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The application of on training monitoring digital model for effectiveness maritime cadets on board training activities

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Abstract: Effective monitoring of On-Board Training (OBT) activities is essential in maritime seamanship education to ensure cadets develop the necessary competencies and problem-solving abilities. Traditional monitoring methods often lack real-time tracking, structured feedback, and comprehensive evaluation; therefore, there is a need for an On-Training Monitoring Application model. On-Training Monitoring is a digital monitoring application designed to improve training supervision, structured feedback, and evaluation of cadet performance during OBT. This study aims to assess the On-Training Monitoring application to enhance cadets' competence and problem-solving abilities during OBT. The research is based on experiential learning theory and competency-based training models, which emphasize real-time monitoring, systematic feedback, and data-driven evaluation as key factors in improving training outcomes. This study employed a quantitative approach involving maritime cadets and instructors undergoing OBT. Data were collected through a structured survey and system logs from the On-Training Monitoring application. Statistical analysis techniques included descriptive statistics, correlation analysis, and t-tests to evaluate the effectiveness of On-Training Monitoring in improving training outcomes. The results indicated that On-Training Monitoring was able to enhance competency development by providing real-time monitoring and structured feedback, which positively impacted the improvement of problem-solving skills among cadets. The findings offer valuable insights for maritime education institutions regarding the integration of digital monitoring tools such as On-Training Monitoring to improve training supervision and competency assessment. This research contributes to maritime training literature by introducing On-Training Monitoring as an innovative digital monitoring application and demonstrating its effectiveness in improving cadet competencies and problem-solving skills through data-driven training evaluation.

Keywords: *Competence, Digital application, Maritime cadet, on board training, Problem solving.*

1. Introduction

In the world of higher education, especially in the maritime and aviation fields, On Board Training (OBT) plays a very important role. This experience not only aims to improve cadets' technical skills but also sharpen their competence and problem-solving abilities. However, the evaluation process during the training period is often a challenge. An accurate assessment of a Cadet's performance during on-board training can affect the perception of the quality of education received [1]. On board training and simulation play an important role in maritime and aviation higher education, enhancing both technical and non-technical skills. Evaluation of Cadet performance during this training is challenging but critical to assessing the quality of education [2].

Current monitoring and assessment systems are often limited to manual reports, which are sometimes ineffective in providing quick and comprehensive feedback [3]. This can lead to a gap between Cadets' expectations of training and actual outcomes. Although on-board training plays an important role in improving Cadets' skills in the maritime field, there is no specific application available in Indonesia to monitor Cadets' activities during on-board training [4]. It is in this context

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that it is important to develop an application that can effectively monitor Cadet progress during on-board training and provide real-time assessment of critical aspects such as competence and problem-solving ability [5].

Recent research highlights the importance of developing a web-based application to monitor and evaluate Cadet activities in higher education. The application is called the On Training Monitoring (On Training Monitoring) application. The system aims to replace paper-based manual processes with a more efficient digital solution. Such applications can effectively track maritime Cadets' performance, competencies, internships, and organizational engagement. They provide real-time access to information for Cadets, faculty, and staff, enabling collaborative monitoring and timely feedback. Web-based monitoring systems can also generate accurate reports on Cadet achievements and activities, reducing administrative costs and increasing efficiency. In addition, the integration of mobile technologies, especially Android-based applications, can improve accessibility and user experience [6].

The urgency of developing monitoring applications in higher education is increasing along with the need for a clear and efficient evaluation process. Cadets have to learn various technical and non-technical skills related to future jobs during on-board training [7]. It is convenient to monitor training activities in real-time with applications such as On Training Monitoring. This not only allows academic lecturers to provide quick and precise feedback, but also ensures that Cadets receive appropriate guidance throughout the training process. In addition, applications like this help higher education institutions maintain academic standards, especially in the maritime industry, which requires highly specialized skills. An integrated monitoring system allows colleges to measure cadet performance more thoroughly to ensure that cadets are achieving academic competencies and goals. The application also increases administrative productivity and reduces manual report errors [8].

This research focuses on developing the On Training Monitoring Application as an innovative and integrated evaluation tool. This application is designed to facilitate the assessment of key aspects of competence and problem solving that directly contribute to the level of cadet satisfaction with educational services during on board training. In addition, the use of technology in facilitating evaluation can be a step forward in improving the standard of vocational education in Indonesia. The difference between this research and previous studies is that the On Training Monitoring Application is the first innovation developed and actually used in monitoring and assessing on-board training digitally and in real-time. There is no similar application specifically designed for the needs of seafaring higher education in Indonesia, so the development and implementation of On Training Monitoring presents a new solution that contributes significantly to the digitization of maritime vocational education evaluation.

Based on the background and problem formulation that have been compiled, this study aims to: (1) Describe the procedure for developing an effective On Training Monitoring Application to support on board training according to the needs of Cadets and supervisors, (2) Analyze the effectiveness of using the On Training Monitoring application in improving Cadets' competence during on board training, (3) Analyze the improvement of Cadets' problem solving skills after using the On Training Monitoring Application. With the presence of the On Training Monitoring Application, it is hoped that a more interactive, transparent, and responsive learning ecosystem can be created, so that cadets feel more valued and involved in the process of self-development in an effective and efficient education and training process.

2. Materials and Methods

2.1. Development of on Training Monitoring Digital Application Model

In the growing digital era, the use of technology in the world of vocational education is an inevitable need. In the context of maritime education, On Board Training (OBT) is an important component in the formation of Cadet competencies [9]. However, the monitoring and evaluation system of Cadets during the on-board training period often faces various obstacles, ranging from difficulties in documentation, limited communication, to the lack of transparency in assessment. To

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overcome these problems, the on training Monitoring Application was developed as a digital solution that aims to increase the effectiveness and efficiency of the cadet monitoring process on board. On Training Monitoring application is designed as a technology-based platform that allows instructors, academic supervisors, and cadets to interact in a more transparent, systematic, and real-time monitoring system. With this system, cadets can more easily report their progress, while instructors can provide direct feedback that is faster and more structured. The use of web-based or mobile applications in maritime education is no longer just an innovation, but a necessity in improving the quality of learning [10].

The on Training Monitoring app serves as a digital evaluation tool that overcomes some of the key constraints of a manual reporting system. Some of the key benefits of the app include: (1) Real-Time Monitoring with On Training Monitoring, instructors can see the cadets' progress in real time, including task achievements, difficulties encountered, and competencies mastered. (2) Data-driven evaluation, the system enables automatic data collection and analysis, so that evaluation reports are more accurate and can be used to improve learning methods. (3) More effective interaction, Cadets can ask questions or report obstacles faced directly through the system, which will facilitate communication with academic supervisors or instructors. (4) Integrated data storage, all reports, evaluation records, and feedback are stored in a digital database, so they can be accessed at any time without the risk of data loss as in paper-based manual systems [11].

2.2. Main Characteristics and Features of on Training Monitoring Digital Application Model

As a technology-based monitoring system, on Training Monitoring has several key features designed to improve the effectiveness of the on board Training process, including: (1) Interactive Dashboard that provides an integrated view that allows Cadets, instructors, and institutions to view training progress data, (2) Competency Assessment System, where this feature allows instructors to provide assessment of Cadets' technical skills based on completed tasks. (3) Digital Performance Reporting by Cadets by uploading daily/weekly reports, (4) Online Instructor Feedback and Guidance, allowing for more efficient two-way communication. (5) Integration with Maritime Education System, (6) Data Security and System Accessibility, ensuring that only authorized parties can access certain information.

The on training Monitoring application is a digital innovation designed to improve the effectiveness of the Cadet monitoring system during onboard training. With advanced features such as real-time monitoring, data-driven evaluation, direct interaction with instructors, and integration with other maritime education systems. Previous research shows that application-based digital systems have successfully improved learning effectiveness, evaluation transparency, and cadet engagement in various educational contexts [12].

2.3. The Concept of Competence in Cadets

Competence is a multidimensional concept that includes basic, general, academic, vocational, and professional abilities. Competence is strongly correlated among various components, such as knowledge, skills, values, and attitudes, which are reflected in one's habits of thinking and acting, and one's personal qualities [13]. In the context of education, professional competence refers to a broad and deep mastery of learning materials, including mastery of the curriculum and scientific substance. Competence is generally defined as a combination of skills, knowledge, attributes, and behaviors that enable a person to perform certain tasks or activities in a particular job [14].

Cadet competency development can be done through education, training, and experience according to the required level. Cadet competence is a fundamental concept in education and training, encompassing academic knowledge, practical skills, attitudes, and behaviors [15]. In maritime education, competencies include higher-order thinking skills, such as application, analysis, evaluation, and creativity. Competency-based training is key in facing the demographic bonus and labor transformation. The effectiveness of training can be measured through evaluation, providing feedback

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for companies to improve human resource competencies [16].

The competency development process involves planning, implementation, and evaluation, with training needs analysis as an important first step. Effective training can increase employee productivity and help them work more effectively and efficiently [17]. In the era of globalization and rapid technological development, competence is increasingly considered a key indicator of an individual's success in adapting to a dynamic work environment. Education and training must be designed to develop competencies that are relevant and in line with industry needs, so that graduates are not only ready for their chosen jobs but also able to innovate and contribute to the progress of the organization. An understanding of competence also includes the importance of continuous evaluation to ensure that Cadets can measure and improve their competence over time. In the context of the On Training Monitoring application, the measurement of Cadet competencies during on-board training is crucial to ensure that Cadets not only acquire knowledge but are also able to apply it in real situations, making them better prepared to face future professional challenges [18].

2.4. Problem-Solving Ability of Cadets

Problem-solving ability is a crucial skill in education and everyday life, involving processes of analysis, reasoning, and evaluation to overcome challenges. The process of identifying problems and finding practical solutions to overcome them is known as Problem Solving [19]. Therefore, everyone can develop creative ideas to overcome difficulties. Problem solving is an ability that includes the ability to seek information, analyze conditions, and recognize problems to develop alternatives to enable appropriate decision making to achieve the desired goals [20].

The steps of problem solving involve various levels of cognitive abilities, ranging from remembering and understanding to analyzing and evaluating [21]. A strategy often used in mathematics learning is the problem-solving model, which provides systematic steps to guide students in the problem-solving process [22]. The importance of problem-solving skills in an educational context lies in their ability to shape critical and creative thinking patterns among Cadets. Through learning that encourages problem solving, Cadets are encouraged to think analytically, consider multiple perspectives, and develop innovative solutions. In the context of On Training Monitoring (On Training Monitoring) applications, good problem-solving skills can be evaluated and enhanced through structured training, ensuring that Cadets are not only technically but also mentally prepared for the challenges ahead [23].

2.5. Relationship between on Training Monitoring Application Role, Competence, and Problem-Solving Ability in Cadets

2.5.1. The Role of on Training Monitoring Application for Cadet Competence Improvement

The on training monitoring application plays a very strategic role in improving Cadet competence during the training process, especially in the context of on-board training. By providing an intuitive digital platform, On Training Monitoring enables Cadets to conduct real-time monitoring and evaluation of their progress. This facility not only makes it easier for Cadets to access information about training activities but also provides immediate feedback that is crucial for self-development [24]. Through features within the app, such as skills and competency assessments, Cadets can actively measure their abilities in various aspects, from technical knowledge to soft skills. The app also encourages Cadets to participate in a more proactive learning process, where they are encouraged to set personal goals, monitor progress, and reflect on their learning experience [25]. This makes Cadets more accountable for their learning, thus increasing motivation and desire to improve.

In addition, On Training Monitoring Model also provides instructors with a useful tool to monitor the cadets' overall performance. With integrated data, instructors can identify the strengths and weaknesses of each Cadet more accurately, allowing for more targeted guidance [26]. In this context, the app not only serves as an evaluation tool but also as an interactive tool that strengthens communication between Cadets and instructors, thus creating a more collaborative learning

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environment. As such, the On Training Monitoring app is not just a tool to monitor training activities, but also an effective catalyst in the Cadet competency development process. By utilizing this technology, Cadets can significantly improve skills and knowledge, better preparing themselves for the challenges in an increasingly complex professional world [26].

2.5.2. The Role of on Training Monitoring Application for Cadet Problem-Solving Ability Enhancement

The on training Monitoring Application Model has great potential in training and enhancing Cadets' problem-solving abilities, which are essential skills in the professional world. Through the interactive features provided, On Training Monitoring can be an effective tool to encourage Cadets to deal with various challenges that arise during the on-board training process. By presenting real-life scenarios that require critical analysis and informed decisions, the app creates an environment that supports the development of problem-solving skills [27]. One of the ways the app exercises problem-solving skills is by providing relevant and situational case studies. Cadets can be exposed to a variety of situations that require analytical thinking and resolution strategies. Through simulations and specially designed tasks, Cadets not only learn how to recognize problems, but are also trained to evaluate various alternative solutions and select the most effective approach [28].

The instant feedback provided by the app also helps Cadets in understanding their mistakes and honing their reflective skills. On Training Monitoring facilitates collaboration between cadets in solving problems [29]. The discussion or forum feature in the app allows cadets to exchange ideas and perspectives, enriching their learning experience [30]. When Cadets work together in groups to solve problems, they learn from each other and develop interpersonal skills that support collective problem-solving abilities. With this approach, On Training Monitoring serves not only as a monitoring tool but also as an active and dynamic learning platform. Thus, this application contributes significantly to preparing Cadets to face complex and diverse challenges in the world of work, making them more prepared and competitive in an ever-evolving industry [31].

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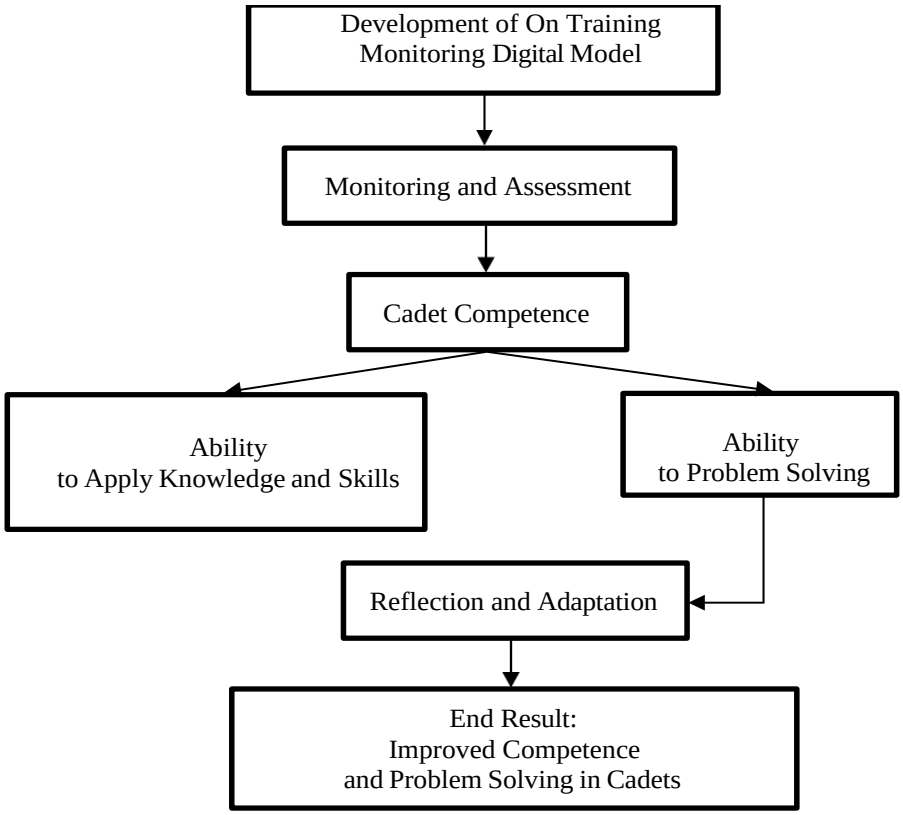

Figure 1.
Diagram of Research Framework.

2.6. Hypothesis

H_1: The use of the On Training Monitoring Application model significantly improves Cadet competence during on-board training.

H_2: The use of the On Training Monitoring Application model significantly improves the problem-solving ability of Cadets during on-board training.

With the formulation of the hypothesis, this study aims to explore and analyze how the use of the On Training Monitoring application significantly contributes to the improvement of competence and problem-solving skills in Cadets during the implementation of on-board training. In the context of maritime vocational education, technical and non-technical competencies are important elements that must be possessed by Cadets to face the dynamics of work on board. The use of On Training Monitoring is expected to overcome the limitations of manual monitoring systems through the provision of digital reporting, real-time monitoring, and immediate feedback that can increase cadet engagement in the learning process. In addition, On Training Monitoring also serves as a supporting medium for reflective learning, where Cadets are encouraged to identify problems, analyze situations, and devise solutions systematically. Therefore, this research not only tests the effectiveness of the application from the technical side but also maps the relationship between the use of On Training Monitoring, increased competence, and strengthening problem-solving skills. The results of this research are expected to provide theoretical and practical contributions to the development of digital-based vocational education systems, as well as a reference for shipping education institutions in designing learning strategies that are more adaptive, responsive, and integrated with the needs of the maritime industry.

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2.7. Research Method

2.7.1. Research Variables

In this study, there are several main variables described with operational definitions as follows:

2.7.1.1. Independent Variables

1. Use of the On Training Monitoring Application

Operational definition: Utilization of the On Training Monitoring application by cadets and instructors during OBT. Measurement technique: User survey and application activity log analysis. Indicators: Frequency of use, monitoring features used, user satisfaction, and effectiveness of feedback.

2.7.1.2. Dependent Variable

2. Cadet competence

Operational definition: Cadets' technical and non-technical competences acquired and improved during OBT.

Measurement technique: Assessment of competence by the instructor using the competency rubric.

Indicators: Technical and non-technical competence evaluation scores, improvement in skills during the training period.

2.8.1.3. Problem-Solving Ability

Operational definition: Cadet's ability to identify, analyze, and solve problems that arise during OBT. Measurement technique: Direct assessment by the instructor and analysis of Cadet reports.

Indicators: Quality of problem identification, effectiveness of proposed solutions, collaboration in problem solving, and response to feedback.

2.8.1.4. Population and Sample

The population in this study was all cadets of the Nautical and Engineering study programs who were undergoing on-board training on various ships in semesters V and VI, and Lecturer Instructors at the Nautical and Engineering Study Programs. The number of cadets included in this population is 80. The research sample was taken by purposive sampling, where researchers selected cadets who had completed at least one month of on-board training.

2.9. Place and Time of Research

This research was conducted at Semarang Maritime Polytechnic, Indonesia with the consideration that this institution is one of the leading maritime education institutions in Indonesia, which has adequate infrastructure and long experience in organizing On Board Training (OBT). The research implementation time was designed within a period of 12 months, starting from the application development stage, training on the use of the application for cadets and instructors, direct implementation of the On Training Monitoring application, to data collection, analysis, and evaluation of research results. The research was conducted from January to December 2024, taking into account the academic cycle and OBT implementation schedule at the institution.

2.10. Data Collection Techniques

Pre-test and post-test, the two main instruments in this study, were used to measure the competence and problem-solving ability of Cadets before and after using the On Training Monitoring (On Training Monitoring) application during on-board training on the ship. Data analysis techniques in this study included various statistical techniques to evaluate the effectiveness of the On Training Monitoring application. The following are the analysis methods used, namely (1) Descriptive Statistics, used to understand data distribution, mean, median, standard deviation, minimum, and maximum values of the research variables. (2) Pearson Correlation Analysis, used to measure the relationship between variables, such as the relationship between OBT monitoring and training

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evaluation or between feedback and competency improvement. (3) Paired T-Test was used to compare differences before and after the use of the On Training Monitoring application.

3. Result of Research

3.1. Analysis of on Training Monitoring Development

This research presents an analysis of the development of the On Training Monitoring application in improving the competence and problem-solving ability of Cadets in the context of On Board Training (OBT). The main focus of this research is to test the effectiveness of the On Training Monitoring application in supporting Cadets to better understand and apply knowledge and skills in real training settings. Whilst the results obtained provide a positive indication of the application, it is important to further question how such success relates to other factors that may contribute to Cadet proficiency.

Table 1.
Variable Descriptive Statistics.

Variable	Mean	Median	Std. Dev.	Min.	Max.
OBT Difficulty	4.25	4	1.66	2	7
OBT Preference	3.99	4	1.56	1	7
Before OBT	4.4	4	1.82	1	7
After OBT	6.5	7	1.19	2	7
OBT Monitoring	6.24	7	1.41	2	7
Problem-Solving OBT	4.16	4	1.71	1	7
Feedback	3.99	4	1.55	2	7
OBT Expectations	6.36	7	1.29	2	7
OBT Evaluation	3.53	4	1.14	1	5
OBT Guidance	6.15	7	1.47	2	7

Interpretation of Table 1.

a. OBT difficulty (4.25): Respondents on average experienced a "Medium" level of difficulty in On-Board Training (OBT).
b. OBT Preference (3.99): Preference for the training method varied, but tended to be neutral to positive.
c. Before vs. After OBT: The average rating before OBT was 4.40, while after OBT it increased to 6.50, indicating a significant increase in competence.
d. OBT Monitoring & Mentoring (6.24 & 6.15): Monitoring and guidance had a high average, indicating great attention from the instructor.
e. OBT Problem-Solving (4.16): Problem-solving skills are at a medium level, indicating there is still room for improvement.
f. OBT Feedback (3.99) & Evaluation (3.53): Ratings regarding feedback and evaluation were relatively neutral, indicating the need for improvement in the evaluation system.
g. OBT Expectations (6.36): Cadets' expectations of the OBT are high, indicating a high expectation of the benefits of the training.

The results of descriptive analysis using the MEANS procedure show the data distribution of the main variables in the study related to the development of the On Training Monitoring (On Training Monitoring) application. The mean level of OBT Difficulty experienced by Cadets was 4.28, with a standard deviation of 1.69, indicating a variation in the experience of difficulty during On Board Training. OBT preference had a mean of 4.00, indicating a fairly even choice of OBT method among participants. Before using On Training Monitoring, Cadet competency level had a mean score of 4.43, while after the use of the app, it increased to 6.47, indicating a significant improvement with a lower standard deviation (1.21), indicating a more consistent improvement. OBT monitoring had a mean of 6.32, indicating that the monitoring aspect worked well during the program.

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Table 2.
The MEANS Procedure

Variable	Mean	Std dev.	Minimum	Maximum
Difficulty_OBT Preference_OBT Before_OBT After_OBT Monitoring_OBT Problem_Solving_OBT FeedBack Expectation_OBT Evaluation_OBT Guidance_OBT	4.2763158	1.6939003	2	7
	4	1.5916449	1	7
	4.4342105	1.8499407	1	7
	6.4736842	1.2162641	2	7
	6.3157895	1.3585338	2	7
	4.1842105	1.7489847	1	7
	4	1.5748016	2	7
	6.3289474	1.3204864	2	7
	3.5131579	1.1488362	1	5
	6.1052632	1.4929072	2	7

The OBT Problem Solving and Feedback variables had averages of 4.18 and 4.00, indicating that Cadets' problem-solving skills are reasonably well developed with balanced feedback support. Expectations of OBT were high, with a mean of 6.33, reflecting Cadets' expectations of the programmed. Cadets' final evaluation of the program had a score of 3.51, indicating the need for further improvement. OBT mentorship had a mean of 6.10, indicating good mentor support during OBT.

Table 3.
Descriptive Statistics.

Variable	Mean	Median	Std. Dev.	Minimum	Maximum
Difficulty_OBT	4.2500000	4.0000000	1.6649780	2.0000000	7.0000000
Preference_OBT	3.9875000	4.0000000	1.5629714	1.0000000	7.0000000
Before_OBT	4.4000000	4.0000000	1.8183314	1.0000000	7.0000000
After_OBT	6.5000000	7.0000000	1.1906811	2.0000000	7.0000000
Monitoring_OBT	6.2375000	7.0000000	1.4074283	2.0000000	7.0000000
Problem_Solving_OB	4.1625000	4.0000000	1.7169575	1.0000000	7.0000000
T FeedBack	3.9875000	4.0000000	1.5466890	2.0000000	7.0000000
Expectation_OBT	6.3625000	7.0000000	1.2950123	2.0000000	7.0000000
Evaluation_OBT	3.5250000	4.0000000	1.1360045	1.0000000	5.0000000
Guidance_OBT	6.1500000	7.0000000	1.4677978	2.0000000	7.0000000

3.2. Descriptive Statistical Analysis

Descriptive statistical analysis provides an overview of the data distribution of the variables used in this study. From the results of the analysis, the average OBT Difficulty experienced by Cadets during On Board Training (OBT) is 4.25 with a median of 4.00 and a standard deviation of 1.66, indicating that the level of difficulty is quite varied, but most Cadets experience moderate to high difficulty. On the OBT Preference aspect, the mean obtained was 3.99 with a median of 4.00, indicating that the methods used in OBT were quite in line with Cadet expectations. Meanwhile, the Cadet competency level before using the On Training Monitoring application had an average value of 4.40, which increased to 6.50 after using the application. This indicates a significant improvement in the Cadets' ability after using On Training Monitoring, with a smaller standard deviation (1.19), indicating a relatively consistent improvement.

Table 3. The OBT Monitoring aspect had a mean of 6.2375, with a median of 7.00, indicating that monitoring during OBT went well. The OBT Problem Solving variable had a mean of 4.1625, indicating that Cadets found it quite helpful in developing their problem-solving skills. Feedback had a mean of 3.9875, indicating that the feedback provided during the training was quite useful. Cadets' expectations of the OBT program were high, with a mean score of 6.3625, reflecting positive expectations of the learning outcomes. However, the final evaluation of the program showed a mean score of 3.525, which is still relatively low and indicates the need for further evaluation to improve the

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quality of the program. OBT mentorship had a mean of 6.15, with a median of 7.00, indicating that mentor or supervisor support during OBT was rated fairly good by Cadets. These findings provide insight that the development of the On Training Monitoring application has a positive impact on improving Cadets' competence and experience during On Board Training.

3.3. Analysis of the Relationship between Variables

Analysis of the relationship between variables was conducted to understand the relationship between various aspects that influence the effectiveness of On Board Training (OBT) and the use of the On Training Monitoring (On Training Monitoring) application.

Table 4.
Relationship between Variables.

10 Variables:	Difficulty_OBT Preference_OBT Before_OBT After_OBT Monitoring_OBT Problem_Solving_OBT FeedBack Expectation_OBT Evaluation_OBT Guidance_OBT

From the results of the correlation analysis, it was found that OBT Difficulty had a negative correlation with OBT Evaluation, indicating that the higher the level of difficulty perceived by Cadets, the lower the evaluation of the program. In contrast, OBT Preference and After OBT showed a moderately strong positive correlation, signaling that training methods that match Cadet preferences contribute to improved competence after OBT. In addition, OBT Monitoring had a positive relationship with OBT Guidance, suggesting that good supervision from mentors plays an important role in supporting Cadets during training. Furthermore, Problem Solving OBT is positively correlated with Feedback, meaning that the better the feedback provided during training, the higher the Cadet's problem-solving ability. Expectations OBT also had a significant correlation with Evaluation OBT, indicating that high expectations of the program affected how Cadets evaluated their experience.

Overall, the results of this analysis suggest that monitoring, guidance, and feedback factors play a key role in improving Cadet competence during OBT. Therefore, the development of the On Training Monitoring application is expected to be continuously optimized to improve the effectiveness of the training program.

Table 5.
Descriptive statistical analysis.

Variable	N	Mean	Std. Dev.	Sum	Minimum	Maximum
Difficulty_OBT	80	4.25000	1.66498	340.00000	2.00000	7.00000
Preference_OBT	80	3.98750	1.56297	319.00000	1.00000	7.00000
Before_OBT	80	4.40000	1.81833	352.00000	1.00000	7.00000
After_OBT	80	6.50000	1.19068	520.00000	2.00000	7.00000
Monitoring_OBT	80	6.23750	1.40743	499.00000	2.00000	7.00000
Problem_Solving_ OBT	80	4.16250	1.71696	333.00000	1.00000	7.00000
FeedBack	80	3.98750	1.54669	319.00000	2.00000	7.00000
Expectation_OBT	80	6.36250	1.29501	509.00000	2.00000	7.00000
Evaluation_OBT	80	3.52500	1.13600	282.00000	1.00000	5.00000
Guidance_OBT	80	6.15000	1.46780	492.00000	2.00000	7.00000

Descriptive statistical analysis was conducted to understand the distribution of data on the main variables in this study. From the results of the analysis of the 80 samples, the mean level of OBT Difficulty experienced by Cadets was 4.25 with a standard deviation of 1.66, indicating considerable variation in the experience. The minimum value was 2, while the maximum was 7, indicating some Cadets experienced high difficulty in On Board Training (OBT). OBT preferences had a mean of 3.99 with a standard deviation of 1.56, indicating that most Cadets had diverse training method preferences. Before OBT, Cadet competence had a mean of 4.40, which increased significantly after OBT to 6.50, indicating the effectiveness of the training in improving skills.

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Monitoring OBT has a mean of 6.24 with a standard deviation of 1.41, indicating that Cadets generally feel that monitoring in OBT is quite good. Meanwhile, the Problem Solving OBT had an average of 4.16, indicating that Cadets' problem-solving skills still varied and needed to be further improved. In terms of Feedback, the average score was 3.99, indicating that Cadets received mixed feedback during training. OBT Expectations had an average of 6.36, indicating high expectations of the program. However, Cadets' final evaluation of the OBT only reached a mean of 3.52, with a standard deviation of 1.14, indicating a mismatch between expectations and the reality of the training. OBT mentorship had a mean of 6.15, indicating that the mentorship provided during OBT was generally quite good and helped the Cadets in improving their competence. Overall, this analysis shows that while OBT was successful in improving Cadets' competencies, there are still aspects such as problem solving and final evaluation that need to be improved to meet trainees' expectations.

3.4. Comparative Analysis and Effectiveness

To evaluate the changes that occurred before and after on-Board Training (OBT), a difference analysis was conducted between the Before_OBT and After_OBT values.

Table 6.
Difference: Before_OBT - After_OBT.

N	Mean	Std. Dev.	Std. Err.	Minimum	Maximum
80	-2.7500	1.8590	0.2078	-6.0000	3.0000

From the analysis results in Table 6, the following information is obtained: Number of samples (N)= 80; Mean difference (Mean) = -2.7500; Standard deviation (Std Dev) = 1.8590; Standard error (Std Err) = 0.2078; Minimum value = -6.0000; Maximum value = 3.0000. The negative mean value (-2.75) shows that there was a significant improvement after the OBT compared to before the OBT, indicating that participants experienced increased understanding and competence after the training. However, the minimum (-6.0000) and maximum (3.0000) values indicate variation between participants. To test the significance of this difference, a paired t-test could be conducted to ensure that the improvement is not just a statistical fluke, but a real impact of the OBT program.

Table 7.
Paired t-test.

DF	t Value	Pr |t|>
79	-13.23	<0.0001

To assess the effectiveness of On Board Training (OBT) in improving Cadet competence, a difference analysis between Before_OBT and After_OBT scores was conducted. The results of the analysis indicated that Mean difference = -2.7500; 95% confidence interval for Mean (95% CL Mean) = (-3.1637, - 2.3363); Standard deviation (Std Dev) = 1.8590; 95% confidence interval for Std Dev (95% CL Std Dev) = (1.6088, 2.2019); Degrees of freedom (DF)= 79; t Value = -13.23; Probability value (Pr > |t|) = < 0.0001.

The t-test results show a t-value = -13.23 with a p-value < 0.0001, which means the difference between the values before and after OBT is statistically significant. The 95% confidence interval also does not include zero, which further strengthens the evidence of an increase in Cadet competence after the training. Thus, these results indicate that the OBT program effectively improved the Cadets' ability to deal with challenges during shipboard training.

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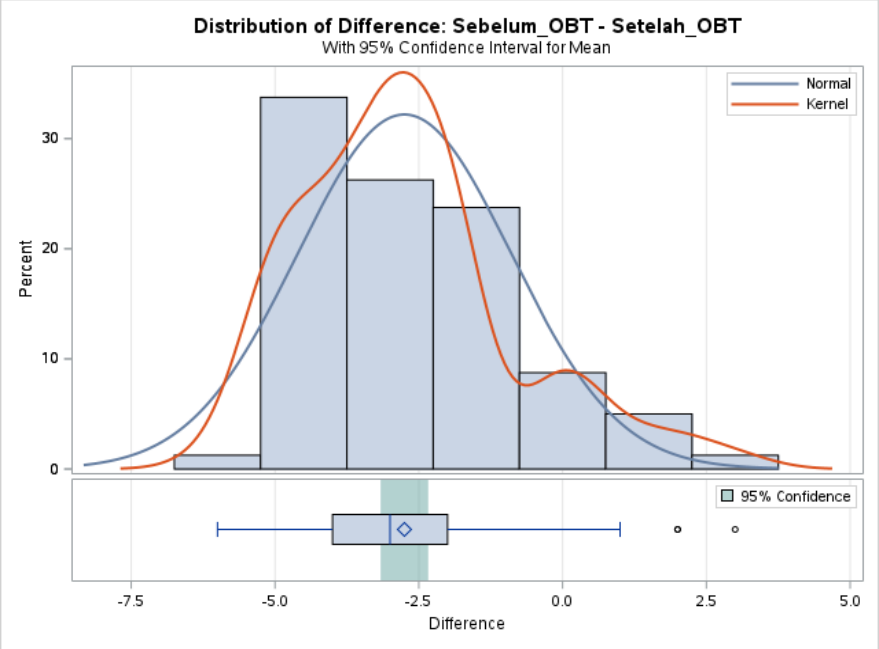

Figure 2.
Distribution of Difference Before OBT and After OBT.

Figure 2. shows the distribution of differences between Before OBT and After OBT scores. Several points can be analyzed from this graph:

3.4.1. Mean Difference (-2.75)

The dashed red line shows the mean difference, which is -2.75. This means there was an overall increase in scores after OBT.

3.4.2. Data Distribution

The histogram shows that the majority of the data is around -3 to -2, indicating that most participants experienced an increase in competence after OBT. The distribution pattern is close to normal with a slight skewness towards the right. Variability (Standard Deviation: 1.859). There were some participants who experienced a greater change in scores (up to 6) or who remained constant (close to 0).

The distribution graph of the difference between Before OBT and After OBT illustrates how participants' scores changed after attending the On-Board Training (OBT) program. From the histogram shown, the average difference in scores is -2.75, indicating a significant improvement after the training. Most of the data falls within the range of -3 to -2, indicating that the majority of participants experienced an increase in competence after OBT. The distribution of the data is close to normal with a slight skewness towards the right, indicating that most participants experienced similar improvements, but there were some individuals with larger or smaller changes. In addition, the standard deviation of 1.859 indicates the variation in score changes. Some participants experienced very significant improvements (up to 6), while others experienced smaller or even flat changes (close to 0).

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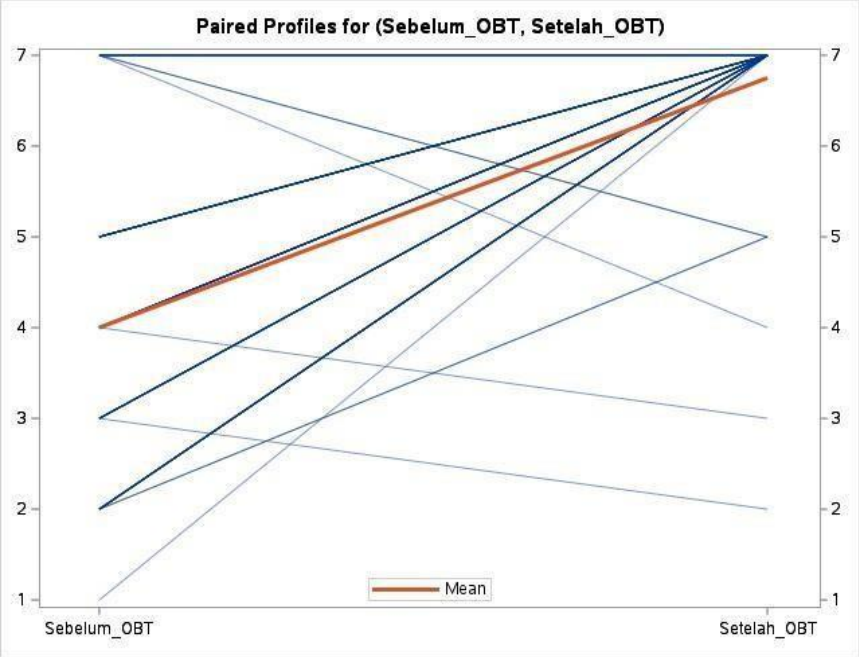

Figure 3.
Paired Profiles for before OBT and after OBT.

Figure 3 Paired Profiles Graph for Before OBT and After OBT illustrates the change in individual scores before and after attending the On-Board Training (OBT) program. The graph shows a line connecting each participant's score before and after OBT, allowing for visual analysis of trends in competency change. From the graph, it can be seen that most of the lines have a downward slope, signaling an increase in scores after the training. The average score before OBT was around 4.4, while after OBT it increased significantly to 6.5, with an average difference of -2.75.

Some participants showed a more drastic improvement than others, as evidenced by the steeper line. However, there were also some individuals with smaller improvements, even close to zero. This variation could be due to individual factors, such as initial readiness level and previous experience in a maritime environment. This graph also helps identify more consistent patterns of change across participants. If most of the lines show uniform improvement, then it can be concluded that the OBT program was successful in improving competence in general. However, if any lines remain horizontal or even increase, then it is necessary to further analyze the factors that led to those participants not experiencing the same improvement.

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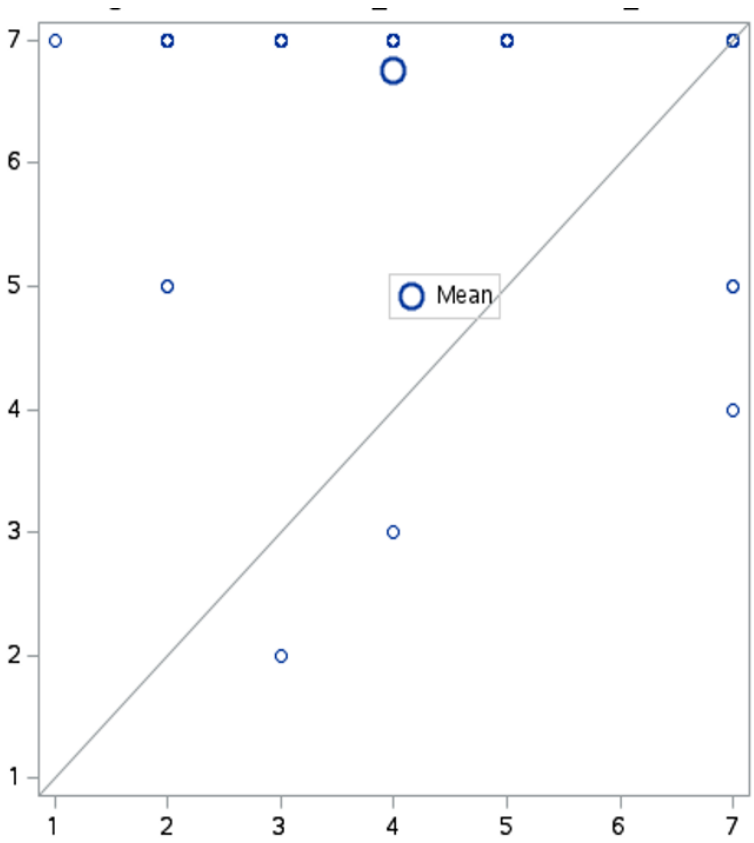

Figure 4.
Agreement of after OBT (Y-Axis) and Before OBT (X-Axis).

Figure 4. The agreement of After OBT and Before OBT illustrates the level of agreement or difference between evaluation results before and after On-Board Training (OBT). This graph is usually presented in the form of a Bland-Altman Plot or scatter plot, which shows the relationship between the two data sets and the extent to which the results after OBT agree or differ from those before OBT. From the resulting graph, it can be observed whether there is a certain pattern in the change of scores. If the data points are scattered around the diagonal line (y=x), this indicates there is high agreement between Before OBT and After OBT, which means the change in scores is relatively small. However, if the points tend to lie above the diagonal line, this indicates an increase in scores after the OBT, indicating the effectiveness of the training.

The mean difference between Before OBT and After OBT is -2.75, which indicates that most participants experienced an increase in scores after the training. However, the graph can also show individual variations, where some participants experienced greater improvement, while others experienced only small or even flat changes. This figure helps in evaluating whether the difference in scores is consistent across participants or whether certain groups experience more significant changes. If there are points that are far from the general pattern (outliers), then further analysis is needed to understand the factors causing the differences.

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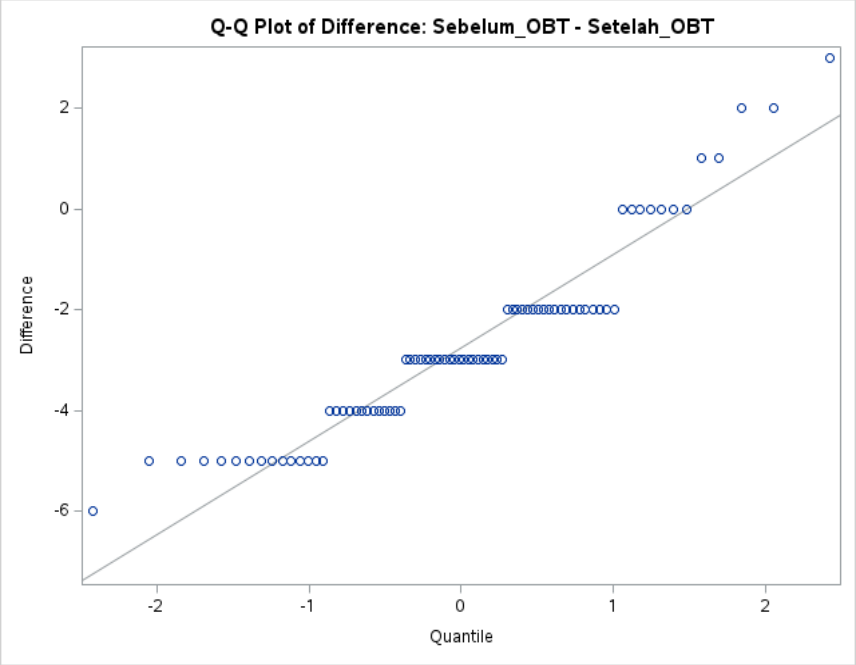

Figure 5.
QQ Plot of Difference Before OBT and After OBT.

Figure 5. The QQ (Quantile-Quantile) Plot is used to evaluate whether the data distribution of the difference between Before OBT and After OBT values follows a normal distribution. In this plot, the horizontal axis (x-axis) represents the quantiles of the theoretical normal distribution, while the vertical axis (y-axis) shows the quantiles of the observed data obtained from the difference between the evaluation results before and after On-Board Training (OBT). The QQ Plot of the Difference Before OBT and After OBT provides a visual representation of the fit of the data to the normal distribution. From the previous analysis, it is known that the mean difference is -2.75 with a standard deviation of 1.859, which indicates a significant change after OBT. By looking at the QQ Plot, we can ascertain whether this change follows a normal pattern or if there are other factors affecting it. If the distribution is close to normal, then the results of the statistical analysis conducted can be more reliable in concluding the effectiveness of the OBT program in improving Cadet competence.

Table 8.
Dependent Variable: Evaluation_OBT

Number of observations Read	80
Number of Observations Used	80

Table 8. The analysis of the dependent variable, Evaluation of OBT, was conducted based on 80 observations, where all data read was also used in the analysis. This indicates that no data was excluded or disqualified, so the analysis results reflect the entire sample available. By using all 80 observations, this analysis provides more representative and accurate results in describing the evaluation patterns of Cadets after undergoing OBT. The complete data also ensures that statistical results, such as mean scores, variability, and relationships between variables, can be interpreted more validly without bias due to missing data.

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4. Discussion

4.1. On Training Monitoring Application Development

The results showed that the developed On-Training Monitoring application model successfully met the needs of users, especially Cadets and Supervising Lecturers/Instructors. Features such as e-logbook, automatic notifications, real-time feedback, and two-way communication not only facilitate the reporting process but also encourage active and reflective learning. The application of a user-centered design approach in the development of On Training Monitoring allows the system to truly represent the needs of the field. The involvement of cadets and lecturers in the design stage ensures that the features developed are appropriate for the complex and diverse dynamics of on-board training. This finding shows that when a digital monitoring system is designed based on the real needs of users, not just as an administrative reporting system, it can transform into an effective learning tool.

This result is in line with the Competency-Based Training (CBT) theory that emphasizes the importance of learning instruments based on real skills and continuous evaluation. In addition, On Training Monitoring's alignment with Kolb's Experiential Learning principles that encourage learning through experience, reflection, and application validates the pedagogical approach used in the development of this system. The success of the app in facilitating practice-based learning experiences suggests that digital systems can be functionally integrated in experiential learning models. The integration of digital systems in vocational training, particularly in maritime education, shows great potential in improving learning effectiveness and adaptability. The On Training Monitoring application is a clear example of how technology can overcome infrastructure limitations through its offline synchronization feature that enables continuous monitoring even in environments with low connectivity.

This adaptability is particularly important in maritime contexts, where conventional monitoring methods are often inadequate. Digital technologies such as On Training Monitoring have been shown to improve the monitoring of maritime education and training and increase user satisfaction. In addition, the use of virtual simulations and cloud-based tools also strengthens the flexibility and effectiveness of practice-based teaching, while expanding access to learning materials. While the benefits of digital systems in vocational training are clear, challenges such as the need for adequate technological infrastructure and training for educators remain major barriers to widespread implementation. Therefore, efforts to overcome these challenges are key to maximizing the potential of digital transformation in education.

4.2. Effectiveness of on Training Monitoring in Improving Cadet Competence

Quantitative data showed a significant improvement in Cadet competency after using On Training Monitoring, as indicated by a paired t-test. Cadets are better able to understand instructions, carry out work practices, and demonstrate accountability in reporting and task completion. On Training Monitoring provides a structured and continuous feedback loop, so cadets receive immediate evaluation and can improve performance in real time. This reflection cycle encourages learning that is not one-way, but interactive and cadet-centered.

This confirms CBT theory, which states that competency development demands instruments that can record, evaluate, and guide cadets constantly. Competency development also aligns with the view that the integration of knowledge, attitudes, and skills is a crucial aspect in competency development, especially in a field such as Cognitive Behavioral Therapy (CBT). Competency-based education emphasizes the importance of synergizing these three aspects so that learners can face professional challenges effectively. To support this process, continuous assessment tools such as Computer-Based Tests (CBT) are needed to evaluate learning outcomes while ensuring that education programs are aligned with competency standards. However, research shows that while CBT training significantly improves Cadet competence, metacognitive skills do not always keep pace. This indicates that many cadets tend to underestimate their competence, which indicates a gap in self-assessment skills and may affect their readiness for the world of work. Therefore, while the competency-based education

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approach has made significant progress, the challenge ahead is how to develop better metacognitive training to enable Cadets to accurately assess their abilities and be confident when entering the professional environment.

The increase in competency scores is dominant in the indicators of technical ability and understanding of SOPs on board. This strengthens the validity that On Training Monitoring is able to fill gaps in vocational learning practices that were previously less well documented. Digital applications such as On Training Monitoring are not just administrative tools, but should be positioned as part of a strategic pedagogical instrument. On Training Monitoring's contribution is as an integrative platform between the assessment process, mentoring, and learning reflection.

4.3. Effectiveness of on Training Monitoring in Improving Problem Solving

One of the most interesting contributions of On Training Monitoring is the improvement of Cadets' problem-solving skills during on-board training. Observations and self-assessments show that cadets become more systematic in dealing with problems, from identification, analysis, solving, to evaluating solutions. As On Training Monitoring provides a documentation space that supports reflection on problems encountered and solutions applied, cadets are encouraged to map their thought processes and learn from previous experiences. In addition, the communication feature allows lecturers to provide scaffolded support for cadet decision-making.

This improvement is in line with Polya's Problem-Solving Model, which includes four systematic stages in solving problems. In the context of vocational education, this process supports the theory of Problem-Based Learning (PBL), which emphasizes that problem-based learning creates deep learning and contextual understanding. The integration of Polya's Problem-Solving Model in vocational education is in line with the principles of Problem-Based Learning (PBL), which encourages deep learning and contextual understanding. PBL emphasizes student engagement in solving real problems, thus improving not only technical skills (hard skills) but also soft skills that are critical for work readiness. Meta-analysis shows that PBL has a significant impact on learning outcomes in the context of vocational education, with an effectiveness value of 1.02. In addition, this approach is proven to improve critical thinking, learning motivation, and group work dynamics, even showing an increase in students' psychomotor skills by 17%. PBL also encourages a shift in the learning paradigm from teacher-centered to student-centered, thus fostering independence and independent research skills. However, the successful implementation of PBL is highly dependent on proper learning design and facilitator support. In addition, this approach encourages active collaborative learning, which is an important foundation in developing critical thinking skills. Although PBL shows promising results in vocational education, some critics claim that its effectiveness may vary depending on the specific scope and challenges faced by cadets. Therefore, a customized approach is needed to suit the needs and characteristics of each educational environment.

Data from the application logs show an increase in the frequency of problem reporting by Cadets and supervisor responses to these problems. This shows that the app becomes an active learning medium, not just a passive one. In contrast to conventional reporting systems, On Training Monitoring contributes as a platform that facilitates the formation of critical and reflective mindsets through the problem-solving cycle. This is an innovation in the context of maritime vocational education, where real-time problem-solving skills are needed in the field.

5. Conclusions

This research provides important findings regarding the success of the developed-On Training Monitoring digital application model, which has successfully created an effective solution in supporting the Cadet on Board Training process. The application not only fulfils the practical needs of Cadets and supervisors, but also proves to be able to strengthen its user interaction, as well as effectively improve Cadets' technical and non-technical competencies and problem-solving abilities during On Board Training.

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The On Training Monitoring Application was developed with a focus on the needs of cadets, lecturers/instructors, and maritime education managers. This method uses an in-depth needs analysis to determine what features and functions are required to support On Board Training (OBT). Subsequently, the system design was conducted iteratively with users as the main source of feedback. In addition, the testing and evaluation phase was conducted directly with supervisors and a sample of Cadets. This was done to ensure that the application performed as expected and that the Cadets were able to resolve issues that arose during the OBT. The results show that On Training Monitoring supports important features such as a structured and easily accessible feedback mechanism, a two-way communication system that facilitates coordination between Cadets and mentors, a digital E-logbook that facilitates recording daily activities, and real-time monitoring of Cadet activities on board. The app not only helps to oversee the training process, but also provides an easy and responsive user experience, increasing everyone's engagement.

This study shows that the use of On Training Monitoring has a significant impact on improving students' abilities. Statistical tests showed that the pre-test and post-test Cadet competency scores were significantly different. The p-value is well below the significance limit ($p < 0.001$). This shows that the improvement in proficiency did not happen by chance; it was a direct result of using the app to support learning in the field. On Training Monitoring not only assists Cadets in keeping records and reports, but it is also a learning tool that helps in thinking and self-assessing consistently. Supervisors can provide timely direction and correction to the competency development process thanks to the real-time monitoring system and quick feedback. The competency-based learning pattern, which is currently the main requirement in maritime vocational education, is also supported by the use of this application. On Training Monitoring has been proven to improve Cadets' technical skills in addition to enhancing Cadets' problem-solving skills during On Board Training. In this program, many features encourage Cadets to improve their analytical and creative problem-solving skills that arise during training. This feature also allows Cadets to record the problems they face directly and receive feedback from the supervisor. Test results showed a significant increase in problem-solving scores after using the app. In addition, the On Training Monitoring app can help Cadets acquire soft skills that are crucial for the world of work. By regularly reflecting and evaluating through the app, Cadets learn to think critically, find creative solutions, and make the right decisions in complex situations. This adds value to the On Training Monitoring app as it can help Cadets prepare for the challenges of the maritime professional world in addition to being a monitoring tool.

5.1. Future Work

Based on the conclusions obtained, the following are some important technical and operational future work to be implemented by users of the research results:

a. Maritime education institutions are advised to implement the On Training Monitoring Application widely by providing supporting infrastructure such as a stable internet network, an automatic data synchronization system, and adequate supporting devices.
b. It is necessary to conduct intensive training on the use of the On Training Monitoring Application to cadets and supervisors so that the maximum benefits of the application can be achieved. This training includes application operation, utilization of feedback features, and interpretation of evaluation results.
c. Institutions are advised to develop clear and detailed technical guidelines regarding the use of the On Training Monitoring Application, including reporting stages, real-time communication between cadets and supervisors, and evaluation and monitoring mechanisms that must be carried out consistently.
d. To overcome technical obstacles, educational institutions need to consider implementing a hybrid offline-online system that can store data locally first when an internet connection is not available, and then synchronize it automatically when an internet connection is available.

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e. As a practical implication, it is recommended to conduct periodic evaluations of the implementation of the On Training Monitoring Application to obtain direct feedback from users (cadets and instructors), so that improvements can continue to be made to the application according to the real needs in the field.
f. For future research, it is recommended to expand the scope of the study by involving other maritime institutions and measuring the long-term impact of using On Training Monitoring to strengthen the validity and generalization of the findings of this study.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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