

The Effect of LMS-Based Hybrid Learning on Seafarer Upgrading Training Participants' Satisfaction through Technology Acceptance and Digital Literacy at BP2TL Jakarta

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Abstract

This study aims to analyze the effect of implementing Learning Management System (LMS)-based hybrid learning on the satisfaction of Level III, IV, and V seafarer upgrading training participants at the Jakarta Sea Transportation Education and Training Center (BP2TL Jakarta), with technology acceptance and digital literacy as mediating variables. This study uses a quantitative approach with an explanatory research design. The research population consisted of 172 participants divided into the Nautical Officer and Marine Engineering programs at Levels III, IV, and V. The sample was determined using a stratified random sampling technique based on the criteria of Hair et al. (2021), with a minimum of 150 respondents, and 163 valid questionnaires were successfully collected. Data were analyzed using the Structural Equation Modeling–Partial Least Square (SEM-PLS) method with the help of SmartPLS software. The results show that the implementation of LMS-based hybrid learning has a positive and significant effect on technology acceptance, digital literacy, and training participants' satisfaction. Digital literacy was also proven to have a positive and significant effect on training participants' satisfaction, while technology acceptance had no significant effect on training participants' satisfaction. The mediation analysis further shows that digital literacy significantly mediates the relationship between LMS-based hybrid learning and training participants' satisfaction, whereas technology acceptance does not demonstrate a significant mediating role. This pattern indicates that digital literacy provides a partial mediation mechanism because LMS-based hybrid learning remains directly associated with training participant satisfaction. These findings indicate that the success of LMS-based learning is not only determined by participants' acceptance of technology but is more determined by participants' ability to effectively utilize digital technology to support the learning process. This study implies that BP2TL Jakarta needs to continue improving the quality of its LMS, strengthening participants' digital literacy, and developing a more flexible, interactive hybrid learning model that suits the needs of seafarer training participants.

Keywords: hybrid learning, learning management system, technology acceptance, digital literacy, training participant satisfaction

Introduction

The maritime sector plays a strategic role in supporting the smooth distribution of goods and trade activities, given that most of Indonesia's export value is transported by sea (Emo & Mira, 2024; Suheri et al., 2024). This high dependence on sea transportation demands the availability of competent and professional seafarers in accordance with the

international standards set out in the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Convention (Ghosh et al., 2025; Yi et al., 2025). The need for competent maritime human resources continues to grow along with the increasing complexity of the shipping industry and shipping companies' demands for seafarers who are adaptive to technological developments (Caesar, 2023; Sudewo et al., 2025).

The Jakarta Sea Transportation Education and Training Center (BP2TL Jakarta) is one of the Technical Implementation Units under the Ministry of Transportation responsible for organizing seafarer upgrading education and training programs, including Levels III, IV, and V, so that participants meet the competency standards set by the International Maritime Organization (IMO). Before the implementation of hybrid learning, the learning process at BP2TL Jakarta was still conducted conventionally through full face-to-face instruction, a condition that posed an obstacle for participants who still had shipboard work responsibilities or limited time to attend classes in person. As a Public Service Agency, BP2TL Jakarta is also required to maintain participant satisfaction while encouraging continued participation in subsequent training levels, so a more flexible and adaptive learning innovation is needed to meet participants' needs.

The development of information and communication technology has driven the transformation toward hybrid learning, a learning model that integrates face-to-face instruction with digital technology-based online learning (Radhakrishna, 2023; Gudoniene et al., 2025). This trend has strengthened further in the post-COVID-19 pandemic period, as many educational and training institutions adopted distance learning in response to restrictions on face-to-face activities (Ghafarshad & Sundarapandi, 2025). As the main infrastructure of hybrid learning, the Learning Management System (LMS) plays an important role in managing the delivery of materials, assignments, evaluation, and learning communication (Rofiuddin & Aulia, 2025; Elfitra et al., 2023), while also making it easier for participants to access materials anytime and anywhere (Al-Ataby, 2021). The International Maritime Organization has also emphasized the importance of strengthening distance learning and e-learning in seafarer education to maintain training quality in line with maritime competency demands (IMO, 2026).

Nevertheless, the success of implementing LMS-based hybrid learning is not solely determined by the availability of technology and digital infrastructure. The human factor, as the system's user, plays an important role in determining the effectiveness of technology utilization (Almaiah et al., 2020; Alomari et al., 2020). In practice, not all training participants respond to LMS use with the same level of satisfaction; some participants feel helped by the flexibility offered, while others experience technical and psychological difficulties in adapting to online learning (Ubaidah et al., 2026). This difference in response indicates that training participants' satisfaction needs to be evaluated more deeply by considering the mechanisms that explain how and to what extent technology can affect participants' learning experience.

One mechanism widely used to explain the success of learning technology adoption is technology acceptance, which, in the Technology Acceptance Model (TAM), is influenced by perceived usefulness and perceived ease of use (Or, 2024; Granić, 2022; Scherer et al., 2019). Research by Chen et al. (2023) shows that technology acceptance plays an important role in shaping learning satisfaction in a blended learning context, while Ajlouni et al. (2024) and Nuryakin et al. (2023) confirm that perceived usefulness and perceived ease of use are significantly related to user satisfaction with digital learning systems. Research by Yin et al.

(2024) also shows that technology acceptance is related to learning satisfaction in virtual learning environments, while Aldiabat et al. (2024) prove that synchronous and asynchronous learning affect e-learning user satisfaction.

In addition to technology acceptance, digital literacy is also an important factor in technology-based learning, namely an individual's ability to access, understand, evaluate, and communicate effectively through digital media. Research by Adegbore et al. (2023) shows that digital literacy is significantly related to LMS use among postgraduate students, while Imtihan et al. (2025) confirm that digital literacy plays an important role in strengthening technology utilization and user experience with digital systems. These findings show that the success of digital learning is determined not only by LMS availability but also by users' readiness to accept technology and their digital literacy skills. The two mechanisms represent conceptually different pathways. Technology acceptance reflects whether participants perceive the LMS as useful, manageable, and appropriate for supporting their learning activities, whereas digital literacy reflects whether participants possess the practical capability to navigate, understand, and effectively exploit the digital learning environment. Thus, participants may accept the technology without necessarily being sufficiently capable of using its features and digital resources to obtain an optimal learning experience.

Although various previous studies have examined the relationship between hybrid learning, LMS, technology acceptance, and digital literacy, most of these studies have focused on formal education contexts such as universities with general student subjects. However, the context of seafarer vocational education and training has significantly different characteristics, as participants are required to apply their competencies practically in a dynamic and high-risk work environment, and have heterogeneous backgrounds in work experience, age, and technology readiness. Research that simultaneously positions technology acceptance and digital literacy as mediating variables in the relationship between LMS-based hybrid learning and training participants' satisfaction is still relatively limited, especially in the maritime vocational training context, indicating a research gap that underlies this study. Examining these mechanisms in maritime vocational education is particularly important because digital learning must not only be accepted by participants but must also support competency development for occupations characterized by practical tasks, strict professional standards, and high operational risk.

LMS-Based Hybrid Learning and Technology Acceptance

The implementation of LMS-based hybrid learning provides participants with repeated exposure to digital learning features, including access to materials, assignment submission, assessment activities, and online interaction. According to the Technology Acceptance Model, direct experience with a system can strengthen perceptions of usefulness and ease of use, which in turn shape users' acceptance of the technology (Or, 2024; Granić, 2022; Scherer et al., 2019). In a hybrid learning environment, participants are able to experience the practical benefits of the LMS, particularly greater flexibility in accessing learning resources and managing learning activities. Chen et al. (2023) and Nuryakin et al. (2023) indicate that perceived usefulness and ease of use contribute to positive responses toward technology-supported learning. Accordingly, a well-implemented LMS-based hybrid learning system is expected to strengthen participants' acceptance of the technology.

H1: LMS-based hybrid learning has a positive and significant effect on technology acceptance.

LMS-Based Hybrid Learning and Digital Literacy

LMS-based hybrid learning requires participants to actively engage with digital platforms rather than merely receive learning materials passively. Through repeated interaction with the LMS, participants practice accessing digital information, navigating online features, communicating through digital media, and managing electronic learning resources. Such activities may gradually strengthen participants' ability to use technology effectively. Adegbore et al. (2023) highlight the relationship between digital literacy and LMS utilization, while Imtihan et al. (2025) emphasize the importance of digital capabilities in strengthening users' experience with digital systems. In the maritime training context, continuous exposure to an LMS can therefore serve not only as a delivery mechanism but also as an environment through which participants develop their digital competence.

H2: LMS-based hybrid learning has a positive and significant effect on digital literacy.

LMS-Based Hybrid Learning and Training Participant Satisfaction

Hybrid learning combines the flexibility of online learning with the direct interaction offered by face-to-face instruction. This combination can improve participants' learning experiences by reducing limitations associated with time and location while maintaining opportunities for direct guidance and practical interaction. These advantages are particularly relevant for seafarer upgrading training participants, many of whom may have work responsibilities and high occupational mobility. Chen et al. (2023) demonstrate that blended learning experiences are associated with learning satisfaction, while Aldiabat et al. (2024) show that synchronous and asynchronous learning arrangements contribute to satisfaction with e-learning. Therefore, when LMS-based hybrid learning offers accessible materials, flexible learning arrangements, and effective interaction, participants are expected to report higher satisfaction with the training process.

H3: LMS-based hybrid learning has a positive and significant effect on training participant satisfaction.

Technology Acceptance and Training Participant Satisfaction

Technology acceptance represents participants' perception that the LMS is useful and sufficiently easy to operate. When participants perceive a digital learning platform as useful for achieving learning objectives and manageable during learning activities, they are more likely to interact with the system with less technological resistance and frustration. Previous research suggests that technology acceptance contributes to learning satisfaction in blended and virtual learning environments (Chen et al., 2023; Ajlouni et al., 2024; Yin et al., 2024). Nuryakin et al. (2023) similarly show that perceived usefulness and perceived ease of use are important determinants of users' responses to online learning systems. Therefore, stronger acceptance of the LMS is expected to contribute to a more positive learning experience and greater participant satisfaction.

H4: Technology acceptance has a positive and significant effect on training participant satisfaction.

Digital Literacy and Training Participant Satisfaction

Digital literacy enables participants to use LMS functions, obtain and evaluate digital information, communicate through online learning platforms, and independently resolve routine difficulties encountered in technology-supported learning. Participants with stronger

digital literacy are therefore likely to experience fewer operational barriers and to derive greater benefits from digital learning resources. Adegbore et al. (2023) identify digital literacy as an important factor associated with LMS utilization, while Imtihan et al. (2025) indicate that users' digital capabilities strengthen their experience in interacting with digital systems. In the context of hybrid seafarer training, participants who are better able to exploit digital learning resources should be more capable of participating effectively in the learning process, thereby increasing their satisfaction.

H5: Digital literacy has a positive and significant effect on training participant satisfaction.

The Mediating Role of Technology Acceptance

Technology acceptance may provide a perceptual mechanism through which LMS-based hybrid learning influences participant satisfaction. Hybrid learning exposes participants to the functionality and benefits of the LMS, which can strengthen perceptions that the system is useful and manageable. These positive perceptions may subsequently reduce resistance toward technology and facilitate a more comfortable learning experience. Thus, the contribution of LMS-based hybrid learning to satisfaction may occur not only directly through flexibility and accessibility but also indirectly through participants' acceptance of the learning technology. This mechanism is consistent with the logic of TAM, in which perceived usefulness and ease of use shape favorable responses toward technology-supported activities (Or, 2024; Granić, 2022; Scherer et al., 2019), while previous studies have linked technology acceptance with learning satisfaction (Chen et al., 2023; Ajlouni et al., 2024; Yin et al., 2024). H6: Technology acceptance mediates the relationship between LMS-based hybrid learning and training participant satisfaction.

The Mediating Role of Digital Literacy

Digital literacy represents a capability-based mechanism that may explain how LMS-based hybrid learning translates into participant satisfaction. The implementation of hybrid learning creates repeated opportunities for participants to operate LMS features, interact with digital materials, communicate online, and manage technology-supported learning activities. These experiences may strengthen digital literacy, enabling participants to use the learning environment more effectively and with fewer difficulties. In contrast to technology acceptance, which concerns participants' perceptions of the system, digital literacy concerns their actual capability to exploit the digital learning environment. Adegbore et al. (2023) and Imtihan et al. (2025) support the importance of digital competence in effective technology utilization and positive user experiences. Consequently, LMS-based hybrid learning may enhance satisfaction partly because it develops the capabilities participants need to derive greater value from digital learning.

H7: Digital literacy mediates the relationship between LMS-based hybrid learning and training participant satisfaction.

Method

This study uses a quantitative approach with an explanatory research design to analyze the relationship between the implementation of LMS-based hybrid learning, technology acceptance, digital literacy, and the satisfaction of Level III, IV, and V seafarer upgrading training participants at BP2TL Jakarta (Sugiyono, 2023). Primary data were collected through a five-point Likert-scale questionnaire distributed to training participants

who took part in LMS-based hybrid learning, while secondary data were obtained from BP2TL Jakarta's internal documents, training implementation reports, and various literature relevant to the research topic.

The research population consisted of 172 seafarer upgrading training participants divided into the Level III Nautical Officer program (37 participants), Level III Marine Engineering program (35 participants), Level IV Nautical Officer program (21 participants), Level IV Marine Engineering program (21 participants), Level V Nautical Officer program (34 participants), and Level V Marine Engineering program (24 participants). This heterogeneous population characteristic led to the use of a stratified random sampling technique, in which samples are drawn randomly from each stratum according to its population proportion, so that each participant group is proportionally represented in the research sample. The sample size was determined based on the criteria of Hair et al. (2021) for SEM-PLS analysis, namely a minimum of 5 to 10 times the number of research indicators. With 30 indicators used to measure the research variables, the minimum sample size set was 150 respondents (30×5). After the data collection process, 163 questionnaires met the criteria and could be processed, so the number of respondents used exceeded the required minimum sample size.

This study involves four variables: Implementation of LMS-Based Hybrid Learning (X) as the exogenous variable; Technology Acceptance (Z1) and Digital Literacy (Z2) as mediating variables; and Training Participant Satisfaction (Y) as the endogenous variable. The Implementation of LMS-Based Hybrid Learning variable describes the application of a learning model that integrates face-to-face instruction with LMS-based learning. Technology Acceptance describes the level of participants' acceptance of learning technology based on perceived usefulness, ease of use, and social environment support. Digital Literacy describes participants' ability to use digital technology effectively, understand digital information, and interact through digital media. Training Participant Satisfaction describes participants' level of satisfaction with the learning materials, methods, interaction, facilities and learning media, and the benefits gained from the training.

Data analysis was carried out using the Structural Equation Modeling–Partial Least Square (SEM-PLS) method with the help of SmartPLS software. Before testing the model, a Kruskal-Wallis difference test was conducted to determine differences in perception among training levels, given that the data did not meet the normality and homogeneity assumptions required for the parametric One-Way ANOVA test. Next, the measurement model (outer model) was evaluated to test convergent validity (outer loading > 0.70 and Average Variance Extracted/AVE > 0.50), discriminant validity (cross loading), and construct reliability (Cronbach's Alpha and Composite Reliability > 0.70). The structural model (inner model) was evaluated through the coefficient of determination (R-Square) and hypothesis testing using the bootstrapping procedure, with the criterion that a hypothesis is accepted if the t-statistics value is greater than 1.96 or the p-value is less than 0.05 (Hair et al., 2021).

Results and Discussion

The object of this study is BP2TL Jakarta, one of the Technical Implementation Units under the Transportation Human Resources Development Agency that organizes Level III, IV, and V seafarer upgrading training programs for the Nautical Officer and Marine Engineering programs. In line with the need for learning flexibility for participants with high work

mobility, BP2TL Jakarta implements a hybrid learning model that integrates face-to-face instruction with LMS-based online learning.

Table 1. Respondent Characteristics (n = 163)

Characteristic	Category	Number (People)	Percentage (%)
Age	< 25 years	49	30.1
	26–30 years	44	27.0
	31–35 years	25	15.3
	36–40 years	20	12.3
	> 40 years	25	15.3
Training Level	Level III	68	41.7
	Level IV	40	24.5
	Level V	55	33.7
Study Program	Nautical Officer	87	53.4
	Marine Engineering	76	46.6
Total		163	100.0

Source: Primary Data, Processed by Researcher (2026)

Based on age characteristics, most respondents were in the under-25-years age group, namely 49 people or 30.1%, followed by the 26–30-years age group with 44 people or 27.0%, while the 31–35-years and over-40-years age groups each numbered 25 people or 15.3%. This distribution shows that the research respondents came from a fairly diverse age range, although dominated by participants under 30 years of age, indicating variation in participants' experience levels and career stages in undertaking technology-based learning.

Based on the training level attended, most respondents were Level III seafarer upgrading training participants, numbering 68 people or 41.7%, followed by Level V participants with 55 people or 33.7%, while Level IV participants numbered 40 people or 24.5%. Based on study program, respondents from the Nautical Officer program numbered 87 people or 53.4%, while participants from the Marine Engineering program numbered 76 people or 46.6%. This composition shows that both competency fields were relatively well represented in proportion to their population, so the research results can provide a more comprehensive picture of the implementation of LMS-based hybrid learning in seafarer education and training.

Descriptive Analysis of Variables

Table 2. Descriptive Statistics of Research Variables

Variable	Mean	Category
LMS-Based Hybrid Learning Implementation (X)	4.28	Very High
Technology Acceptance (Z1)	4.26	Very High
Digital Literacy (Z2)	4.24	Very High
Training Participant Satisfaction (Y)	4.27	Very High

Source: Primary Data, Processed by Researcher (2026)

All research variables were in the very high category based on Arikunto's (2022) interval criteria. The LMS-Based Hybrid Learning Implementation variable obtained the highest average score on the indicator of ease of accessing materials anytime and flexibility of study time (mean = 4.35), while the indicator of ease of communicating with instructors through the LMS obtained a relatively lower score (mean = 4.18), indicating room for strengthening interaction features. The Technology Acceptance variable shows that the ease of using the LMS was the most dominant indicator (mean = 4.33), while support from the learning environment obtained a relatively lower score (mean = 4.23). For the Digital Literacy variable, the ability to utilize LMS features and collaborate through digital platforms obtained the highest score (mean = 4.26), while the ability to understand material in digital form obtained the lowest score (mean = 4.20). Meanwhile, the Training Participant Satisfaction variable shows that the benefit of training in improving knowledge received the highest rating (mean = 4.34), while the attractiveness of the learning method received a relatively lower score (mean = 4.20). Overall, these findings show that participants gave very positive assessments of the implementation of LMS-based hybrid learning at BP2TL Jakarta, although the aspects of interaction and variation in learning methods still have room for further development.

Kruskal-Wallis Difference Test

Table 3. Kruskal-Wallis Difference Test Results Across Training Levels

Variable	Kruskal-Wallis H	df	Asymp. Sig.	Description
LMS-Based Hybrid Learning Implementation	6.556	2	0.038	Significantly different
Technology Acceptance	5.171	2	0.075	Not significantly different
Digital Literacy	4.658	2	0.097	Not significantly different
Training Participant Satisfaction	2.018	2	0.365	Not significantly different

Source: Primary Data, Processed by Researcher (2026)

The Kruskal-Wallis test results show that only the LMS-Based Hybrid Learning Implementation variable exhibited a significant difference in perception across training levels (Asymp. Sig. = 0.038 < 0.05), indicating that participants at Levels III, IV, and V had different experiences and assessments of the implementation of LMS-based learning, likely influenced by variations in work experience and the intensity of technology use at each level. In contrast, the Technology Acceptance (Asymp. Sig. = 0.075), Digital Literacy (Asymp. Sig. = 0.097), and Training Participant Satisfaction (Asymp. Sig. = 0.365) variables showed no significant differences across training levels, indicating that technology acceptance, digital literacy, and participant satisfaction levels were relatively consistent across all levels of the seafarer upgrading training program at BP2TL Jakarta.

Outer Model

Table 4. Construct Validity and Reliability Test Results (Outer Model)

Variable	Outer Loading	Cronbach's Alpha	Composite Reliability	AVE
LMS-Based Hybrid Learning Implementation	0.788–0.893	0.945	0.954	0.722
Technology Acceptance	0.849–0.903	0.942	0.954	0.775
Digital Literacy	0.883–0.940	0.960	0.968	0.834
Training Participant Satisfaction	0.863–0.925	0.974	0.977	0.808

Source: Primary Data, Processed by Researcher (2026)

The outer model test was conducted to assess the validity and reliability of the research constructs. All indicators in each variable had outer loading values above 0.70, so all indicators were declared to meet the convergent validity criteria. The Average Variance Extracted (AVE) value for each construct ranged from 0.722 to 0.834, well above the minimum value of 0.50, meaning each construct was able to explain more than 50% of its indicators' variance. Discriminant validity testing through cross loading shows that all indicators had the highest loading values on their respective measured constructs compared to other constructs, so all constructs were declared to have good discriminant validity, with no overlapping measurement between constructs.

The reliability test results show that all variables had Cronbach's Alpha and Composite Reliability values above 0.70, with the highest values found in the Training Participant Satisfaction variable (Cronbach's Alpha = 0.974; Composite Reliability = 0.977). Thus, all constructs in this study were declared valid and reliable, making them suitable for use in structural model (inner model) testing.

Inner Model and Hypothesis Testing

Table 5. R-Square Values of Endogenous Variables

Endogenous Variable	R-Square	Description
Technology Acceptance	0.831	Strong
Digital Literacy	0.712	Moderate to strong
Training Participant Satisfaction	0.861	Strong

Source: Primary Data, Processed by Researcher (2026)

The R-Square value for the Technology Acceptance variable was 0.831 (strong category), meaning that the implementation of LMS-based hybrid learning is able to explain 83.1% of the variation in technology acceptance. The R-Square value for the Digital Literacy variable was 0.712 (moderate-to-strong category), showing that the implementation of LMS-based hybrid learning is able to explain 71.2% of the variation in digital literacy. Meanwhile,

the R-Square value for the Training Participant Satisfaction variable was 0.861 (strong category), meaning that the implementation of LMS-based hybrid learning, technology acceptance, and digital literacy together are able to explain 86.1% of training participant satisfaction, while the remaining 13.9% is explained by other factors outside this research model. These results indicate that the research model has good explanatory power for the three endogenous variables.

Hypothesis testing was carried out through the bootstrapping procedure, with the criterion that a hypothesis is accepted if the t-statistics value is greater than 1.96 and the p-value is less than 0.05. The path coefficient hypothesis testing results are presented in Table 6.

Table 6. Hypothesis Testing Results (Path Coefficient)

Hypothesis	Variable Relationship	Original Sample	T-Statistics	P-Values	Description
H1	Hybrid Learning → Technology Acceptance	0.912	49.919	0.000	Accepted
H2	Hybrid Learning → Digital Literacy	0.844	27.430	0.000	Accepted
H3	Hybrid Learning → Training Participant Satisfaction	0.320	2.344	0.019	Accepted
H4	Technology Acceptance → Training Participant Satisfaction	0.187	1.421	0.155	Rejected
H5	Digital Literacy → Training Participant Satisfaction	0.461	5.361	0.000	Accepted

Source: Primary Data, Processed by Researcher (2026)

Mediation Effect Testing

In addition to examining the direct relationships among the research variables, this study also tested the mediating roles of technology acceptance and digital literacy in the relationship between LMS-based hybrid learning and training participant satisfaction. The mediation analysis was conducted by examining the specific indirect effects through the bootstrapping procedure. An indirect effect is considered significant when the t-statistics value exceeds 1.96 and the p-value is below 0.05.

Table 7. Mediation Hypothesis Testing Results (Specific Indirect Effects)

Hypothesis	Variable Relationship	Original Sample	T-Statistics	P-Values	Description
H6	Hybrid Learning → Technology Acceptance → Training Participant Satisfaction	0.171	1.420	0.156	Rejected
H7	Hybrid Learning → Digital Literacy → Training Participant Satisfaction	0.389	5.260	0.000	Accepted

Source: Primary Data, Processed by Researcher (2026)

Discussion

The Effect of LMS-Based Hybrid Learning Implementation on Training Participants' Technology Acceptance

The test results show that the implementation of LMS-based hybrid learning has a positive and significant effect on training participants' technology acceptance (original sample = 0.912; t-statistics = 49.919; p = 0.000), so H1 is accepted. This finding is consistent with the Technology Acceptance Model (TAM), which explains that technology acceptance is shaped by perceived usefulness and perceived ease of use (Or, 2024; Granić, 2022). In the context of seafarer training, LMS use gives participants direct experience in accessing materials and interacting through digital platforms, thereby shaping the perception that the LMS is useful and easy to use. This result reinforces the findings of Chen et al. (2023), who emphasize the important role of technology acceptance in the success of blended learning, as well as Nuryakin et al. (2023), who show that perceived usefulness and ease of use shape users' positive attitudes toward online learning. This finding indicates that BP2TL Jakarta needs to continue strengthening the quality of LMS implementation, in terms of ease of access, clarity of the learning flow, and instructor support, so that participants' technology acceptance continues to increase.

The Effect of LMS-Based Hybrid Learning Implementation on Training Participants' Digital Literacy

The test results show that the implementation of LMS-based hybrid learning has a positive and significant effect on training participants' digital literacy (original sample = 0.844; t-statistics = 27.430; p = 0.000), so H2 is accepted. Continuous LMS use encourages participants to become more accustomed to operating digital devices, accessing online information, and communicating through digital media, thereby gradually improving participants' technical, cognitive, and social skills in utilizing technology. This finding is consistent with Adegboire et al. (2023), who show a significant relationship between LMS use and digital literacy skills among postgraduate students. In the context of BP2TL Jakarta, digital literacy skills are crucial because participants come from diverse work experience and technology readiness backgrounds, so the implementation of LMS-based hybrid learning helps participants adapt to a more flexible and structured learning system.

The Effect of LMS-Based Hybrid Learning Implementation on Training Participants' Satisfaction

The test results show that the implementation of LMS-based hybrid learning has a positive and significant effect on training participants' satisfaction (original sample = 0.320; t-statistics = 2.344; $p = 0.019$), so H3 is accepted. Flexibility in study time, ease of access to materials, and the integration of face-to-face and online learning provide a learning experience that better suits the needs of seafarer participants, who generally have high work mobility. This finding is consistent with Chen et al. (2023), who show a positive relationship between blended learning and learning satisfaction, as well as Aldiabat et al. (2024), who prove that both synchronous and asynchronous learning affect online learning system user satisfaction. This study extends these findings to the context of seafarer education and training, which has different characteristics from general formal education, and confirms that BP2TL Jakarta needs to continue maintaining the quality of LMS implementation in order to sustain and improve participant satisfaction.

The Effect of Technology Acceptance on Training Participants' Satisfaction

The test results show that technology acceptance has no significant effect on training participants' satisfaction (original sample = 0.187; t-statistics = 1.421; $p = 0.155$), so H4 is rejected. This finding is interesting because, descriptively, technology acceptance is in the very high category (mean = 4.26), yet this high level of acceptance does not automatically differentiate satisfaction levels among participants. This condition can be explained by the relatively homogeneous technology acceptance among participants, so that the variation in technology acceptance becomes too small to explain the variation in satisfaction. These results indicate that seafarer training participants' satisfaction is determined more by the quality of the material, learning methods, interaction with instructors, and the perceived benefits of training, rather than by technology acceptance alone. This finding is not entirely consistent with Ajlouni et al. (2024) and Yin et al. (2024), but is in line with Ratnasari et al. (2025), who show that not all TAM components directly affect e-learning user satisfaction. The implication is that BP2TL Jakarta needs to direct its satisfaction-improvement strategy not only toward ease of LMS use but also toward the quality of a more tangible learning experience relevant to seafarers' competency needs.

The Effect of Digital Literacy on Training Participants' Satisfaction

The test results show that digital literacy has a positive and significant effect on training participants' satisfaction (original sample = 0.461; t-statistics = 5.361; $p = 0.000$), so H5 is accepted and represents the largest direct path of influence on satisfaction among the three predictors. Participants who are able to use digital devices, access information effectively, and utilize online learning features tend to have a smoother and more comfortable learning experience. This finding is consistent with Adegbore et al. (2023) and reinforced by Imtihan et al. (2025), who show that digital literacy plays an important role in strengthening technology utilization and digital system user experience, as well as Yin et al. (2024), who confirm the relationship between users' ability to utilize technology and digital learning satisfaction. In the context of BP2TL Jakarta, whose participants are heterogeneous in terms of age and technology experience, strengthening digital literacy is an important strategy to ensure that all participants can obtain optimal benefits from LMS-based learning.

The Mediating Role of Technology Acceptance in the Relationship between LMS-Based Hybrid Learning and Training Participant Satisfaction

The mediation test indicates that technology acceptance does not significantly mediate the relationship between LMS-based hybrid learning and training participant satisfaction (original sample = 0.171; t-statistics = 1.420; $p = 0.156$), so H6 is rejected. Although LMS-based hybrid learning strongly increases participants' technology acceptance, the increased acceptance does not necessarily translate into higher satisfaction. This result is consistent with the direct-effect findings, in which hybrid learning has a strong and significant effect on technology acceptance, whereas technology acceptance itself does not significantly affect participant satisfaction.

This finding suggests that participants' willingness to accept and use the LMS is not sufficient to explain how hybrid learning generates satisfaction. In the context of seafarer upgrading training, participants may perceive the LMS as useful and relatively easy to operate, but their satisfaction is likely to depend more strongly on the actual learning experience, including the relevance of training materials, flexibility of learning, interaction with instructors, and the extent to which the learning process supports their professional competency needs. Therefore, technology acceptance appears to function more as a prerequisite for participating in LMS-based learning than as a psychological mechanism that directly converts hybrid learning experiences into satisfaction.

The finding also provides an important qualification to the Technology Acceptance Model. While TAM explains why individuals are willing to accept and use a technological system, technology acceptance does not necessarily guarantee satisfaction with the broader learning experience. This result differs from studies reporting a stronger relationship between technology acceptance and learning satisfaction (Chen et al., 2023; Ajlouni et al., 2024; Yin et al., 2024), but supports the argument that satisfaction in technology-supported learning may depend on factors extending beyond perceived usefulness and ease of use. For BP2TL Jakarta, this means that improving LMS usability alone may not be sufficient to increase participant satisfaction. Greater attention should be directed toward learning quality, instructor interaction, relevant digital content, and the integration of online and face-to-face learning activities.

The Mediating Role of Digital Literacy in the Relationship between LMS-Based Hybrid Learning and Training Participant Satisfaction

The mediation test shows that digital literacy significantly mediates the relationship between LMS-based hybrid learning and training participant satisfaction (original sample = 0.389; t-statistics = 5.260; $p = 0.000$), so H7 is accepted. LMS-based hybrid learning provides participants with continuous opportunities to access digital materials, operate LMS features, communicate through online platforms, and manage learning activities digitally. These experiences strengthen participants' digital literacy, which subsequently contributes to a more effective and satisfying learning experience.

The significant indirect effect indicates that the benefits of LMS-based hybrid learning are not generated solely by providing greater flexibility or access to learning resources. Hybrid learning also develops participants' capacity to use digital technology effectively, and this capability becomes an important mechanism through which satisfaction is created. Participants with stronger digital literacy are more capable of navigating LMS features, accessing and understanding digital learning materials, participating in online

activities, and overcoming minor technological difficulties independently. As a result, they are more likely to experience the hybrid learning process as convenient, useful, and satisfying.

This result is consistent with Adegbore et al. (2023), who emphasize the importance of digital literacy in LMS utilization, and Imtiyan et al. (2025), who demonstrate that users' digital capabilities contribute to a more positive experience with technology-based systems. The finding also extends previous digital learning research by demonstrating that digital literacy functions not only as an individual capability but also as a mechanism connecting the implementation of hybrid learning with participant satisfaction in maritime vocational education and training.

Because the direct relationship between LMS-based hybrid learning and training participant satisfaction remains significant ($\beta = 0.320$; $p = 0.019$), while the indirect relationship through digital literacy is also significant ($\beta = 0.389$; $p = 0.000$), digital literacy can be interpreted as providing partial mediation. This means that LMS-based hybrid learning improves participant satisfaction both directly and indirectly by strengthening participants' digital literacy. Interestingly, the indirect effect through digital literacy is larger than the direct effect, suggesting that the development of participants' capability to effectively use digital technology represents an important mechanism underlying the success of LMS-based hybrid learning at BP2TL Jakarta.

From a practical perspective, BP2TL Jakarta should therefore complement LMS development with systematic efforts to strengthen participants' digital literacy. Short LMS orientation sessions, practical guidance before training, accessible technical assistance, and digital learning tutorials could be particularly valuable for participants with different ages, occupational backgrounds, and levels of technological experience. Strengthening digital literacy will allow participants not merely to access the LMS, but to use its learning resources more effectively, thereby maximizing the benefits of hybrid learning and enhancing overall training satisfaction.

Conclusion

This study shows that the implementation of Learning Management System (LMS)-based hybrid learning plays an important role in shaping technology acceptance, digital literacy, and the satisfaction of Level III, IV, and V seafarer upgrading training participants at BP2TL Jakarta. The implementation of LMS-based hybrid learning was proven to have a positive and significant effect on technology acceptance and digital literacy, showing that ease of access to materials, flexibility of study time, and interaction support through the LMS can increase participants' technology acceptance as well as their digital literacy skills. The implementation of LMS-based hybrid learning also has a direct positive and significant effect on training participants' satisfaction, confirming that the integration of face-to-face and online learning can provide a more flexible learning experience that suits participants' needs. However, technology acceptance was not proven to have a significant effect on training participants' satisfaction, indicating that technology acceptance has not yet become a major determinant of satisfaction, while digital literacy was proven to have a positive and significant effect on participant satisfaction, with the largest direct contribution among the predictor variables. Overall, the findings of this study confirm that the success of LMS-based learning in maritime vocational education and training is not solely determined by the availability of technology or its acceptance by users, but is more determined by the extent to

which participants are able to effectively utilize digital technology to support competency achievement and a satisfying learning experience.

Based on these findings, BP2TL Jakarta is advised to continue improving the quality of LMS-based hybrid learning implementation, including by developing more interactive learning features, improving the quality of digital materials, and strengthening communication features such as discussion forums and online consultation, given that the aspect of communication between participants and instructors through the LMS still has room for improvement. Given that digital literacy was proven to be the most determining factor for participant satisfaction, BP2TL Jakarta needs to strengthen digital literacy programs through LMS-use training before learning begins, provide easy-to-understand technical guides, and offer mentoring for participants who experience difficulties, with special attention to the ability to understand learning materials in digital form. Given that technology acceptance has no direct effect on satisfaction, satisfaction-improvement strategies should be directed toward the quality of a more tangible learning experience, such as material relevance, variation in learning methods, and the intensity of instructor interaction, rather than solely toward ease of technology acceptance. Instructors also need to improve the quality of learning interaction, both directly and through the LMS, so that participants gain an active and communicative learning experience. For future researchers, it is recommended to add other variables that could potentially affect the satisfaction of technology-based learning participants, such as system quality, service quality, learning motivation, learning engagement, and self-efficacy, in order to gain a more comprehensive understanding of the successful implementation of LMS-based learning in the context of maritime vocational education and training.

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