exhibits strong predictive power for Maritime Workforce Readiness (MWR), with a high R^2 value of 0.713. This indicates that cadets' preparedness particularly their ability to respond effectively in safety-critical operational environments is shaped primarily by the quality of practical, hands-on learning they receive. Meanwhile, the explained variances for Maritime Safety Competence (MSC) ($R^2 = 0.331$) and Safety Self-Efficacy (SSE) ($R^2 = 0.351$) are moderate, suggesting that while scenario-based instruction is a major determinant of these outcomes, institutional factors such as instructor proficiency, onboard training infrastructure, and the broader safety culture of maritime academies also play essential roles. These findings reinforce Indonesia's ongoing human resource development agenda, which prioritizes experiential, competency-based maritime training to build a skilled and safety-oriented workforce.

Table 6. R-Square Result.

Construct	R Square	R Square Adjusted
Maritime Workforce Readiness	0.713	0.708
Maritime Safety Competency	0.331	0.327
Safety Self-Efficacy	0.351	0.347

Source: SEM-PLS Result Analysis.

The centrality of practical instruction becomes even more evident in the structural pathway analysis presented in Table 7, where Practice-Based Teaching (PBT) emerges as the most influential pedagogical factor in shaping cadets' safety mindset and operational capability. PBT demonstrates strong, statistically significant direct effects on MWR ($\beta = 0.749$, $p < 0.001$), MSC ($\beta = 0.575$, $p < 0.001$), and SSE ($\beta = 0.592$, $p < 0.001$). These large effect sizes ($f^2 = 0.465-0.541$) underline the pivotal role of hands-on, scenario-driven training in cultivating both technical competence and internalized safety values. Importantly, the downstream relationships reveal a crucial distinction: while MSC significantly predicts readiness ($\beta = 0.417$, $p < 0.001$), SSE does not ($\beta = 0.078$, $p = 0.322$). This pattern emphasizes that cadets' operational competence manifested

through skills in emergency response, hazard control, fire suppression, and survival craft operations is far more consequential for readiness than psychological confidence alone. Confidence without demonstrated skill may even be counterproductive in high-risk maritime settings.

Table 7. F-Square Result.

Path	f^2 Value	Effect Size
PBT → MWR	0.465	Large
PBT → MSC	0.495	Large
PBT → SSE	0.541	Large
MSC → MWR	0.198	Medium
SSE → MWR	0.007	Negligible

Source: SEM-PLS Result Analysis.

Hypothesis testing produced a clear pattern of effects supporting most of the proposed relationships. Practice-Based Teaching (PBT) has a strong, positive, and statistically significant direct effect on Maritime Workforce Readiness ($\beta = 0.749$; $t = 15.804$; $p < 0.001$), providing strong support for H1. PBT also exerts significant positive effects on Maritime Safety Competence ($\beta = 0.575$; $t = 7.935$; $p < 0.001$) and on Safety Self-Efficacy ($\beta = 0.592$; $t = 8.958$; $p < 0.001$), thereby supporting H2 and H3. The path from Maritime Safety Competence to Workforce Readiness is significant ($\beta = 0.417$; $t = 5.652$; $p < 0.001$), supporting H4 and confirming that demonstrable safety competence contributes substantively to workforce readiness. By contrast, the effect of Safety Self-Efficacy on Workforce Readiness is not significant ($\beta = 0.078$; $t = 0.992$; $p = 0.322$), leading to rejection of H5 and indicating that safety self-efficacy does not function as a direct predictor of readiness in this model. Indirect-effect analysis shows that mediation through Maritime Safety Competence (PBT→MSC→MWR) is significant (indirect $\beta = 0.240$; $t = 4.592$; $p < 0.001$), supporting H6 and confirming partial mediation. In contrast, mediation via Safety Self-Efficacy (PBT→SSE→MWR) is not significant (indirect $\beta = 0.046$; $t = 0.984$; $p = 0.326$), leading to rejection of H7. Consequently, the mediation hypothesis that includes safety self-efficacy is not supported.

These empirical results imply that Practice-Based Teaching primarily enhances workforce readiness by strengthening demonstrable technical safety competence, while increases in safety self-efficacy produced by PBT do not automatically translate into greater readiness without additional experiential or contextual support; additional interventions (such as onboard

training, mentoring, or authentic emergency experience) are therefore required to enable safety self-efficacy to effect observable improvements in safety-related job readiness. Hypothesis test results are reported in Table 8.

Table 8 shows that MSC significantly mediates the relationship between PBT and readiness (indirect $\beta = 0.240$, $p < 0.001$), whereas SSE does not (indirect $\beta = 0.046$, $p = 0.326$). This means that competence—not self-belief is the mechanism through which practice-based instruction translates into genuine safety readiness. Cadets internalize a safety mindset only when they repeatedly perform safety procedures under controlled, performance-verified conditions. This finding carries an important policy implication: strengthening the safety orientation of Indonesia’s maritime workforce requires prioritizing performance-based assessments and competency verification, rather than relying on self-perceptions of capability.

Taken together, insights from Table 6, Table 7, Table 8, and the relational structure depicted in Figure 1 highlight that PBT acts as the central driver shaping cadets’ safety knowledge, attitudes, and behaviors. By repeatedly engaging cadets in authentic maritime scenarios—ranging from high-stakes simulations and shipboard emergency drills to navigation challenges and equipment-handling exercises, institutions cultivate strong situational awareness and decision-making under operational pressure. Ultimately, readiness for maritime work, especially safety readiness, does not originate from theory-based instruction or from confidence alone. It emerges from demonstrated competence under realistic, practice-based conditions. This competency-driven approach is therefore essential for advancing Indonesia’s strategic goal of developing a professional, safety-conscious, and internationally competitive maritime workforce.

Table 8. Hypotheses Testing.

Hypothesis	Path	Original Sample (β)	Standard Deviation	T Statistics	P Values	Decision
H1	PBT → MWR	0.749	0.047	15.804	0.000	Supported
H2	PBT → MSC	0.575	0.073	7.935	0.000	Supported
H3	PBT → SSE	0.592	0.066	8.958	0.000	Supported
H4	MSC → MWR	0.417	0.074	5.652	0.000	Supported
H5	SSE → MWR	0.078	0.079	0.992	0.322	Not Supported
H6	PBT → MSC → MWR (indirect)	0.240	0.052	4.592	0.000	Supported
H7	PBT → SSE → MWR (indirect)	0.046	0.047	0.984	0.326	Not Supported

Source: SEM-PLS Result Analysis.

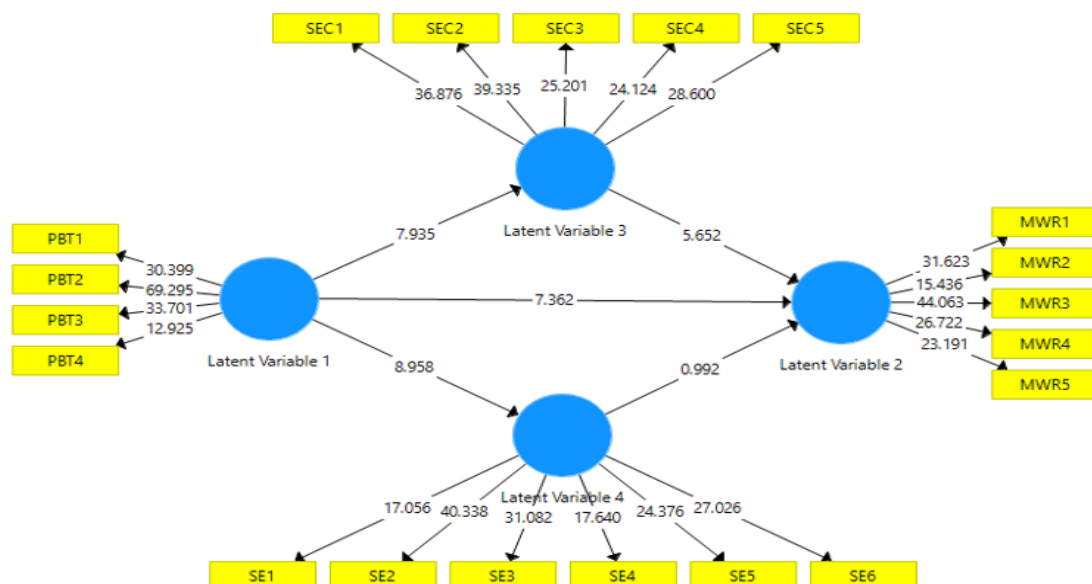


Figure 1. Research Path Model.

This study highlights the crucial role of Practice-Based Teaching in strengthening the safety mindset, safety competence, and overall readiness of Indonesia's future maritime workforce. While PBT substantially enhances readiness, competence, and self-efficacy, only competence directly predicts readiness and mediates the influence of instructional strategies on employability. Confidence, although improved through PBT, does not independently translate into operational readiness unless validated through performance in realistic environments. These findings emphasize that Indonesia's maritime human resource development must prioritize competency-driven, experiential, and safety-centered training to produce a workforce capable of contributing to national maritime safety and competitiveness.

POLICY IMPLICATIONS

To strengthen Indonesia's maritime human resource development, policy efforts should prioritize embedding a national framework that standardizes practice-based safety training across all maritime education institutions. Establishing clear requirements for simulator hours, emergency drills, and survival craft practice aligned with STCW competencies will help ensure consistent training quality, especially when supported by periodic audits and accreditation reviews. These standards must be complemented by sustained investment in high-fidelity training infrastructure, including advanced simulators, firefighting and damage-control facilities, survival craft training centers, and VR-based emergency response systems. Such facilities are essential for creating realistic learning environments where cadets can internalize safety procedures through repeated, authentic practice.

Equally important is the development of a robust performance-based assessment system that uses objective rubrics, certified assessors, and documented competency evidence to evaluate cadets' readiness. External moderation and industry validation can further enhance the credibility of assessment outcomes and ensure alignment with real operational demands. Strengthening shipboard learning environments is also critical, as structured safety drills, mentorship by qualified safety officers, and standardized logbooks help bridge the gap between classroom instruction and the realities of onboard operations. Close collaboration between maritime academies, shipping companies, classification societies, and port authorities will foster more integrated safety culture networks, harmonize expectations and

reinforce consistent safety values throughout the cadet training pipeline.

Enhancing instructor competence is another priority. Instructors must be equipped with advanced pedagogical skills in scenario-based teaching, hazard recognition, crisis management, and effective safety communication to maximize the impact of practice-based learning. Finally, sustained research support is necessary to deepen understanding of safety mindset development. Longitudinal studies that track cadets from pre-sea training through sea-time experience can provide valuable insights into how competence and self-efficacy evolve and how training systems can be further improved. By integrating these policy directions, Indonesia can strengthen both the competence and mindset dimensions of maritime safety, ensuring a professional, safety-oriented, and globally competitive maritime workforce.

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AUTHORS CONTRIBUTION STATEMENT

Soleh Uddin, as the lead author, was responsible for conceptualisation of the research problem and objectives, research design and methodology, development of the research instrument with safety focus, coordination of data collection, statistical analysis using PLS-SEM, interpretation of results, manuscript drafting and writing, and correspondence with the journal. Syafni Yelvi Siska served as co-author, contributing to methodology refinement and validation, instrument validation and pilot testing, data collection support and quality assurance, translation between Indonesian and English, critical review and editing of the manuscript, and interpretation of findings from a pedagogical practice perspective. Both authors have read and approved the final manuscript and accept responsibility for the accuracy and integrity of the work reported.

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