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# Analyze of Education and Training Using Ship Engine Simulators at STIP Jakarta Indonesia

Journal of Electrical Systems

***Abstract:*** - On this research paper, we analyze Cadet Engineer, junior engineer, senior level Operational engineers, and senior management level engineers will carry out experiments using speed data from various scenarios on the ship engine simulator and then the experimental results will use educational and training analysis on the ship engine simulator to find out the right time. Later analysis also revealed that human errors occur due to the following reasons: Lack of knowledge of the overall system and fundamental operations, Insufficient confirmation of operations and Incomplete knowledge of the sequence of operations. the role of the instructor will be explained to reduce the causes of human error and to improve educational performance according to the implementation and development of each scenario based on expert justification and reference to IMO and SOLAS Standards. various safety procedure scenarios for all Engineers in the hope of minimizing accidents that cause loss of life at sea. For the purpose of training engine plant operations using a PC-based Engine Room Simulator (ERS), describe the features of human errors by incompetent trainees in marine engine plant operations and demonstrate the necessary improvements in training to reduce such errors from an educational technology point of view. Examination of these data has shown that errors occur primarily due to errors of omission and inadvertent action. Further analysis was carried out on these errors by the engineer trainees to determine the characteristics of errors caused in the process of acquiring procedural knowledge for operations according to the implemented development of various safety scenarios.

***Keywords:*** Analysis of Education, Training, Ship Engine Simulator.

## INTRODUCTION

According to data from the KNKT, from 2010 to 2016 there was an increase in maritime transportation accidents, both caused by sinking ships, ship collisions, or ships catching fire.1. During that year, 658 people died and 568 people were injured, 51% of accidents were caused by technical problems and 49% were caused by human error. Data on ship accidents investigated by KNKT2.
Through their work, it has been proved that the contemporary engine room simulator could be also used as an examining tool, offering an unbiased judgment of the participant gained skills, and his ability to handle various critical situations (Listew- nik 2005, 1). Kluj has evaluated engine room simulators utilizing practical usability criteria (Kluj 2003, 445). Other researchers have focused on the development of in- telligent tutoring systems for engine room simulators (Sugita 2005, 1) or the enhance- ment of competence based training and assessment for marine engineers in a simu- lated environment (Cross, 2003, 1).

Educational simulation is designated as a model of a certain phenomenon or an activ- ity that the users employ and learn through interaction with simulation (Alessi and Trollip 2001, 185). The first educational programs of simulation were created in the early 1970's and, as software, they clearly had a reverse pedagogic orientation from the classical teaching with computer assistance. Simulation programs are based more on
A. Bandura's views on Social Learning Theory (Komis 2004, 78).

The aim of this paper is to outline an analysis of examination results in applying various safety scenarios and learning practices to an integrated bridge engine simulation and evaluate whether the basic knowledge, operation and management level skills achieved with training in a marine engine simulator Basic computer training can be transferred to operation in the simulator machine to know the exact time.
. Naturally, no simulation can cover the need of acquiring a minimal level of dexterities and knowledge in educating marine engineering officers, thus this knowledge should be supplemented with edu- cational trips or with an aid of similar official learning mechanisms (Cohen 1994, 1).

methods and ways of expression, already known from his individual world, thus deep- ening into the specialty he is studying (Jimoyiannis and Komis 2001, 183).
Concerning simulation software, the destination of which is, basically, educational, it has been mainly developed on a clarification model of the phenomenon in ques- tion. If the model is unknown to the trainee, simulation is called

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modeling. Other- wise, it is called behaviorist, and we can discern three categories (Komis 2004, 78):

Current educational views assert that students should get mingled with modeling activ- ities, recognizing in them the advantages of scientific approach and the use of methods and practices, which resemble authentic scientific activities (Gilbert and Boulter 2000, 227).

Marine simulation allows the creation of real, dynamic situations that take place on a ship at sea in a controlled surrounding where marine engine officers can (Kluj 2001, 5):

The characteristics that an engine room simulator should have in the training of apprentice marine engineer officers are the following (Kluj 2001, 5):

. The programs of adjustment-simulation represent schematically a real situation or a phenomenon. Depending on the situations that are assimilated, these programs are categorised as follows (Papachristos 2003, 108):

The model Det Norske Veritas for the Certification of Marine Systems of Simulators proposes the following classification of simulators (Kluj 2001, 5):

Muirhead proposes a more representative classification system, based also on four categories, taking into consideration the start of new experiments by Force Technology and STN-Atlas in 2002 to link different simulation centres, using the Inter- net and the power and speed of broandband connections (Muirhead 2004, 139):

The engine room simulator constitutes a basic tool in practical education and train- ing of apprentice marine engineers in“real” situations of operation in a typical engine room of a vessel. The subjects that follow concern educational usefulness and opera- tion of the system, as well as its characteristics (Norcontrol 2000, 1):

Data on ship accidents investigated by KNKT2:

Table 1 NTSC data.

| No. year | Number of Accidents | Sinking ship | Ship Burns/Explodes | CrashBoat | Ship Stopped | Die /Is lost | wounded |
|---|---|---|---|---|---|---|---|
| 2010 | 4 | 1 | 1 | 3 | 0 | 100 | 104 |
| 2011 | 6 | 1 | 3 | 2 | 0 | 10 | 51 |
| 2012 | 4 | 0 | 2 | 2 | 0 | 447 | 0 |
| 2013 | 6 | 2 | 2 | 2 | 0 | 15 | 85 |
| 2014 | 7 | 2 | 3 | 2 | 0 | 86 | 346 |
| 2015 | 11 | 3 | 4 | 3 | 1 | - | - |
| 2016 | 11 | 4 | 4 | 3 | 0 | 2 | 2 |
| **Total** | **53** | **13** | **19** | **17** | **1** | **662** | **590** |

Therefore, recommendations need to be given to all stakeholders to minimize the occurrence of maritime transportation accidents. During this learning process, the learning process analysis used to evaluate education and training on marine engine simulators is all cadet engines, junior engineers, operational senior level engineers and management level senior engineers using speed data in carrying out various development scenarios according to each level. based on expert justification with reference to IMO and STCW standards.

Operational knowledge in a ship engine factory, which is part of a marine engineer's duties, is the procedural knowledge necessary for the smooth operation of the engine. Unskilled trainees must acquire such knowledge through actual operating experience on board ships or through educational training. Since unskilled trainees are assumed to make a lot of human errors, OJT (On the Job Training) which is training on the actual operation of a marine engine factory, would be a risky option. Simulator training is safe training and does not damage the machine and others, so it is very effective to learn basic knowledge about machine operation before starting OJT.

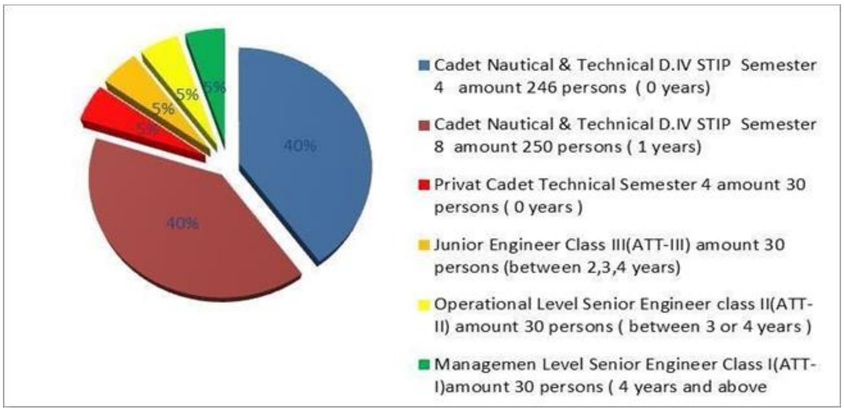
The content also involves a presentation on how Resource Management skills development is implemented in the Ship Engine Simulator including an Integrated Ship Engine Resource Management Demonstration3.

In simulator training, the trainee's operational behavior, or the trainee's operational procedures until he or she gets the machine to a certain state, is recorded as data for easy review. Checking the operational procedures from the point of operational error will really help the instructor to know how the machine should be operated for the trainees, what knowledge is or is not required for operation and whether the instructor's knowledge is appropriate or not. The reason why this paper is addressed to unskilled trainees is because their experience level is low and therefore the effects of simulator training can be discovered without being affected by experienced knowledge. In this research Cadet Engineer, junior engineer. Operational senior level engineers and management level senior engineers will conduct experiments using data speed scenarios on ship engine simulators. then the experimental results will use educational analysis and ship engine simulator training to find out the right time according to each scenario based on expert justification and IMO Standard and SOLAS references. Then an analysis of education and training was carried out using a ship engine simulator.
Machine simulators also reveal that human errors occur due to the following reasons4: Lack of knowledge about the overall system and its underlying operations, Preparation & Coordination of team work, Team work less compact(between semesters VIII and IV), Lack of Motivation (especially semester IV), Implementation of Scenarios, Less effective in introducing equipment, Lack of operational confirmation, Less careful in reading instructions,
Lack of support from other teachers, Incomplete knowledge of operational sequences, Weak attitudes and behavior in the team and desire to work together.

Research Time Frame January-July 2023

| No | Activity Review | Month | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | Training preparation | | | | | | | |
| 2 | Training implementation and Assesment | | | | | | | |
| 3 | Training implementation and Assesment | | | | | | | |
| 4 | Training implementation and Assesment | | | | | | | |
| 5 | Reports Resulth and evaluation | | | | | | | |

**Figure 1**. RESPONDENT PROFILE




**Identify potential obstacles**

The main problem :

(Private Cadet Engineers, ATT III, ATT II & ATT I main problems) Lack of knowledge of the entire system and basic operations

Insufficient confirmation of operations Incomplete knowledge of operational sequences Preparation & coordination of team work:

Less cohesive team (Between Smt. VIII and IV), Lack of motivation (especially Smt. IV) Implementation of Scenarios, Less effective in introducing equipment, Less careful in reading instructions, Lack of support from other teachers.

-Risks:

Reaching an agreement does not occur according to schedule. Inconsistency in personnel criteria

Lack of attention to existing values or systems in the industry will not be in accordance with the conditions of the maritime industry

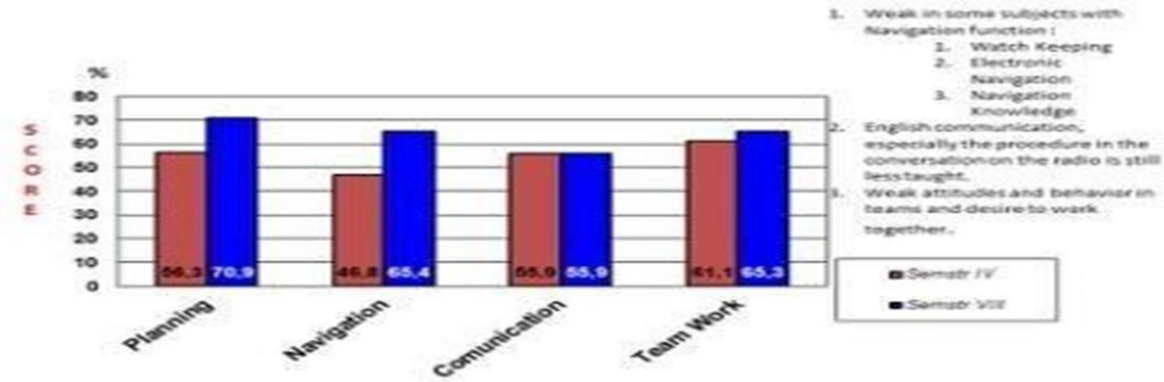



**Figure 2** Scope of Problems of the Nautical Department Ment

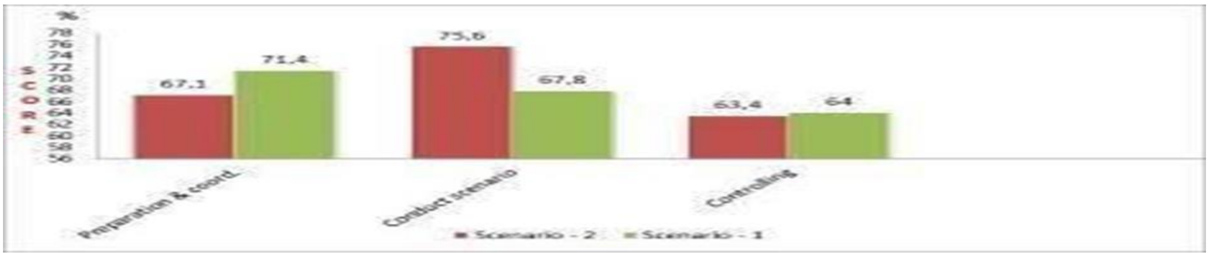



**Figure 3** Scope of Issues Technical Department

The aim of this paper is to outline an analysis of examination results in applying various safety scenarios and learning practices to an integrated bridge engine simulation and evaluate whether the basic knowledge, operation and management level skills achieved with training in a marine engine simulator Basic computer training can be transferred to operation in the simulator machine to know the exact time.

**METHOD**

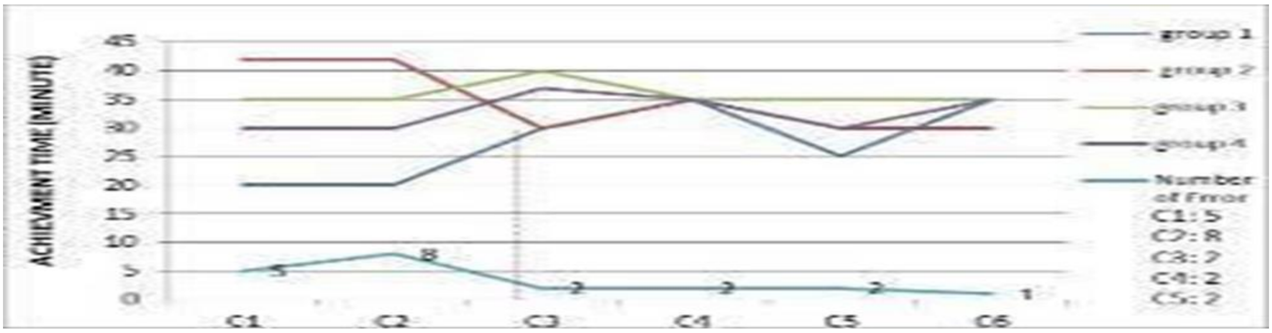



**Figure 4** Pre-Assessment Evaluation Chart: Private Cadet Engine Simulator Program February 2023

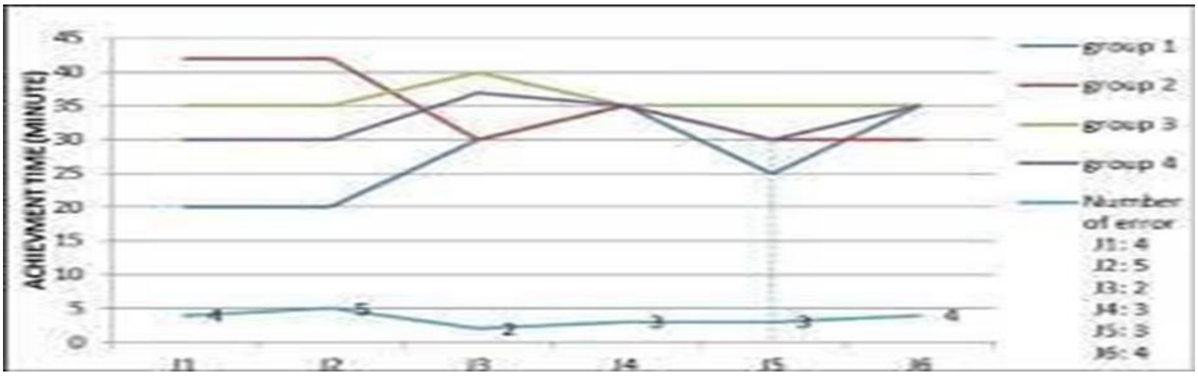



**Figure 5** Chart Evaluation Pre-Assessment: Junior Engineer/ATT-III (STIP) Engine Simulator Program March 2023

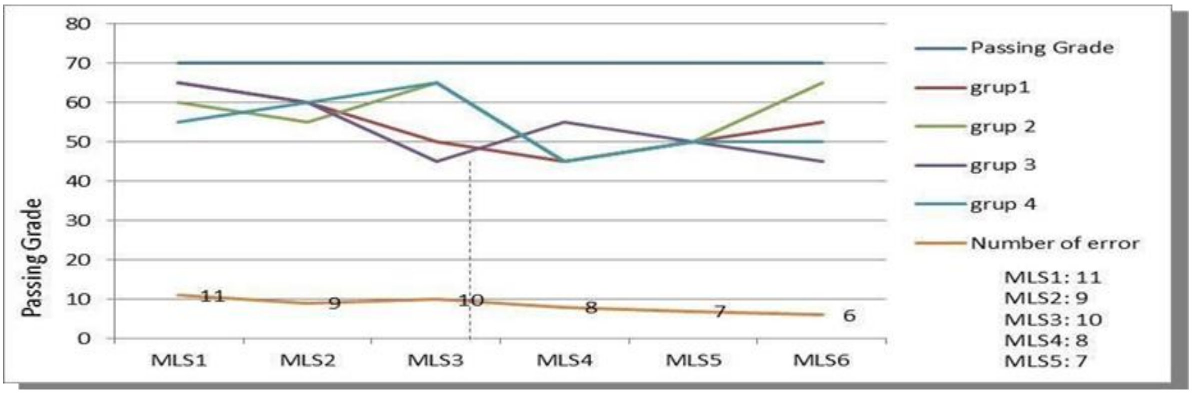



**Figure 6** Pre-Assessment Evaluation Chart: Senior Operations Technician/ATT-II (STIP)

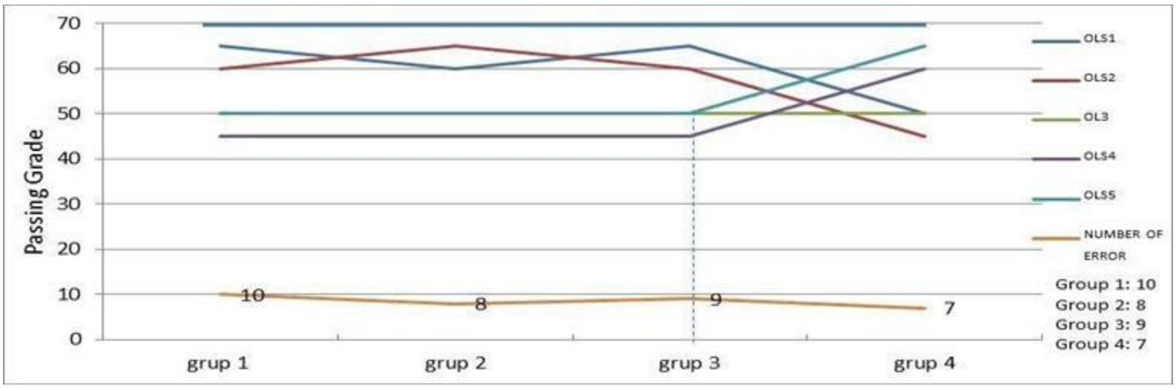



**Figure 7** Pre-Assessment Evaluation Chart: Senior Management Engineer / At-Ti (Stip) Machine Simulator Program June 2023

**RESULTS AND DISCUSSION**

**Table 2.** Relations Between Achievement Time and Number of Errors Junior Engineer /ATT III

| | JUNIOR engineer | time standard | group 1 | group 2 | group 3 | group 4 | Number of error |
|---|---|---|---|---|---|---|---|
| 1 | scenario for preparing for getting underway | 30 minute | 20min | 42min | 35min | 30min | 4 |
| 2 | scenario for manouvering to open sea | 30 minute | 20min | 42min | 35min | 30min | 5 |
| 3 | scenario for steady steaming | 20 minute | 30min | 30min | 40min | 37min | 2 |
| 4 | scenario for approaching harbour | 20 minute | 35min | 35min | 35min | 35min | 3 |
| 5 | enario for finishing with engine | 15 minute | 25min | 30min | 35min | 30min | 3 |
| 6 | Scenario for operation of OILERS and Cargo Turbines | 30 minute | 35min | 30min | 35min | 35min | 4 |

**Table 3.** Relationship Between Achievement Time and Number of Private Cadet Errors

| Private Engineer Cadet | time standards | group 1 | group 2 | group 3 | group 4 | Number error |
|---|---|---|---|---|---|---|
| 1: Scenario to prepare to start | 30 minutes | 20 minutes | 42 minutes | 35 minutes | 30 minutes | 5 |
| 2 : Scenario for maneuvering into the open sea | 30 minutes | 20 minutes | 42 minutes | 35 minutes | 30 minutes | 8 |
| 3 : Scenario for stable steaming | 20 minutes | 30 minutes | 30 minutes | 40 minutes | 37 minutes | 2 |
| 4 : Scenario for approaching the port | 20 minutes | 35 minutes | 35 minutes | 35 minutes | 35 minutes | 2 |
| 5 : Scenarios for solving with machines | 15 minutes | 25 minutes | 30 minutes | 35 minutes | 30 minutes | 2 |
| 6 : Scenarios for operation UX.BOILERS and Cargo Turbines | 30 minutes | 35 minutes | 30 minutes | 35 minutes | 35 minutes | 1 |

**Table 4.**

| SENIOR OPERATIONS ENGINEER | Passing grade score | Group 1 | group 2 | group 3 | group 4 |
|---|---|---|---|---|---|
| OLS1: Scenarios for failures and emergencies | 70 | 65 | 60 | 65 | 50 |
| OLS2: Scenarios for team training | 70 | 60 | 65 | 60 | 45 |
| OLS3: Scenarios for fault | | 50 | 50 | 50 | 50 |

| | | | | | |
|---|---|---|---|---|---|
| diagnosis and tracking | 70 | | | | |
| OLS4: Crisis management scenarios | 70 | 45 | 45 | 45 | 60 |
| OLS5: Restoring to normal scenario operation | 70 | 50 | 50 | 50 | 65 |
| NUMBER OF ERRORS | | 5 | 2 | 6 | 4 |

Relationship Between Achievement Time and Number of Operational Errors Senior Engineer/ATT II

The relationship does not show a clear correspondence between the score and the number of errors. Meanwhile, for the assessment method, checking the score and error ratio. The results of this research also show the need to check these two things for training assessment.

**Table 5.** Relations Between Achievement Time and Number of Errors Management Senior Engineer/ATT I

| MANAGEMENT SENIOR ENGINEER | Passing grade score | grup1 | grup 2 | grup 3 | grup 4 | NUMBER OF ERROR |
|---|---|---|---|---|---|---|
| MLS1 : Scenario fouling and wear | 70 | 65 | 60 | 65 | 55 | 5 |
| MLS 2 : Scenario combustion performance | 70 | 60 | 55 | 60 | 60 | 2 |
| MLS 3 : Scenario control loop optimizing | 70 | 50 | 65 | 45 | 65 | 4 |
| MLS 4 : Scenario heat balance/recovery | 70 | 45 | 45 | 55 | 45 | 2 |
| MLS 5 : Scenario variable pitch | 70 | 50 | 50 | 50 | 50 | 1 |
| MLS 6 : Scenario external condition | 70 | 55 | 65 | 45 | 50 | 3 |

**Table 6.** Operation Records (historical data)

| Time | Operation Equipment | Condition |
|---|---|---|
| 13:50:44 | No. 1 Main L.O Pump | Run |
| 13:50:44 | Piston Cool Oil Non-Flow | Normal |
| 13:50:44 | Main L.O Inlet Press | Normal |
| 13:50:44 | Piston Cool Oil Inlet Press | Normal |
| 13:50:46 | No. 2 Cam L.O Boost Pump | RUN |
| 13:50:46 | CamShaft L.O Inlet Press | Normal |
| 13:51:03 | Abnormal Turning | Abnormal |
| 13:51:05 | Abnormal Turning | Normal |
| 13:52:04 | Turning Gear | Disengage |
| 13:52:32 | Indicator Cock | Open |
| 13:52:50 | Priming | On |
| 13:53:12 | Turning Motor | Run |

**Table 7.** Operational Content based on the competencies of Cadets and Young Engineers, ATT III/II/I

| Error type | Number of errors |
|---|---|

| | |
|---|---|
| Termination of Operations | 43 |
| Extra operations | 50 |
| Operational sequence error | 22 |
| Forgot to confirm the operation | 17 |
| Repetition of the same operation | 10 |
| Other | 8 |
| Total | 150 |

**Table 8.** Specific Operating Errors

| Error details | Number of cases |
|---|---|
| The pre-pump is turned on | 35 |
| When the pump is turned on, the required valve is not opened | 20 |
| The order of operation of the main engine rotation is reversed | 15 |
| Diesel oil heating | 10 |
| Failure to close the steam valve to heat the cooling fresh water | 13 |

**Discussion**

The aim of marine engine factory simulator training is to acquire procedural knowledge, that is, to know the current situation of the engine factory and the preparatory operations for the next steps. The data in this case is primarily the history of operational procedures for the operation.

Asfor example, in the case of transferring fuel oil in a tank to another tank, it is very important to know whether fuel oil is in the tank or not and what the condition of the tank is (such as the condition of the outlet valve). If the tank is ready for fuel oil transfer, then the tank for receiving fuel oil must be checked before starting the transfer pump. Thus, the operational procedure history consists of confirmation of the condition and operational procedures of the machine. The purpose of this data collection is to look at operational errors to determine the cause of the error from the history.

Data collection in the AGB and Kongsberg Simulator was carried out on fourth-level training participants Cadet, junior, operational and management level engineers5. Operational data was collected from 10 trainees who experienced simulator training for approximately 4 hours.

The data content is around 25 sheets of operational procedure steps for starting the main engine in the ship's engine room. The trainee operates the engine and valves on a graphical screen that simulates the engine room using a mouse (as shown in Figure 1), while remote operation of the main engine is carried out on a graphical screen from the control panel (as shown in Figure 2). There is also a screen that simulates the fuel oil system in the engine room. Meanwhile, for the operational history of training participants, pump start/stop operations are stored on the PC as operational history. The data is collected via a local area network. Sample data is shown in Table 1 which consists of operational hours, operating content, machine equipment, and alarm conditions.

Trainees make various kinds of mistakes during their operations before achieving the goal6. Table 2 shows the number of errors made by trainees known from operational history. These errors show a tendency for 2 polarization. The 5 trainees made only 5 errors and it is assumed that they followed anticipated operational procedures. Meanwhile, trainees who make 14 errors or more are assumed to have difficulty in following anticipated operational procedures and they are confused in finding operational procedures and repeat the same procedures thereby seriously damaging machines and equipment.

**Table 9.** Operation records (Historical data)

| **Time** | **Operational Equipment** | **Condition** |
|---|---|---|
| 13:50:44 | No. 1 Main LO Pump | Run |
| 13:50:44 | Piston Cooling Oil Not Flowing | Normal |
| 13:50:44 | Press Main LO Inlet | Normal |
| 13:50:44 | Press Piston Cold Oil Inlet | Normal |
| 13:50:46 | No. 2 LO Cam Booster Pumps | Run |
| 13:50:46 | LO Cam Shaft Press Inlet | Normal |
| 13:50:50 | No. 1 Main Coolant FW Pump | Run |
| 13:50:50 | Press the Cold FW Inlet | Normal |
| 13:51:03 | Abnormal Turning | Abnormal |
| 13:51:05 | Abnormal Turning | Normal |
| 13:52:04 | Turning Gears | Let go |
| 13:52:32 | Indocator Chicken | Open |
| 13:52:50 | Priming | On |
| 13:53:12 | Turning the Motor | Run |

Assessment of the results of simulator training for trainees is made based on achievement time and number of errors. Figure 3 shows the actual relationship between achievement time and number of errors. Table 10. Number of errors and number of students.

**Table 10.**Number of errors and number of students

| Number of errors | The number of students | Number of errors | The number of students |
|---|---|---|---|
| 5 | 5 | 11 | 5 |
| 6 | 5 | 12 | 5 |
| 7 | 5 | 13 | 5 |
| 8 | 5 | 14 | 5 |
| 9 | 5 | 15 | 5 |
| 10 | 5 | 17 | 5 |

The relationships in Figure 3 do not show a clear correspondence between achievement times and number of errors. Some trainees spend a short time achieving targets but make many mistakes. Meanwhile, for the assessment method, checking the achievement time and error ratio. The results of this research also show the need for good checks for training assessment, Content of Operational Errors by incompetent trainees. The study was conducted to determine the types of operational errors that occurred during training by PC7-based ERS. Unskilled trainees find it difficult to carry out systematic operations and know the purpose of those operations, which ultimately leads to operational errors8. Errors of this kind are called behavioral errors that are easily distinguishable from the outside and are classified as emergent errors, to take into account training techniques and instruction methods in training using simulators, the content of errors by the trainee is checked after practice. Since it is difficult to make a surgery plan in the case of some beginners, assessing the current state and intent of the surgery is difficult for them to understand. Therefore, these operational errors are classified into external level errors called easily observable behavioral errors. Types of errors and their number are shown in Table 11.

**Table 11.**Error classification

| Error type | Number of errors |
|---|---|

| | |
|---|---|
| Operational negligence | 63 |
| Extra operations | 60 |
| Operation sequence error | 24 |
| Forgot to confirm the operation | 11 |
| Repetition of the same operation | 9 |
| Other | 6 |
| Total | 173 |

In some error cases, the meaning of "stand by" was not clear to the trainee and he turned on the stand by pump. This error occurs in all pumping systems that have a main pump and a standby pump. Some errors occur due to incorrect valve operation. Operational errors occur sometimes because the pumps are far apart on the screen and their operation is forgotten. All these errors indicate that the systematic confirmation that changed the start of the machine was forgotten. Many errors in the simulator occur due to poor mouse handling.

**Table 12.**Certain operation errors

| Error details | Number of cases |
|---|---|
| The pre-pump is turned on | 40 |
| When the pump is turned on, the required valve does not open | 22 |
| The order of operation of the main engine rotation is reversed | 12 |
| Diesel oil heating | 11 |
| Failure to close the steam valve to heat the cooling fresh water | 11 |

Freeing cadets from the burden of curriculum and allowing cadets to focus on big concepts empowers cadets to follow interests, seek connections, reformulate ideas, and reach unique conclusions. Information is an individual's interpretation. The learning and assessment process is not easy to manage because it is invisible. I put forward an idea/proposal for combining the learning process between Senior Cadets (post marine practice/Semester VIII) and Junior Cadets (pre-marine practice/Semester IV). This activity is for practical learning. The Nautical Department uses the Bridge Simulator, and the Engineering Department uses the Engine Room Simulator. The learning process combines nautical and engineering. This program is called an integrated bridge engine simulator. They were divided into small groups consisting of 10 people per group. And the composition of each group consists of 5 Senior Cadets and 5 Young Cadets to practice tasks in the Bridge Simulator (Nautics Department) and Engine Room Simulator (Engineering Department). Previously, we had trained/taught each group with predetermined scenarios for practice in each simulator. In the final stage, all groups will take a practical exam (assessment). The assessment criteria for passing are a score of 70 and above, and safe conditions (no collisions, overtopping, or engine trouble/black out) and duration of implementation are also recorded for each group. And we compete in this activity, so that there is healthy competition between them. The winner is the group that gets the highest score, safe conditions, and the fastest duration of implementation. Next, the winning groups from each department were given prizes. Give examples of real interactions that you have demonstrated in improving the quality of student activities and the benefits of activities for both students at your institution and other parties involved. Interaction with students In implementing the integrated bridge machine simulator activities described previously, we have trained/guided each group to practice the predetermined scenarios. Furthermore, if there is a group that we feel is still not fluent, then we give that group the opportunity to practice again outside of the schedule. Then the end of all trial groups.

where the stages are: initial briefing, scenario implementation, and debriefing. During the debriefing, comments will be given regarding the progress of the scenarios that have been practiced, and evaluation of records of mistakes that have been made, so that they do not happen again in the future. And group members can ask about the evaluation of the implementation of their scenarios.

***Main Engine Rotating Gear Operation***

Most errors in main engine turning operations occur in operational procedures, because the mental model of the turning gear is not formed. The operation is carried out only by setting it on the CBT without paying attention to the procedure, Operation of the Cooling Jacket Heating System, Errors in the operation of the heating system occur due to a lack of conceptual knowledge about fuel oil heating and incorrect heating times. For proper operation of the system, both procedural knowledge and conceptual knowledge are required. Mistakes due to forgetting to close the steam valve also occur. This is because attention is not paid to changes in cooling jacket temperature. Such errors indicate the need for education about changes in system conditions after operation of individual equipment. Adequate explanation and instruction regarding use of the monitor is considered essential. The instructor must teach checking changes in the condition of the ship's engine installation after operation, Reaction to an Alarm by an incompetent Trainee, Operation by an incompetent engineer is highlighted when the alarm sounds. When alarms are created by incorrect operational procedures, incompetent trainee technicians tend to repeat the same procedures from the beginning. For example, when the turning motor is turned on while the indicator button is closed, the abnormal turning alarm will sound automatically. An incompetent trainee, without trying to find the reason for the operational error, tends to simply repeat the same procedure until he realizes the operational error and corrects it. This type of human error is a human error in judgment. Our study of how incompetent trainees react to alarms showed that the same operation was repeated an average of 2.5 times. When the alarm sounds, the trainee focuses his or her attention on not creating the alarm and stops the loop to avoid the alarm. Knowledge to find the cause of the error is considered insufficient. Some type of support system that helps the unskilled trainee to assume the cause of the error will be necessary in addition to simple alarms of system abnormalities. In addition, instructors must not only teach procedural knowledge, but must also teach about the methods of information acquisition needed to make appropriate judgments.

Behavior of Incompetent Intern Engineers During Operation, To characterize the characteristics of incompetent apprentice engineers, their operations were videotaped. Some erroneous operations that do not appear in the operational data list are as follows:
Opening all valves, Opening valves from top to bottom, Opening valves in a left to right direction, No equipment operation indicated, Making a mistake in setting the valve opening time on the starting air system, Making a mistake in the operational sequence of the main engine in the control room, Important analysis10. It is very easy to acquire conceptual knowledge like machine structure, etc. in classroom teaching, but it is not enough for the actual operation of the machine. Junior engineers are required to have more information about the condition of pumps that will be running or are on standby. Such knowledge, which is usually gained through experience at sea, can also be gained through independent learning with simulators. If the knowledge gained through independent learning is insufficient, it must be supplemented by the instructor. The acquisition of knowledge through the coordination of independent learning and the instructor is of utmost importance.

***Acquisition of Knowledge about the System***

Junior engineers understand the names and functions of the machines and equipment to be operated, but they often fail to understand machine and equipment combinations and their meaning. Sometimes valves near the pump are recognized and operated, but valves far from the pump are forgotten and not operated.
A common example of a lack of systematic knowledge is that they open all the valves and/or open the valves in a right to left direction on the screen. Since the simulator can overlay the ship's engine installations as energy flows on screen, it will be important to show them the system so they can understand it.

***Improved Assessment Capabilities.***

When junior technicians are asked to make some decisions during the operation of the simulator, they are responsible for operating the machine with incorrect judgment or proceeding without any judgment because they do not have the necessary knowledge for the judgment criteria. When assessment is required, the assessment criteria must be shown to them. In some cases, they succumb to operational failure under satisfactory operating conditions. The instructor must show them the conditions necessary to continue the operation.

***Proposed Solutions (Recommendations)***Implemented Roles Lecture Constructivists Roles Implemented Model Roles

The role applied by the constructively Lecture during assessment & evaluation
Constructive Learning Strategy: Building coordination and communication during the preparation of the maritime industry cadet character book, Monitoring progress, Establishing an agreement in accordance with the maritime industry system that will be adopted Implementing Various Safety Scenarios

**Table 13.**Grand design run down standard activities engine simulator training program cadet training program d.iv stip / private / junior engineer jakarta

**Description :**
ForIn this study, there were 20 Cadet Engineers who were undergoing the Engine Simulator program. On the first day, all engineer cadet members will take part in CBT (Computer Base Training) with material consisting of:
C1: SCENARIO TO PREPARE TO START.
C2: SCENARIO FOR MANEUVERING TO THE HIGH SEA. C3: SCENARIO FOR STABLE STEAMING.
C4: SCENARIO FOR APPROACHING THE PORT. C5 : SCENARIO FOR COMPLETION WITH MACHINE.
C6: SCENARIO FOR OPERATION OF AUX.BOILER AND CARGO TUBE.

**Table 14.**Senior Engineer /ATT II STIP JAKARTA

| | | | | | |
|---|---|---|---|---|---|
| **Time** | **CBT** | **ENGINE COMPARTMEN T SIMULATOR** | **CBT** | **ENGINE COMPARTME NT SIMULATOR** | **ASSESSMENT Groups 1, 2, 3, 4, 5** |
| 07.30 - 09.00 | OLS1: SCENARIOS FOR FAILURES AND EMERGENCIES | OLS1 : SCENARIO FOR FAILURES AND EMERGENCI ES | OLS1: SCENARIOS FOR FAILURES AND EMERGENCIES | OLS1 : SCENARIO FOR FAILURES AND EMERGEN CIES Y | OLS1 : SCENARIOS FOR FAILURE AND EMERGENCI ES |
| 09.00 - 10.30 | OLS2: SCENARIOS FOR TEAM TRAINING | OLS2: SCENARIOS FOR TEAM TRAINING | OLS2: SCENARIOS FOR TEAM TRAINING | OLS2: SCENARIOS FOR TEAM TRAINING | OLS2: SCENARIOS FOR TEAM TRAINING |
| *Coffee Break* | | | | | |
| 10.30 - 11.55 | OLS3: SCENARIOS FOR FAULT DIAGNOSIS AND TRACKING | OLS3: SCENARIOS FOR FAULT DIAGNOSIS AND TRACKING | OLS3: SCENARIOS FOR FAULT DIAGNOSIS AND TRACKING | OLS3: SCENARIOS FOR FAULT DIAGNOSIS AND TRACKING | OLS3: SCENARIOS FOR FAULT DIAGNOSIS AND TRACKING |
| *Lunch time* | | | | | |
| 13.00 - 14.30 | OLS4: CRISIS MANAGEMENT SCENARIO | OLS4: CRISIS MANAGEMENT SCENARIO | OLS4: CRISIS MANAGEMENT SCENARIO | OLS4: CRISIS MANAGEMEN T SCENARIO | OLS4: CRISIS MANAGEMENT SCENARIO |
| | OLS5: | OLS5: RESTORING TO NORMAL SCENARIO | OLS5: RESTORING TO NORMAL SCENARIO | OLS5: RECOVERY TO NORMAL SCENARIO | OLS5 : RESTORING SCENARIOS TO NORMAL |

**INFORMATION :**

For this study, we have 20 Operational level Senior Engineers who are undergoing the Machine Simulator

Program Course.

On the first day, all engineer cadet members will take part in CBT (Computer Base Training) with material consisting of:

OLS1: SCENARIOS FOR FAILURES AND EMERGENCIES OLS2: SCENARIOS FOR TEAM TRAINING

OLS3: SCENARIOS FOR DIAGNOSIS AND TRACKING ERRORS OLS4: CRISIS MANAGEMENT SCENARIOS OLS5: RESTORING TO NORMAL OPERATION SCENARIO

The second day of attending CBT (Computer Base Training) with material consisting of: OLS1: FAILURE SCENARIOS AND EMERGENCIES

OLS2: SCENARIOS FOR TEAM TRAINING

OLS3: SCENARIOS FOR DIAGNOSIS AND TRACKING ERRORS OLS4: CRISIS MANAGEMENT SCENARIOS OLS5: RESTORING TO NORMAL OPERATION SCENARIO

@ Day 3 and 4 practice in the Engine Simulator with material consisting of: OLS1: SCENARIOS FOR FAILURES AND EMERGENCIES

OLS2: SCENARIOS FOR TEAM TRAINING

OLS3: SCENARIOS FOR DIAGNOSIS AND TRACKING ERRORS OLS4: CRISIS MANAGEMENT SCENARIOS OLS5: RESTORING TO NORMAL OPERATION SCENARIO

@ Day 5 Assessment in Engine Room Simulator Groups 1,2,3,4,5 with material consisting of: OLS1: SCENARIOS FOR FAILURES AND EMERGENCIES

OLS2: SCENARIOS FOR TEAM TRAINING

OLS3: SCENARIOS FOR DIAGNOSIS AND TRACKING ERRORS OLS4: CRISIS MANAGEMENT SCENARIOS OLS5: RESTORING TO NORMAL OPERATION SCENARIO.

**Table 14.**Senior Engineer /ATT 1 STIP JAKARTA

| Time | CBT | ENGINE COMPARTMENT SIMULATOR | CBT | ENGINE COMPARTMENT SIMULATOR | ASSESSMENT Groups 1, 2, 3, 4, 5 |
|---|---|---|---|---|---|
| 07.30 - 09.00 | MLS 1: DIRT AND WEAR SCENARIO | MLS 1: SCENARIO DIRT AND WEAR | MLS 1: DIRT AND WEAR SCENARIO | MLS 1: DIRT AND WEAR SCENARIO | MLS 1: POILING SCENARIO AND USE |
| 09.00 - 10.30 | MLS 2: PERFORMANCE BURNING SCENARIO | MLS 2: PERFORMANCE BURNING SCENARIO | MLS 2: PERFORMANCE BURNING SCENARIO | MLS 2: PERFORMANCE BURNING SCENARIO | MLS 2: PERFORMANCE BURNING SCENARIO |
| | | | | | |
| 10.30 - 11.55 | MLS 3: SCENARIO CONTROL LOOP OPTIMIZATION | MLS 3: SCENARIO CONTROL LOOP OPTIMIZATION | MLS 3: SCENARIO CONTROL LOOP OPTIMIZATION | MLS 3: SCENARIO CONTROL LOOP OPTIMIZATION | MLS 3: SCENARIO CONTROL LOOP OPTIMIZATION |
| | | | | | |
| 13.00 - 14.30 | MLS 4 : HEAT BALANCE / | MLS 4 : HEAT BALANC | MLS 4 : HEAT BALANC | MLS 4 : HEAT BALANCE / | MLS 4 : HEAT BALANCE |

| | | | | | |
|---|---|---|---|---|---|
| | RECOVE RY SCENARI O | E / RECOVE RY SCENARI O | E / RECOVER Y SCENARI O | RECOV ERY SCENAR IO | / RECOVER Y SCENARIO |
| 14.30 - 15.30 | MLS 5: VARIABL E PITCH SCENARI O | MLS 5: VARIABL E PITCH SCENARI O | MLS 5: VARIABL E PITCH SCENARI O | MLS 5: VARIAB LE PITCH SCENAR IO | MLS 5: VARIABLE PITCH SCENARIO |
| | | | | | |
| 15.45 - 17.00 | MLS 6 : EXTERN AL CONDITI ON SCENARI O | MLS 6 : EXTERN AL CONDITI ON SCENARI O | MLS 6 : EXTERNA L CONDITI ON SCENARI O | MLS 6 : EXTERN AL CONDIT ION SCENAR IO | MLS 6 : EXTERNA L CONDITIO N SCENARIO |

**DESCRIPTION:**

For this study, we had 20 Management level Senior Engineers undergoing a Machine Simulator Program Course. On the First & Second Day, all engineer cadet members will take part in CBT (Computer Base Training) with material consisting of:
MLS 1: DIRT AND WEAR SCENARIO
MLS 2 : COMBUSTION PERFORMANCE SCENARIO MLS 3 : CONTROL LOOP OPTIMIZATION SCENARIO MLS 4 : HEAT BALANCE/RECOVERY SCENARIO MLS 5 : VARIABLE PITCH SCENARIO
MLS 6 : EXTERNAL CONDITION SCENARIO

**Practice Days 3 & 4 in the Engine Simulator with material consisting of:**
MLS 1: DIRT AND WEAR SCENARIO
MLS 2 : COMBUSTION PERFORMANCE SCENARIO MLS 3 : CONTROL LOOP OPTIMIZATION SCENARIO MLS 4 : HEAT BALANCE/RECOVERY SCENARIO MLS 5 : VARIABLE PITCH SCENARIO
MLS 6 : EXTERNAL CONDITION SCENARIO

**@ Day 5 Assessment in Engine Room Simulator Groups 1,2,3,4,5 with material consisting of:**
MLS 1: DIRT AND WEAR SCENARIO
MLS 2 : COMBUSTION PERFOMANCE SCENARIO MLS 3 : CONTROL LOOP OPTIMIZING SCENARIO
MLS 4 :
HEAT BALANCE/RECOVERY SCENARIO MLS 5 :
VARIABLE PITC SCENARIO
MLS 6 : EXTERNAL CONDITION SCENARIO

Benefits of the activity: The benefit of the integrated bridge machine simulator activity is to measure the extent of absorption of theory and practice that has been taught previously. Because this activity is comprehensive, it includes several/cross learning at once. So that the evaluation results from this activity can be followed up, which lessons are lacking, and which lessons are sufficient. And of course it must involve lecturers from each department, so that each lecturer concerned can follow up on the results of this evaluation in facing the next semester.
This will continuously improve the quality of learning, and in turn will improve the quality of the training graduates themselves.
says that knowledge is non-objective, temporary, constantly changing, and uncertain. Several things that receive attention from constructivist learning, namely: prioritizing real learning in relevant contexts, prioritizing

processes, embedding learning in the context of social experience, learning is carried out in an effort to construct experience.

Constructivism, one of the philosophical schools of knowledge which is the result of one'sown construction. The process of knowledge formation takes place continuously and there is always reorganization or reconstruction due to new understanding. Knowledge cannot simply be transferred from the lecturer's brain to the student's brain. Constructivism in the learning process Learning forms meaning Learning is the process of developing thinking by creating new insights. The learning process occurs when a person's schemes stimulate further thinking. Learning outcomes are influenced by the cadet's exposure to the physical world and environment and depend on what the cadet knows. Several things that receive attention from constructivist learning, prioritize real learning in relevant contexts, prioritize the process of embedding learning in the context of social experiences, learning carried out in an effort to construct experiences.

**CONCLUSION**

PC based ERS supports incompetent engineer trainees, Need to apply constructivist learning process & Role Play model, There is no correspondence between time to achievement and number of errors, Educational support by instructors will be indispensable for correction of such inadequacies and instructors should not only teach knowledge about basic operating procedures, but should also teach checking criteria for normal operation or abnormal operation.

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