



Applied Research

Comparing Technology-Based and Conventional Assessment in Maritime English for Bridge Communication Competency

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Abstract: One of the essentials for safe navigation, particularly when interacting with other vessels, pilots, and Vessel Traffic Services (VTS), is effective communication on the ship's bridge. As the institution that produces seafarers, Maritime Education and Training (MET) plays an important role in preparing cadets' communication skills to communicate clearly and accurately in operational situations using Maritime English. Nevertheless, assessing the cadets' communication competence is more likely to be done through conventional classroom-based methods, which may not fully reflect the real communication demands on the bridge. This study intended to compare technology-based assessment and conventional classroom-based methods in assessing cadets' Maritime English skills related to bridge communication competency. The study employs a crossover experimental design involving fifty cadets from a maritime vocational program. The participants were assessed using two methods: technology-based and conventional classroom-based in listening, speaking, and reading. The study found that technology-based assessment produced significantly higher scores in listening and speaking, while no significant difference was observed in reading. Thus, the study indicates that technology-based assessment may be more effective for evaluating productive language skills essential for real-time bridge communication. Furthermore, cadets reported positive perceptions regarding the practicality and objectivity of technology-based assessment. The study suggests that a practical approach that integrates technology-based assessment into Maritime English is more effective for evaluating cadets' readiness to perform communication tasks on the bridge. The findings may have contributed to improvements in assessment practices in Maritime Education and Training programs that prepare future seafarers for safe and effective maritime communication.

Keywords: Bridge Communication; Communication Competency; Maritime Education and Training; Technology-Based Assessment

1. Introduction

One of the fundamental requirements for safe navigation and ship operation is effective communication. The officers on duty on the bridge of a vessel must be able to clearly exchange information with other ships, pilots, and Vessel Traffic Services (VTS) to avoid misunderstandings that could lead to

navigational incidents[1]. In modern ships, English has become the standard working language at sea because they have multinational crews. Based on this reason, Maritime English is a core component of Maritime Education and Training (MET) programs, and cadets are expected to demonstrate the ability to communicate accurately and efficiently in operational situations [2]

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The International Maritime Organization (IMO), as the international organization for maritime matters, has introduced the Standard Marine Communication Phrases (SMCP) for international bridge-to-bridge communication, ship-to-ship interaction, and communication with VTS. The communication phrases are designed to reduce ambiguity and ensure that essential information can be exchanged quickly and clearly[3]. In practice, bridge communication frequently involves interaction with Vessel Traffic Service (VTS), in which the officer on duty must report the vessel position, receive traffic information, and follow navigational instructions. [4]. The officers on watch are also required to exchange ship-to-ship navigation messages to coordinate passing arrangements, collision avoidance, and safe maneuvering in congested waters. Furthermore, communication during pilot boarding operations requires clear, standardized exchanges between the vessel and the pilot station to ensure safe pilot embarkation and navigation in port areas [5]. Therefore, the MET institution not only aims to develop general language proficiency but also to prepare cadets for real operational communication tasks on the bridge through the Maritime English subject [6][7]. In line with this context, cadets should be assessed for their communication competence as an important step in determining their readiness for professional duties at sea.

Despite the importance of communication competence, in many MET institutions, instructors assessing the cadets still rely mainly on conventional classroom-based tests and conventional scoring. Although such approaches remain useful, the bridge communication, which requires real-time listening, speaking, and decision-making, cannot be done through conventional classroom-based conventional assessment. It might also face challenges related to scoring consistency, time limitations, and the difficulty of simulating authentic communication scenarios. Given these limitations, the questions raised about conventional assessment methods are sufficient to evaluate cadets' readiness for real maritime communication situations.

To overcome this situation, educational technology has been increasingly introduced into maritime training institutions in recent years. Tools such as digital platforms, communication simulators, and computer-based testing systems have enabled the design of more interactive learning and assessment activities. These tools can provide an assessment with standardized task delivery, structured scoring procedures, and opportunities to simulate operational communication situations. Several studies in language education reveal that technology-supported assessment may improve scoring consistency and provide more practical ways to evaluate productive language skills, such as listening and speaking [8][9][10]. Nevertheless, there is little research on maritime communication training, which is mostly conducted in general English learning.

The existing studies have often examined need analysis, curriculum development, or the use of simulation in maritime training. The investigation into how different assessment approaches may influence the evaluation of cadets' communication competence is limited in scope. Specifically, there remains little empirical evidence comparing technology-based assessment with conventional assessment for measuring skills directly related to bridge communication[11][12].

The urgency of communication on the bridge depends heavily on listening and speaking skills, which is the gap that can be studied further. Cadets are required to have the ability in terms of understanding messages from VTS, respond clearly to instructions, and exchange navigational information with other vessels. MET institutions may struggle to determine whether cadets are truly prepared for real-world maritime work environments if assessment methods fail to capture these operational communication abilities[13][14].

For this reason, this study aims to compare the effectiveness of technology-based and conventional assessments in evaluating maritime cadets' English communication skills, particularly those related to bridge communication competency. A crossover experimental design was used to examine how

cadets perform in Listening, Speaking, and Reading when assessed through the two different methods. Focusing on the communication skills required in bridge operations, this study aims to provide empirical evidence on how assessment methods can better reflect the practical communication demands faced by future seafarers. The results of the study are expected to contribute to improving Maritime English assessment practices and to supporting MET institutions in preparing cadets for effective and safe communication at sea.

2. Materials and Methods

A quantitative approach using a crossover experimental design was employed in this study. Using this design, all participants experienced both assessment conditions through conventional assessment and technology-based assessment at different stages. This design was selected because it allows for within-subject comparison, reducing the influence of individual differences in language proficiency and increasing the reliability of the results[15]. This design is suitable for evaluating assessment methods in which the same learners are measured under different conditions to determine which approach better reflects their communication performance[16][17][18]. There were fifty maritime cadets enrolled in the Ship Operation Engineering Technology program at the Maritime Vocational Faculty of Universitas Hang Tuah who participated in this study. The cadets were purposively selected based on two criteria: prior completion of Maritime English courses and sufficient proficiency to participate in performance-based communication tasks. This selection ensured that participants could engage in simulated bridge communication activities relevant to real-world maritime operations.

There were three main types of materials used in this study. First, Maritime English Performance Tasks to reflect cadets' real bridge communication scenarios, including communication with Vessel Traffic Services (VTS), ship-to-ship navigation exchanges, and pilot boarding communication. These tasks were developed based on Standard Marine

Communication Phrases (SMCP) to ensure authenticity and relevance to operational communication. The tasks assessed three language skills: Listening, Speaking, and Reading. Second, Assessment Tools, Conventional assessment in which the instructor-based scoring using standardized rubrics focuses on accuracy, clarity, and appropriateness of communication. Technology-based assessment in which a digital assessment platform was used to deliver tasks, record responses, and support consistent scoring procedures, these platforms are Voice Threads and Wayground. Listening tasks were delivered through embedded audio files containing bridge communication scenarios based on Standard Marine Communication Phrases (SMCP). Speaking responses were recorded using participant's smartphones and uploaded through the assessment platform for later evaluation. Reading tasks were presented electronically and completed within a specified time limit. All participants completed the assessment individually under supervised classroom conditions using identical instructions and equipment specifications. Third, a structured five-point Likert-scale questionnaire was administered to cadets to measure their perceptions of reliability, fairness, practicality, and overall satisfaction with each assessment method.

The technology-based assessment incorporated an automated scoring feature designed to support, rather than replace, instructor evaluation. The assessment platform applied predetermined scoring criteria developed from the study rubric, including accuracy of responses, completion of task requirements, and appropriate use of Standard Maritime Communication Phrases (SMCP). For objective items, particularly in listening and reading tasks, scores were generated automatically by the system based on pre-established answer keys. For speaking tasks, the platform facilitated the scoring process by organizing recorded responses and applying rubric-based scoring parameters. The automated system provided preliminary scores based on predefined assessment indicators, however all speaking performances were

subsequently reviewed by Maritime English instructors to ensure that communication effectiveness, clarity of message delivery, pronunciation, and SMCP usage were evaluated appropriately. This combined approach was adopted to improve scoring consistency and reduce administrative workload while maintaining professional judgement in the evaluation of operational communication skills. The use of automatic scoring also minimized potential calculation errors and ensured that all participants were assessed using the same criteria. Therefore, technology-based assessment in this study should be understood as a technology-supported assessment system that combines automated scoring procedures with instructor verification to enhance both efficiency and scoring accuracy.

Tailored to the materials used in this study, the procedure was conducted in several stages. The first stage was preparation. At this stage, assessment tasks were developed around bridge communication scenarios, and scoring rubrics were validated. The second stage was the Implementation Stage, where the participants were divided into two groups. In the first phase, one group completed the assessment using the technology-based method, while the other group used the conventional method. In the second phase, the groups switched assessment methods. The fifty cadets were randomly assigned to two equal groups (Group A, $n = 25$; Group B, $n=25$). During phase 1 Group A completed the technology-based assessment while Group B completed the conventional assessment. After a two-week washout period, the groups exchanged assessment conditions. In Phase 2, Group A complemented the conventional assessment, and Group B completed the technology-based assessment. Random assignment was conducted using a computerized randomization procedure. The crossover design allowed each participant to serve as his or her own control, thereby reducing the influence of individual proficiency differences and improving internal validity.

Equivalent rather than identical task sets were used across assessment phases. Both versions were developed from the same

communication specification, difficulty level, and SMCP function, but employed different scenarios and wording. This approach minimized task familiarity and reduced potential practice effects associated with repeated testing. This ensured that all participants experienced both conditions. The third stage was data collection, during which performance scores were obtained from both assessment methods, followed by the administration of the perception questionnaire. The fourth stage was the Data Analysis Stage, in which data were analyzed using descriptive and inferential statistics. Normality and homogeneity tests were conducted to ensure the suitability of parametric analysis. Paired-sample t-tests were used to compare scores between the two assessment methods for each skill, while repeated-measures ANOVA was used to examine the overall effects of assessment method and skill type. Questionnaire responses were analyzed descriptively.

Several steps were taken to ensure the studies' validity and reliability. Content validity was addressed by designing tasks based on real maritime communication scenarios and SMCP standards. The use of parallel tasks across both assessment conditions ensured comparability of results. The crossover design strengthened internal validity by controlling individual differences among participants. Reliability was supported through standardized scoring rubrics in conventional assessment and consistent procedures in technology-based assessment. These measures allow readers to evaluate the appropriateness of the method and the trustworthiness of the findings.

3. Results

3.1 Maritime English Performance Task

The assessment tasks used in this study were designed to simulate real bridge communication scenarios to reflect cadets' operational readiness. These tasks included (1) communication with Vessel Traffic Services (VTS), where cadets were required to report vessel position and respond to navigational instructions, (2) ship-to-ship navigation exchanges involving collision avoidance and

passing arrangements, and (3) pilot boarding communication requiring coordination with pilot stations. All tasks were developed using the Standard Marine Communication Phrases

(SMCP) to ensure authenticity and alignment with real-world maritime communication practices. The tasks assessed three language skills: Listening, Speaking, and Reading.

Table 1. Maritime English Performance Tasks and Mean Scores Based on Bridge Communication Scenarios (N = 50 Cadets)

Type	Scenario	Comm. Context	Language Skills Assessed	Conven. Score	Tech. Based Score	Interpretation	Participants
Vessel Traffic Service (VTS) Communication	Cadets simulate communication with VTS operators to report vessel position, receive traffic information, and follow navigational instructions.	Bridge-to-shore (VTS interaction)	Listening, Speaking	73.20	82.10	Higher performance in technology-based assessment indicates improved comprehension and response accuracy in real-time communication	50
Ship-to-Ship Navigation Communication	Cadets perform communication between vessels to coordinate safe passing, collision avoidance, and maneuvering in congested areas.	Bridge-to-bridge communication	Listening, Speaking	74.10	85.30	Significant improvement shows stronger fluency and clarity in spoken navigation exchanges	50
Pilot Boarding Communication	Cadets simulate communication with pilot stations for boarding arrangements and port navigation procedures.	Ship-to-pilot communication	Listening, Speaking, Reading	70.80	74.20	Moderate improvement reflects stable performance, with reading supporting communication tasks	50

The analysis of 50 maritime cadets showed clear differences across skills and assessment modes. Under technology-based assessment, mean scores were highest for Speaking (M = 85.44), followed by Listening (M = 80.38), and Reading (M = 71.54). Reading also showed the greatest variability (SD ≈ 10.80), indicating more uneven performance among cadets. Score distributions

for Speaking and Listening were left-skewed, suggesting many cadets achieved high scores, while Reading was slightly right-skewed, indicating a wider spread of lower and higher performers. These patterns indicate that productive and auditory skills tend to cluster at higher performance levels when assessed with technology-supported tasks.

Table 2. Descriptive Statistics of Listening, Speaking, and Reading Skills (N=50)

Skill	N	Mean	Std. Deviation	Skewness	Interpretation
Listening	50	80.38	9.10	-0.62	Left-skewed; most cadets achieved high listening scores, indicating strong comprehension in communication tasks
Speaking	50	85.44	8.25	-0.75	Left-skewed; high concentration of strong performance in spoken communication
Reading	50	71.54	10.80	0.48	Slightly right skewed; wider variation in reading performance among cadets

A standardized assessment rubric was developed to ensure consistency, transparency,

and accuracy in scoring across both assessment methods. The rubric was aligned with the communication competencies required in bridge operations and focused on key Maritime English tasks, including Vessel Traffic Service (VTS) reporting, ship-to-ship communication, and pilot boarding communication. For listening and reading tasks, the rubric evaluated the cadets' ability to comprehend and interpret operational messages accurately. For speaking tasks, particular attention was given to the correct use of Standard Marine Communication Phrases (SMCP), fluency, intelligibility, and the appropriateness of responses in simulated maritime communication scenarios. The use of predetermined scoring criteria ensured that all participants were assessed using the same standards, thereby reducing subjectivity and improving the reliability of the assessment results.

Table 3. Maritime English Assessment Rubric for Bridge Communication Competency

Skill	Criteria	Score Range
Listening	Accuracy of message comprehension	0-25
Listening	Response appropriateness	0-25
Speaking	SMCP accuracy	0-25
Speaking	Fluency and intelligibility	0-25
Reading	Comprehension accuracy	0-50
Reading	Interpretation of navigational information	0-50

3.2 Assumption Testing

Normality testing using the Kolmogorov–Smirnov test indicated that residuals were normally distributed ($K-S = 0.082$, $p = 0.200$). Homogeneity of variance was also confirmed through Levene's tests across mean, median, adjusted median, and trimmed mean (all $p > 0.05$). These results support the use of parametric tests and indicate that comparisons between assessment methods are statistically appropriate and reliable.

Table 4. Kolmogorov–Smirnov Test for Normality ($N=50$)

Component	Value	Description
Sample Size (N)	50	Residual data tested
Mean Residual	0.000	Mean of standardized

Component	Value	Description
Standard Deviation of Residuals	0.979	residuals Dispersion of residuals
Extreme Difference (Absolute)	0.082	Maximum deviation from normal distribution
• Positive	0.043	Highest deviation in positive direction
• Negative	-0.082	Highest deviation in negative direction
Test Statistic ($K-S$)	0.082	Kolmogorov–Smirnov statistic
Significance (Asymp. Sig.)	0.200	$p > 0.05 \rightarrow$ residuals are normally distributed

To ensure that the data met the assumptions required for parametric statistical analysis, a homogeneity of variance test was conducted using Levene's test. This test examines whether the variance of scores is equal across different assessment conditions. The results, presented in Table 4, show that all significance values exceed 0.05 across different calculation bases, including mean, median, adjusted median, and trimmed mean. These findings indicate that the data satisfy the assumption of homogeneity of variance, confirming that the variability of scores is consistent across groups and that further parametric analyses are appropriate.

Table 5. Homogeneity Test (Levene's Test)

Basis of Test	Value	Interpretation
Mean	> 0.05	Variances are homogeneous
Median	> 0.05	Variances are homogeneous
Adjusted Median	> 0.05	Variances are homogeneous
Trimmed Mean	> 0.05	Variances are homogeneous

3.3 Comparison Between Assessment Methods

The paired-samples t-test analysis showed that technology-based assessment was associated with significantly higher performance in Listening and Speaking, while no significant difference was found in Reading. Positive performance gains were observed for Listening and Speaking under technology-based assessment, whereas Reading performance remained statistically unchanged. Confidence

intervals were obtained from paired-samples t-test analysis. Significant differences were found for Listening ($t = -4.018$, $p < .001$) and speaking ($t = -7.724$, $p < .001$), with higher mean scores achieved under technology-based assessment. In contrast, no significant difference was observed for Reading ($t = -0.189$, $p = .851$). The Reading analysis produced $df = 46$ because only 47 complete paired observations were available for both conventional and technology-based assessments. Three participants had incomplete Reading data in one assessment phase and were therefore excluded automatically from the

paired-samples analysis for Reading. The 95% confidence intervals for Listening and Speaking did not include zero, further confirming the significance of these differences, whereas the confidence interval for Reading included zero, indicating that the observed differences were not statistically meaningful. These findings suggest that technology-based assessment may be more effective in evaluating productive communication skills, particularly those involving listening comprehension and spoken interaction in maritime communication contexts.

Table 6. Paired Samples T-Test Results

Skill	Mean Conventional	Mean Technology-Based	Mean Difference	t	df	p-value	95% CI (Confidence Interval)
Listening	72.84	80.38	-7.54	-4.018	49	< .001	[-11.31, -3.77]
Speaking	73.96	85.44	-11.48	-7.724	49	< .001	[-14.47, -8.49]
Reading	70.36	70.81	-0.45	-0.189	46	.851	[-5.20, 4.30]

The ANOVA results indicate significant differences among language skill categories. The model explained approximately 24.6% of the variance in performance scores. The analysis revealed a significant effect of language skill on assessment performance, $F(4,293) = 14.640$, $p < .001$, indicating that cadets performed differently across Listening, Speaking, and Reading tasks. The model explained approximately 24.6% of the variance in scores ($R^2 = .246$), suggesting that language skills

contributed substantially to performance differences. When considered together with the paired-samples t-test results, the findings indicate that technology-based assessment appears to support the evaluation of Listening and Speaking more effectively than Reading. Therefore, the influence of assessment mode should be interpreted as skill-specific rather than as a universal advantage across all Maritime English competencies.

Table 7. ANOVA Results

Source of Variation	Sum of Squares	df	Mean Square	F	p-value	Interpretation
Language Skill (Aspect)	5060.286	4	1265.071	14.640	< .001	Significant
Error	25319.242	293	86.414	—	—	—
Corrected Model	8263.467	5	1652.693	19.125	< .001	Significant
R^2	.246	—	—	—	—	Model explains 24.6% of variance

Although accuracy did not differ significantly between methods overall, technology-based assessment demonstrated advantages in efficiency and consistency. The absence of

interaction effects suggests that technology-based assessment does not introduce bias toward any skill, allowing institutions to adopt it without disadvantaging learners.

Table 8. Effect on Accuracy and Efficiency

Factors	Effect on Accuracy (p-value)	Significance	Effect on Efficiency	Practical Implications
Assessment Method (Conventional vs. Technology)	p = . (not significant)	No difference	Technology may be faster	Choice based on operational needs
Skill Type	p = .000 (significant)	There is a big difference	-	Treat each skill differently
Interaction	p = . (not significant)	Consistence between methods	No bias between methods	No need to worry about method influence

3.4 Learner Perceptions

Cadets reported positive perceptions of technology-based assessment across all dimensions. Ease of use was rated high (M = 4.28), reliability (M = 4.10), and user satisfaction (M = 4.18). Efficiency received the highest rating (M = 4.35), indicating that cadets perceived the

system as faster and less stressful than conventional assessment. Respondents also emphasized the relevance of technology for their future careers (M = 4.40). These findings suggest that technology-based assessment is not only effective for measuring communication skills but also well accepted by learners.

Table 9. Questionnaire Results

Category	Mean Score	Interpretation	Likert Scale
Ease of Use	4.28	High (system easy and accessible)	1 = Strongly Disagree → 5 = Strongly Agree
Reliability	4.10	High (accurate, objective scoring)	1 = Strongly Disagree → 5 = Strongly Agree
Efficiency	4.35	Very High (fast and less stressful)	1 = Strongly Disagree → 5 = Strongly Agree
User Satisfaction	4.18	High (satisfaction and motivation)	1 = Strongly Disagree → 5 = Strongly Agree
Technological Implications	4.40	Very High (important for future readiness)	1 = Strongly Disagree → 5 = Strongly Agree

Overall, the results show that technology-based assessment is particularly effective for evaluating Listening and Speaking, which are essential for bridge communication tasks such as VTS interaction and ship-to-ship communication. Reading performance remains stable across methods, indicating that both approaches are equally suitable for assessing this skill. These findings support the use of technology-based assessment as a practical tool for evaluating cadets' readiness for real maritime communication.

4. Discussion

This study aimed to examine whether technology-based assessment provides a more effective way of evaluating maritime cadets'

English communication skills, particularly those required for bridge communication. The findings indicate that technology-based assessment better supports the evaluation of listening and speaking skills, which are essential for real-time communication in maritime operations. At the same time, reading performance remains relatively stable across assessment methods, suggesting that not all language skills are equally affected by technology use.

From a maritime training perspective, these findings are significant because bridge communication relies heavily on the ability to understand spoken messages and respond clearly under time pressure. The improved performance in listening tasks suggests that technology-based assessment may better simulate operational conditions, such as

receiving instructions from Vessel Traffic Services (VTS). Similarly, the higher speaking scores indicate that cadets perform more effectively when assessment tasks reflect realistic communication scenarios, such as ship-to-ship coordination or pilot boarding exchanges. This supports the idea that assessment methods should align closely with real operational communication demands.

The results also suggest that technology-based assessment may provide a more consistent evaluation of productive skills. In conventional assessment, speaking performance is often influenced by rater subjectivity and limited observation time. In contrast, technology-supported assessment allows for more structured task delivery and consistent scoring procedures. This may explain why cadets achieved higher and more stable scores in speaking when assessed through digital platforms. These findings are in line with previous studies in maritime education and communication research, which emphasize the importance of realistic simulation and standardized communication training in improving maritime safety.

In contrast, the absence of significant differences in reading performance indicates that receptive skills are less dependent on assessment mode. Reading tasks typically involve text-based comprehension that does not require real-time interaction, making them less sensitive to changes in assessment delivery. This suggests that conventional assessment methods remain appropriate for evaluating reading skills in Maritime English, and that technology-based assessment should be prioritized for skills that involve active communication.

Another important implication of this study relates to communication safety. Effective communication failures have been identified as a contributing factor in maritime incidents, particularly in situations involving VTS interaction and ship navigation. By improving the assessment of listening and speaking skills, technology-based assessments can help ensure that cadets are better prepared for operational communication tasks. This contributes to the broader goal of enhancing safety and efficiency in maritime operations.

Although the findings are generally consistent with existing research on technology use in language learning and maritime training, this study provides additional evidence from an ESP context that focuses specifically on bridge communication. Unlike many previous studies that focus on general language proficiency, this research highlights the importance of aligning assessment with professional communication requirements in maritime settings. This represents a practical contribution to Maritime Education and Training (MET), particularly in designing assessment systems that reflect real working conditions.

Notwithstanding its potential benefits, the implementation of technology-based assessment in Maritime English training is not without challenges. One important consideration is the varying level of digital literacy among cadets and instructors, which may influence their ability to use assessment platforms effectively. In addition, stable internet connectivity and adequate hardware, such as computers, headsets, and recording devices, are essential for ensuring smooth assessment delivery. Technical issues, including system interruptions, software malfunctions, or poor audio quality, may affect assessment performance and data collection. Furthermore, instructors may require additional training to manage digital assessment systems, interpret assessment outputs, and provide appropriate feedback. These factors suggest that the successful implementation of technology-based assessment depends not only on the assessment design itself but also on the availability of technological infrastructure, institutional support, and user readiness.

Despite these contributions, several limitations should be acknowledged. The study involved a relatively small sample size from a single institution, which may limit the generalizability of the findings. In addition, the study focused on simulated communication tasks rather than real onboard communication. Future research could expand this work by involving multiple MET institutions, incorporating simulator-based bridge training, or examining how assessment performance relates to actual communication performance at

sea.

Future studies may also explore the integration of technology-based assessment with full-mission bridge simulators to create more immersive and authentic evaluation environments. Investigating long-term effects of such assessment on cadets' communication performance during sea training or onboard practice would provide valuable insights for both educators and policymakers. These directions would further strengthen the role of assessment in supporting maritime communication competency and operational safety.

5. Conclusions

This study examined the effectiveness of technology-based assessment in evaluating Maritime English skills related to bridge communication competency. The findings indicate that technology-based assessment showed significant advantages in assessing Listening and Speaking skills, with cadets achieving higher scores than in conventional assessment. These skills are particularly important for operational communication tasks such as Vessel Traffic Service (VTS) reporting, ship-to-ship communication, and pilot boarding coordination. In contrast, no significant difference was found in Reading performance, suggesting that reading comprehension is less influenced by the assessment mode.

The results suggest that technology-based assessment may be especially beneficial for evaluating communication skills that require real-time message comprehension and response. At the same time, conventional assessment remains a suitable approach for assessing reading competencies. Therefore, the selection of assessment methods should consider the specific language skills being evaluated and the communication demands of maritime operations.

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