THE TRAİNİNG OF EDUCATOR ON "MEASUREMENT AND ASSESSMENT" WİTHİN THE SCOPE OF STCW

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Abstract. Being an unseperable part of educational process, measurement and assessment is useful for determining whether the education goals are met. Basically, assessment aims at enhancing educative processes and improving student quality. A liable, appropriate, supportive kind of measurement and assessment is not only substantial for learning, but also important for progress of performance, efficiency of the process, and statistical analysis as well. Some professions, which are acquired through certain trainings, have to go through some measurement and assessment processes, for the responsibility they hold within their constitution. Namely, Maritime Education is one of them. What are the necessary criteria and methodology for carrying out a 'measurement and assessment' analysis in a top-level maritime education institution? Hence, are these familiar to the educators? Considering a measurement tool, practicability is an equally important quality as reliability and validity. A measurement tool or method being practical means that it has characteristics like ease of, objective and economic in improvability, reproducability, applicability and scoring. While carrying out the evaluation, the content of the assessment (what to measure?), the method for data acquisition (who should use which assessment tools?), technical requierements of assessment (is the assessment valid and reliable?) and where and how the assessment results are assessed should be worked out.International Maritime Organization's (IMO) STCW convention compels that adequacy of education must be assessed and continuously monitored. In 1995, the convention was revised so as to make clear the efficiency of standards, to determine efficiency needs of instructors and evaluators and to perform effective practice. The whole point in doing so is to determine a common level, while putting the stress on education.

Educators should go under a training program of which standards were set in accordance with the criteria and methodologies of the subjected institution's policy. The aim of this article is first to designate a model of "measurement and assessment training" for a maritime education faculty staff, within the scope stated above, and then to determine its efficacy. Accidents, which took place in the engine room, caused by lack of education, were assigned as the random sample within a certain period of time, and educators were trained in a way that they could assess the issue through Cluster Statistics Analysis. The reason for assigning accidents that were caused by lack of education as the random sample and collecting and assessing related records is to let the instructor base his/her criteria and measures, with which he/she evaluates the students on concrete data. By using this measurement and assessment method, the educator builds up a Stratified Calculation Schedule so as to let the educator define both the levels of efficiency which the student is supposed to acquire and and to let him gradate the measures in between. Through designing an examplar education model, the gain is to set a healthy ground where a self-evaluation method for evaluating the institutions and educators will be build up on.

1. INTRODUCTION

The concept of human factor in the seas includes the crew members serving on the ship and everything that plays a role in the interactions between any person, system or machine on the ship. According to official statistics from US Coast Guard, approximately 80 % of accidents and incidents in marine environments are due to human error or human factors [3]. If human factors in the accidents could be minimized, the number of total accidents happening could be reduced by a half. In order to achieve this improvement, it is essential to move down to the basics and conduct a study within the scope of educational institutions training seamen. This study's priority should be to comprehend the problem and discerning its dimensions; such as by determining the proportion of accidents due to human factor and examining their damages. The stage following this important determination should be statistical

assessment the parameters that are required to avert accidents and then devising a model that will ensure improvement that is also usable by the educators.

When dealing with human factor, which is the primary element in occurrence of marine accidents; it has been identified that causations like carelessness, inadequacy, lack of training, fatigue, lack of dialogue and inadequate coordination are effective. Without a doubt, it is impossible to fully eliminate the accidents caused by human factors, yet a certain amount of reduction in frequency of such accidents can be attained by avoiding those that could be prevented by additional training. The purpose of this article achieving training based improvement by devising a model and assuring its application.

In a report released by Japan's "Marine Accidents Inquiry Agency" in 2004, marine accidents that took place during 2003 have been analyzed. According to this report, among the 715 accidents that happened, 300 of them were caused by (42 %) collusion. When the collusion caused accidents were examined, it was found that 54 % of them were related to "Inadequate watching". Second leading cause was the violation of traffic rules. Other causes could be listed as failure to give sound signals, mismanagement such as giving erroneous orders, inappropriate speed, dozing off, passing ships and not reporting, and failure to display the necessary lights and signs. In the same report, 176 accidents in categorized as grounding that comprised 21 % of total accidents were investigated and an interesting situation was spotted. The foremost reason behind grounding was detected to be dozing off, with a proportion 31 %. When the other accident causes were inspected, it was seen that all of them were caused by human factors. In the same report, it is stated that only 11 % of total accidents happened as a result of mechanical breakdowns [2].

The emerging conclusion is interesting due to determination that almost all marine accidents are caused by human factor; because among the machinery failure linked accidents, the underlying factors behind machinery failures are mostly comprised of deficiencies in machine maintenance attitude and mechanical circuit management. The ratio of accidents arising from mechanical structure related technical errors among general mechanical breakdowns is only 18 % [2], [4].

2. A GENERAL INVESTIGATION INTO MARINE ACCIDENTS DUE TO HUMAN FACTOR

The main factors of accidents are unsafe acts and unsafe conditions. Unsafe Acts encompass human performance factors including operational error on the part of any crew member of a vessel, a pilot or shore personnel. Unsafe Conditions consist of any identified condition contributing to an occurrence such as: Environmental conditions, vessel condition and other conditions.

Causes of accidents in the Baltic Sea during 2006; The main cause of accidents in 2006 is not as clear as the year before due to the lack of information for 35 % of cases. However, human factor seems to continue to be the main reason for an accident to happen (36 %), followed by technical factor (15 %) (Fig. 1) [1].

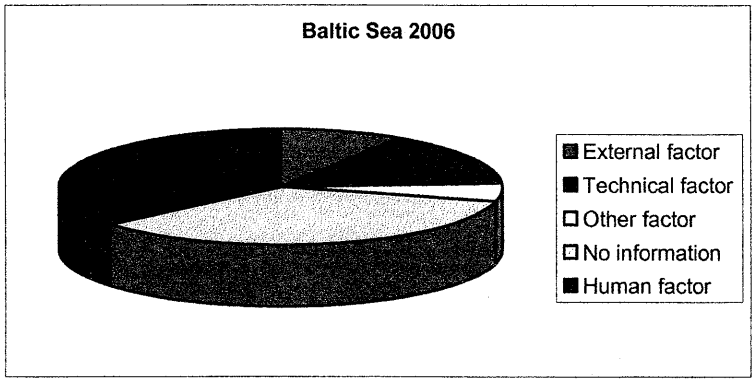

Fig. 1. Causes of accidents in the Baltic Sea during 2006, Total number of ships in accidents: 117 [1]

Human factor was also dominating in accidents with pollution, causing four out of five accident cases (Fig. 2) [1].

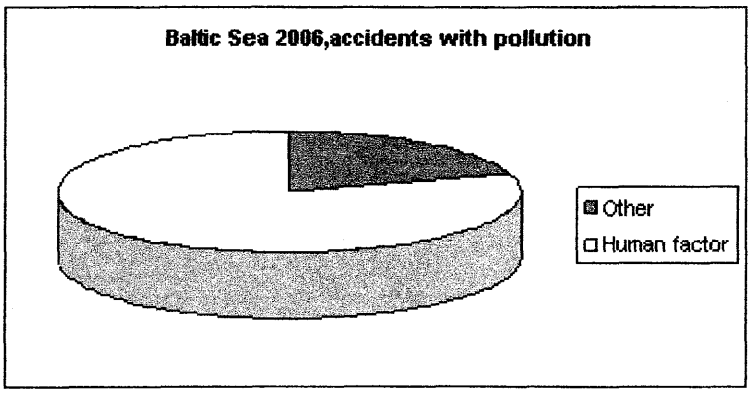

Fig. 2. Causes of accidents resulting in pollution in the Baltic Sea during 2006, Total number of accidents with pollution: 5 [1]

3. MEASUREMENT AND ASSESSMENT EDUCATION MODEL

Institutions giving Maritime Education are increasingly more required than ever to raise graduates that can renovate themselves for adapting to today's conditions, apply what they learned, develop new designs, conduct teamwork and posses communication skills. Mariners that possess these attributes will provide a significant reduction in accidents happening due to human errors. In this context, maritime accidents with human factors have been analyzed by sets statistical method in Istanbul Technical University Maritime Faculty (ITUDF) and "measurement and assessment parameters" were put together. The devised parameters have been utilized for a full academic term by the instruction personnel teaching "Electronics Laboratory" and "Automatic Control" classes in training and evaluation of the students. The data used in the statistical study that was needed for determining and classifying the parameters related to the "Measurement and Assessment Education model" has been collected from the publicly available Internal Maritime Casualties and Incidents reports, which are found in the website of Internal Maritime Organization Global Integrated Shipping Information System. The selected accidents were determined to be the 30 ship accidents taking place between Oct. 10, 2004 – May 16, 2007 and which were attributed to human error, provided that this specific cause being recorded in the accident reports.

We used to cluster statistics method for data analysis that is a multivariate analysis technique that seeks to organize information about variables so that relatively homogenenous groups, or "clusters," can be formed. Cluster analysis is relatively simple, and can use a variety of input data that is a relatively new technique. We used to four basic cluster analysis steps: data collection and selection of the variables for analysis, generation of a similarity matrix, decision about number of clusters and interpretation and validation of cluster solution. The main outcome of a cluster analysis is a dendrogram. It is shown basic steps our study which is also called a hierarchy of model diagram by us (Fig. 3) [5].

Of the investigated accidents, 21 of them were graded as very serious and the remaining 9 as serious or less serious and the classification of the accidents were determined as collision, grounding, capsizing and stopped engine. These accidents have resulted in consequences like loss of life, material damage and environmental pollution. The human errors in the accidents have been classified as inadequacies or deficiencies of the following issues; maintenance, operation, communication, observation and fault diagnosis, keeping pace with technology development, ability to conduct multiple tasks simultaneously, decision to a pressured or emergency situation, adaptation on new situation, keeping the rules, personnel

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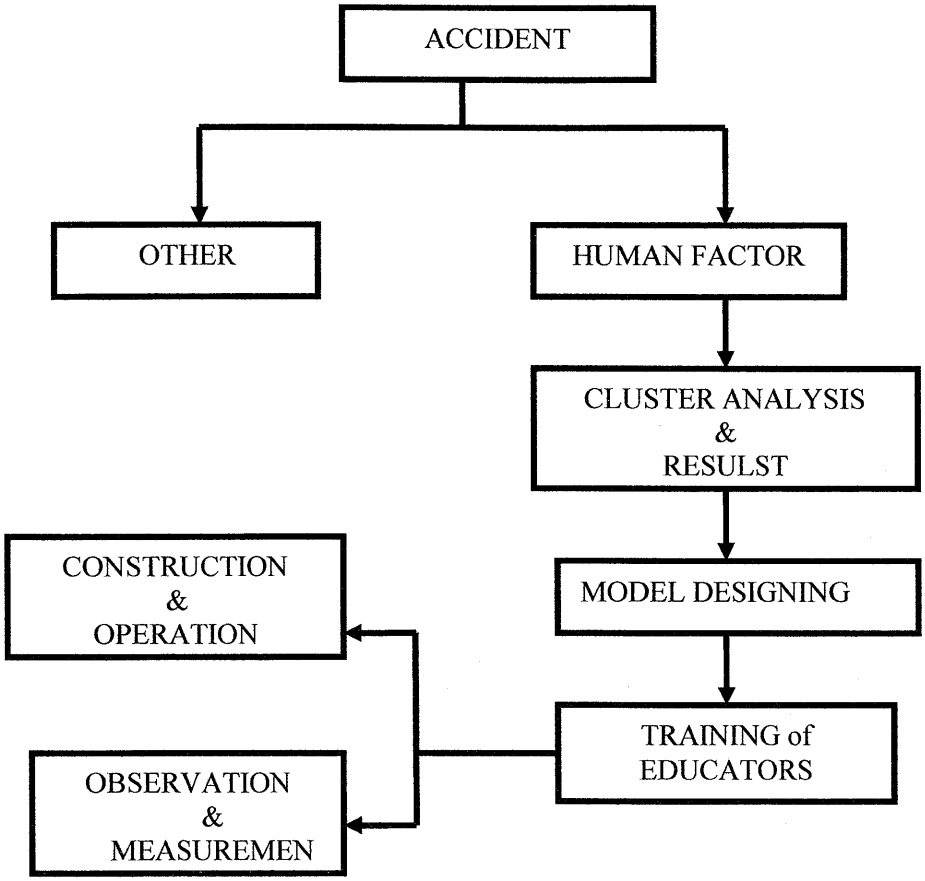

Fig. 3. Hierarchy of model diagram

responsibility, and knowledge and practicability. This classification and the seriousness grades of the accidents they resulted in have constituted the matrix base of our model. After completing the classifications and devising the coefficients that indicate the severity levels of these classifications, the application model's parameters were determined by selecting the factors that could be corrected by training (Fig. 4).

As a result of our study, it has been seen that, as much the information level given in marine education and the implementation skills, it is important that a seaman can achieve teamwork at almost the same proportion, perform a duty without delays within a hierarchical structure by using either verbal or written data transmission tools as needed, besides by virtue of leadership attributes give the most right decision, which means possessing logical thinking skills, and show controlling skills on multi-tasks.

Percentage distribution of human related errors according to ship accidents and according to severity of their damaging consequences is presented in Fig. 5 (having horizantal axis correspondes to human error types) and Fig. 6, respectively. As a result of this statistical study, it has been revealed that inadequacies associated with the adopted theory and limited practice facilities exist in classical education. It has been deduced that it is quite important for the instructor, other than individual measurement and assessment of the student, to evaluate the student with respect to interstudent communication, coordination, attitudes in leadership role, decision making under pressure and emergencies, and process of adaptation to new conditions.

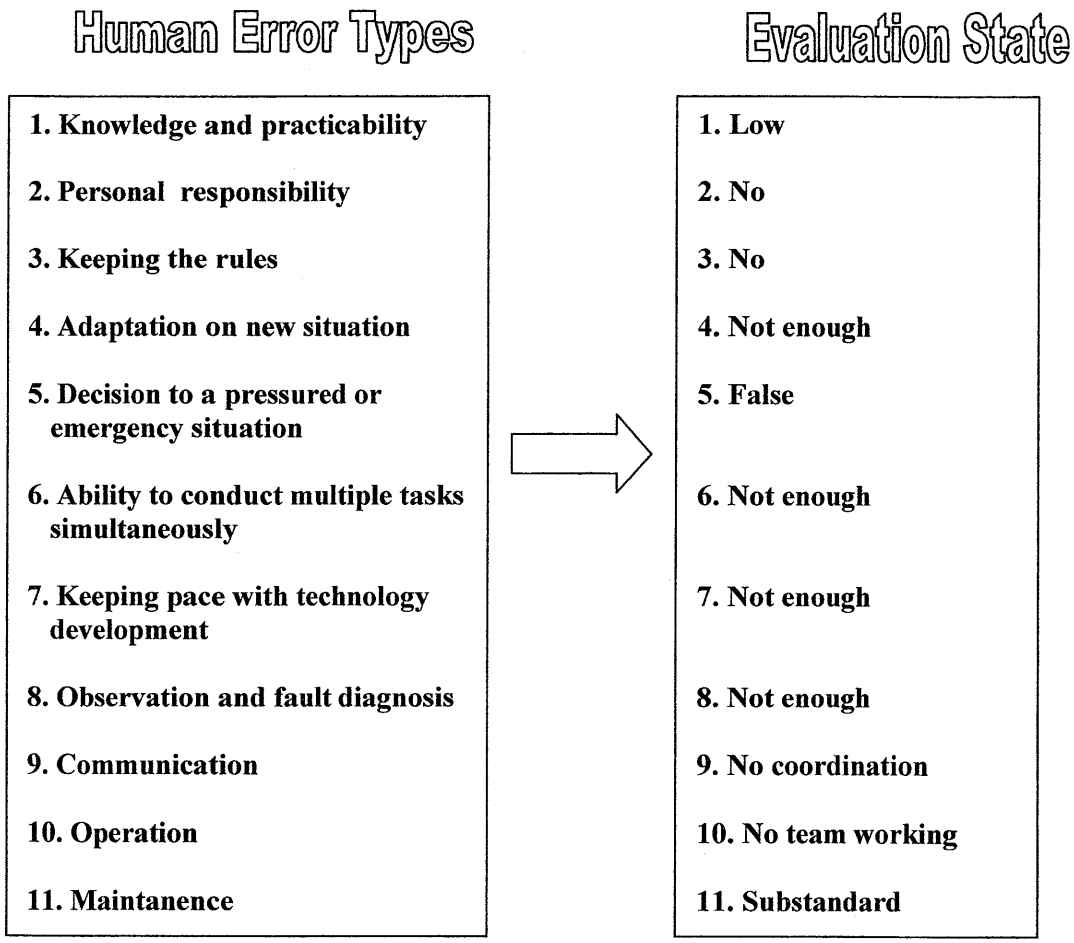

Fig. 4. Evaluation and grading parameters

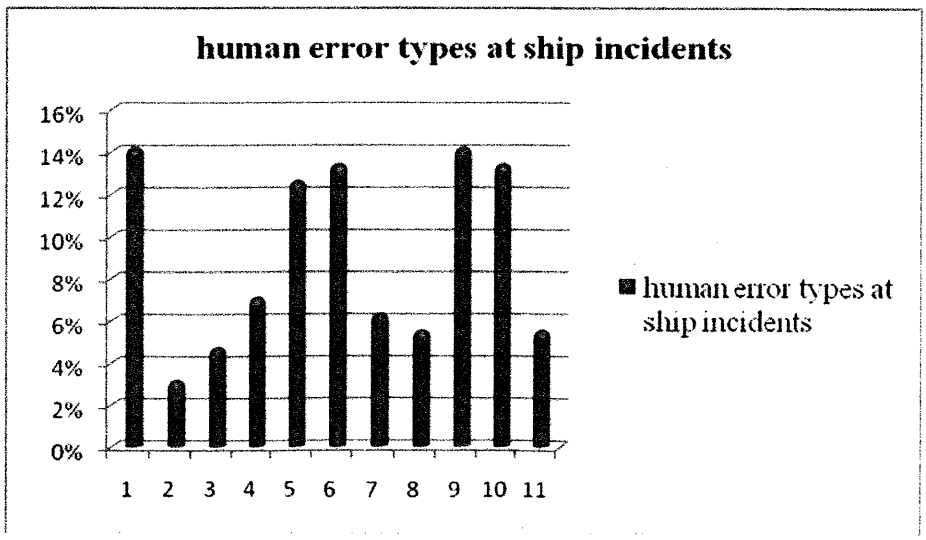

Fig. 5. Percentage distrubution according to human error types at ship incidents

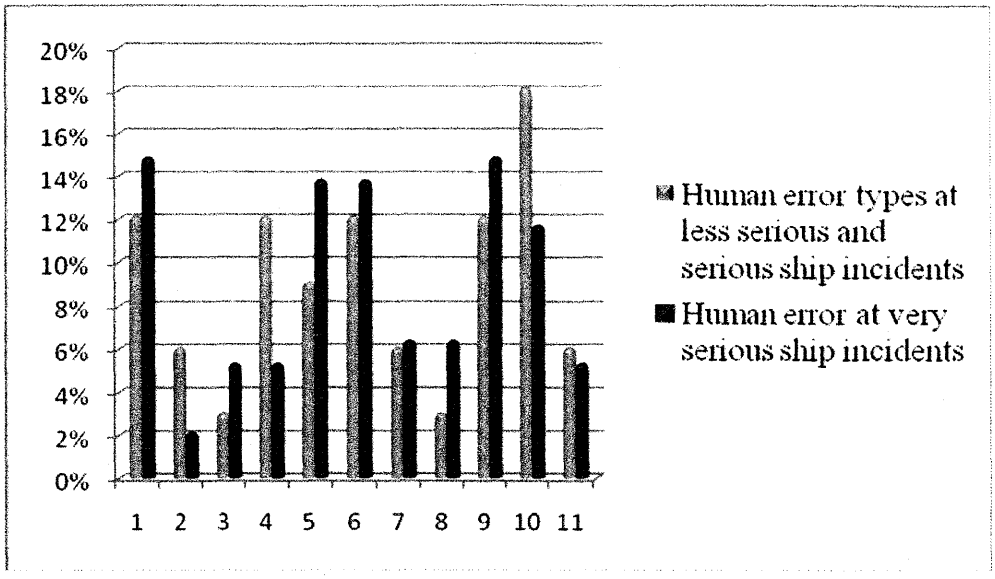

Fig. 6. Percentage distribution according to human error types at less serious – very serious ship incidents

4. MODEL STUDY ABOUT IMPROVEMENTS IN MARINE EDUCATION

The model study is student centered and provides the assessment of the student's competence in in-group cooperation, communication, task sharing, learning technological novelties by identification and practical operations, and leadership attributes. For the application of the model study, the obligation to comply with the course hierarchy with established boundaries was imposed on the student. The education in Maritime Faculty is structured as mathematics and basic sciences in the initial years, then vocational theories and methods and project and system oriented courses in the last years. In the scope of instruction structures this way, the "model" application for each course can be made more functional by dividing the course within itself into subfields and thus, the student can begin his career with relevant attributes that can neutralize the statistical parameters of the accidents.

Within the scope of faculty education program, the selection of two courses for sample application has been decided as "Electrical Laboratory" and "Automatic Control". Before moving on to the application, instructors of these courses have been trained and given information about the model and its application. Regarding the contents of the training, the instructors were informed about the basis of parameters' selection, how the parameters will be evaluated and how they can be applied in accordance with the course content. In this training, course plans have been scrutinized, examined and updated for improvement and a practice application has been performed on the instructors.

By taking into account the continuity of technological innovation; automatic control system's structural elements and the basic theory and numerical problem solution applications about the operational principles of these elements have been studied in automatic control classes. The same parameter has been addressed in Electrical Laboratory classes as well and the students have been exposed to practices about contemporary measurement devices and overcoming measurements problems. In both classes the student has been asked to bring resolutions for various error scenarios given in the scope of his individual knowledge and application level, responsibility attitude and implementations, through which the student targeted to gain education attainment towards giving the best decisions in case of encountering different problems in accordance with changing systematic structures. The student groups formed by educators and the student leaders nominated by a majority vote of these groups are targeted to attain communication and teamwork skills. For each practice study, the groups and the student leader had been changed. By this way, it is aimed for the student to show adaptation to changing circumstances. In Automatic Control

class, in practices concerning level and temperature control, the student groups are asked to obtain the expected values and as a second stage, they have been asked to obtain same measurements again under certain disruptive circumstances. For evaluation of practice work, in case of a group's failure the student leader was deemed unsuccessful and in case of a particular student's failure in the group, that group's students have been deemed unsuccessful. The purpose of this evaluation is to instill the awareness that one personnel's failure within the ship management hierarchy may lead to damaging results for all crew members and even the passengers, if there are any. For Electrical Laboratory class, the student is asked to design a testing apparatus with a different purpose every week and regarding this, information about the goals, methods to follow and expectations has been given at the beginning of the class, and relevant methods to conduct analysis of the results have been taught. For the targeted work, the groups were given instructive schematic plans. The expected measurements were obtained by the groups that designed their apparatuses by correctively construing the plans; those who implemented the plans incorrectly couldn't get any results from their measurement apparatuses. The students are asked to detect their measurement errors by classifying them into environmental factors, human related errors and errors attributed to devices. In the automatic control class, different error scenarios were given to each group by the educator and the groups were asked to bring a resolution for their problem in the most appropriate way. The presentation of the projects and administration of discussions oriented at finding the most correct solution were enabled by cooperation of the group leaders and instructors. For the discussed project topics, group leaders were held responsible in case their group was unable to come up with a suggestion of correct solution. Therefore, the students were enlightened about the scope of leader responsibility and the responsibility of a group member to offer a solution to his/her leader. Of the model studies applied for two courses during the course of one term, the study concerning automatic control class is presented in the table below (Table 1).

Table 1

Model application for automatic control

Automatic control in maritime lecture term plan	Percentage distribution in term	Student evaluation	Student evaluation to human error types
General automatic control system in marine engineering, general automatic control system structure and controller types taught, general problem solutions and simulation studies	30 %	Every student was responsible individually from written exam, and practice exam about simulation studies on a computer	Knowledge and practicibility, personal responsibility, keeping rules, adaptation on new situation
Laboratuary studies on level and temperature control done by groups of students according to various fault scenarios	40 %	1) Laboratuary studies done with groups and a leader in students, and lecturer as a observer. 2) Groups and leader changed every studies by observer 3) Groups reported their studies to a leader. If a group didn't have solution, the leader had been unsuccessfull 4) If a student gave false responce in oral examination by observer, the grup had been unsuccessfull, although the group report was true	Ability to conduct multiple tasks simultaneously, operation, maintanence, observation and fault diagnosis
Projects on possible fault scenarios marine engineering automatic control systems	30 %	1) Project studies done with groups and a leader in students, and lecturer as a observer. 2) Project studies discussed with each group; if other group gave better solution a fault scenario, the group who was responsible the problem had been unsuccessful 3) A leader changed at every problem discussion, who was responsible with a class coordination 4) A leader decided the best solution, and a leader evaluated by observer	Decision to a pressured or emergency situation, keeping pace with technology development, communication

Model applications executed for a full term has positively affected the performance of the students in the ensuing classes. For instance; a student who has taken "Electrical Laboratory" class in accordance with the model has committed fewer errors in "Ship Electronics" course's practices and has been more successful in solving the encountered problems by thinking more comprehensively. Due to "Electrical Laboratory" class being a prerequisite for "Ship Electronics", the student has committed integrated errors in this course much less frequently.

5. CONCLUSION

As a result of the statistical study conducted by utilizing the data compiled from sample accident occurrences, it has been set forth the reality that the attainments which are supposed to be given to the students during maritime education need to much more diversified than the targeted levels during classical education are. While devising the model parameters, the questions regarding the assessment's content (What should be measured?), data collection method (Which assessment tools will be utilized by whom?), technical requirements of the assessment (is the assessment valid and reliable?) have been asked and how the results of the assessment will be utilized was inquired. The instructors of the classes selected for the model application were trained and the course plans have been updated within the scope of this training and their implementation was carried out. The most important deduction from this study was to reveal the necessity that the course instructor should concentrate on application and/or project work in such a way that would support student oriented learning. While instilling academic qualification into the student, a course structure that will support highly essential attributes like responsibility, leadership, analytical thinking, problem solving and discipline should be provided as well. It has been observed that motivation of the students participating in the courses selected for the model application have increased thanks to the application and the responsibility given to him during the application. However, since application and error scenarios are gaining importance and setting up laboratories for various vocational courses and diversification of laboratory equipment and inventories is required, the total cost of a quality maritime education is increasing. In order to lower the cost hike, the applications may be virtually carried out by appropriate software. Instructors in the academic crew should be supported to make them able to program these software products. Besides, graduation and post-graduate thesis work can be directed at the simulation to make the studies more diversified.

The model devised as a result of the conducted study is in conformity with STCW Convention of International Maritime Organization (IMO) and is suitable for their educational competence assessment and continuous watching; however the model parameters can be augmented to constitute a more detailed version. The most essential condition for applicability of the model is the educator instructing the course being trained about the model's materiality and adaptation of its parameters to his classes. Human related errors are expected to be significantly reduced due to systematic application of the model in institutions giving maritime education.

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