Fire Fighting Training for Officers and Captains: A Problem Based Learning Approach

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Abstract

Problem based learning (PBL) is a new and more effective method of training compared to traditional education systems, which has been applied in different types of disciplines with a great success. Previous academic research has found out that the candidates trained with PBL have higher curiosity for learning objectives, greater gained abilities, a longer time of remembrance also with sustainability of learning all through their work life.

In maritime academic training, PBL is not a commonly used training method. With all its well worthy properties, which will be described through this paper, PBL can match maritime training consistently. For this purpose Dokuz Eylül University, School of Maritime Business and Management is working on matching PBL in maritime training program with STCW 78/95.

Emergency procedures, which are one of the core subjects of maritime training, require specific methods and equipment according to SOLAS. Especially fire fighting course for officers and captains should be designed and held with diligence. As SMBM we have developed a new curriculum and a special LEARNING RESOURCES LABORATORY for fire fighting training in accordance with STCW 95 Section A-VI /1-2 "Fire Prevention and Fire Fighting" and Section A-VI /3 "Advanced Fire Fighting".

This paper describes our new Fire Fighting Training System complied with PBL, specifications of our Learning Resources Laboratory for Fire Fighting Training, and the methods used for learner satisfaction measurement.

1. Introduction

Every seafarer who have worked onboard knows very well that, shiplife is always full of problems which requires immediate solutions. Problems are variable depending on the seafarer's education, experience and organisational culture. Forwarding the existence of the problem, to identify the problem and to find solutions for the problem are the most important skills to gain for a future deck officer. As they graduate from the school they instantly become `decision makers`. After they commence their jobs professionally, they will not be given any chance to make wrong or bad decisions.

However, statistics on marine casualties indicate that a common "signature"--that of human error--is present in most maritime disasters. To address this problem, the marine industry must strive to minimize poor human decisions that contribute--directly or indirectly--to a casualty or pollution incident. Education and ***training*** are an effective way to achieve this goal [Wang, J & Zhang S.M. 2000]. According to Nutt [1990] primary reasons of bad decisions of a decision maker are described as; core problems are often taken for granted, and premature commitments to action are made without any clear notion of what is provoking the need to act. Solution can displace problems, symptomatic signals can be considered, and urgency can be misinterpreted. Under these circumstances, accurate and fast decision making is said to be a necessary skill to be gained education should be aimed at training students how to deal with problems in the future, preparing themselves to become active, independent learners and problem solvers, rather than more or less passive recipients of information. [Dolmans & Schmidt 1996].

What does maritime training aim? Todays maritime training founded on the basis of traditional education methods, have became unconscious because of the past and new standards. At this process of fast changes, educational systems, which are open systems, must be more sensitive to all changes. Education systems have two chances : adopt themselves to the process or become a pioneer of process. There is only one other way, which must not be considered, that is to fall behind and rut in a process called `entropy`. The education systems that have changed and keep changing, started to force marine education which is a part of the open system.

A lot of expert seeking for developments at maritime education declare that marine education is in need of changing. Mokhtar (2000) indicates that ISD model and IMO model courses bring system approach to marine education, while Ruan (2002) highlights "enhancing practical skills" and "flexibility of curriculum" problems.

Lewran (2002) indicates that lots of universities have been changed and commenced to apply new educational methods. Lewran also mentions that if maritime education and training providers want to survive and grow, it is essential to participate in these changes now. All of these approaches are pointing us that a change is inevitable for maritime training. For these reasons, Dokuz Eylül University, School of Maritime Business and Management is working on matching Problem Based Learning in maritime training program with STCW 78/95.

2. Definition of PBL

Problem-based learning is an instructional method that is said to provide students with knowledge suitable for problem solving. [Schmid 1983]. While founding the structure of PBL , firstly the target objectives of

- Knowledge
- Skills
- Attitudes

are determined, than the suitable training for this purpose is planned. All the objectives are put in order and the yearly learning targets appear through the process. Planned and sequenced learning objectives are presented to students as a problem in a scenario. Principles for prepared scenarios are as below.[Dolmans 1997]

- The contents of case should adapt well to student' prior knowledge.
- A case should contain several cues that stimulate students to elaborate.
- Preferably present a case in a context that is relevant to future profession.
- Present relevant basic science concepts in the context of a ..... problem to encourage integration of knowledge.
- A case should stimulate self-directed learning by encouraging students to generate learning issues and conduct literature searches.
- A case should enhance students interest in the subject-mater, by sustaining discussion about possible solution and facilitating students to explore alternatives.
- A case should match one or more of the faculty objectives.

A scenario based on above principles takes around two weeks, consisting of 4 sessions about 3 hours each. The sessions are held with small groups consisting of maximum 8 persons each; determine the learning objectives themselves depending on the problems presented in the scenario. Until the next meeting, students use their free learning periods and study on the objectives, which they have derived themselves. When they meet again the students share their knowledge, which they have gained individually and elaborate on the problem applying the new knowledge they have gained. All through the process, between the meetings, laboratory applications, Learning Resources Laboratory practices, simulator training, presentations, field study and supporting educational activities will be carried on by expert lecturers, based on the predetermined skills and attitude achievement objectives planned within the scenario.

In PBL curriculum there are no particular classes such as navigation, compass, emergency procedures etc. A deck officer, an engineer, a captain who is supposed to be decision maker should not decided sticking work to single dimensional aspects, because every operations' macro environmental factors such as low-politics, economic, technologic, social-cultural, environmental, demographic and also micro environmental factors must be considered. To do this he /she has to integrate all the knowledge and use all of them together. This approach puts the maritime training into a multi-discipliner form.

The scenarios of PBL should be modified in accordance with feed-back of the system every year, so the curriculum can be developed and new learning objectives can be inserted into the system easily and this makes the PBL an alive system. The problems, such as, the unachieved objectives can be fixed easily trough the flexibility of the curriculum. At PBL system an intensive control and corrective actions must be carried out. Besides, system administrators should not be afraid to make mistakes, because the learners themselves will force and correct the system with their well-gained skills of researching and curiosity.

Dokuz Eylül University, School of Maritime Business and Management has been working on PBL system for 18 months and will commence the system at 2002-2003 semester. Some call this change "a transformation" while some call "reengineering and even some may call " metamorphosis". What ever you name it if you complain about the present system you have to keep changing not to suffer entropy.

3. Fire Fighting Training

Emergency procedures, which are one of the core subjects of maritime training, require specific methods and equipment according to SOLAS. Especially fire fighting courses for officers and captains should be designed and held with diligence. IMO have declared the standards of the prementioned trainings in accordance with STCW 95

Section A-VI /1-2 "Fire Prevention and Fire Fighting" and Section A-VI /3 "Advanced Fire Fighting" and curriculum of the training is recommended at "Fire Prevention And Basic Fire Fighting (Model Course 1.20)" and "Advanced Fire Fighting (Model Course 2.03)" . Almost all of the curriculum are prepared as reactive based training and focuses on mainly fire fighting fundamentals instead of fire extinction principles that should be the core issue of fire training for decision makers who are expected to assess, get rid of or minimise the potentials of fires before they occur. Are the decision maker officers supposed to be fire fighters or fire preventers? It is beyond arguments that fire fighting techniques is an essential part of training but it should be considered only as an ability to gain.

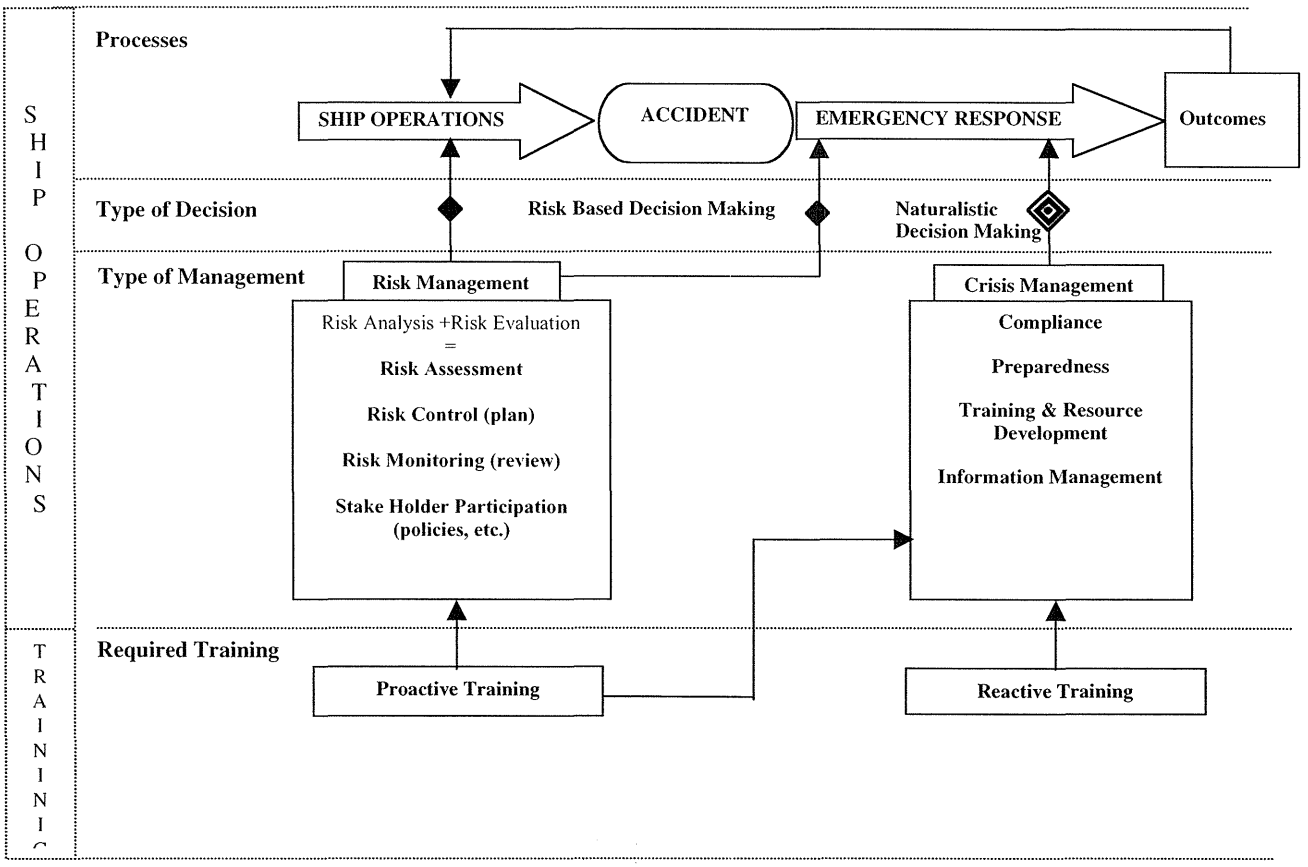

Figure 1 The Role of Training in Ship Operations.

All of the shipboard operations have a risk of fire. Some of the operations, which are carried out at the same time, creates synergy and increases the risk. The important point is each one of the decision maker's ability to risk determine the risk while considering the whole operation as shown **Figure 1.** Risk-based decision making asks the following questions and uses the answers in the decision-making process:[Bert M.]

- What can go wrong?
- How likely are the potential problems to occur?
- How severe might the potential problems be?
- Is the risk of potential problems tolerable?
- What can/should be done to lessen the risk?

Risk based decision maker needs proactive training methods for developing safety culture on board. Extinguishing operations are, one of the operations, which require risk management and crisis management have appropriate learning objectives that is maintain with reactive training methods. And in this situation, decision maker applies naturalistic decision' techniques.

Fire Fighting Training System, which is complied with PBL well fit to constitute safety culture. Because Every safety matter can be integrated with the scenarios. Thus proactive training can be developed easily by PBL. Practical skills, which are required for fire fighting reactive training, can be enhanced by special Learning Resources Laboratory for fire fighting training. A Special Learning Resources Laboratory for Fire Training Courses is proposed to be consisting of following items:

- 40' container with fixed fire pumps.
- 30 cubic meters closed space to use closed space fire, includes,
    - Fire glass, Fixed CO_2 system, Fixed Foam system, Sky Lights, Cowl, Fixed oil line
    - Fire Detectors, Fire Station, CO_2 Box, Sprinkler, etc.
- 4 square meters fire pool to use for open air fire.
- Fixed deck foam gun.
- Other fire fighting equipment
- 8 cubic meters holds model which is equipped fixed CO_2 system.
- Model of life boat manoeuvring pool.

4. Objective

The purpose of this study is to measure the perceptions of the deck officers and the engineers who work as decision makers onboard. The cause of the ship fire and the views of the respondents about maritime fire training have been questioned. The perception differences of deck officers and engineers who are in charge of different operations will be used to highlight Fire Fighting Training System compiled with PBL.

5. Hypothesis

The main hypothesis is developed to test the objectives built on the comparative analysis of the populations:

$\mathbf{H_1}$: Causes of ship fires are perceived different by deck and engine officers.

The main hypothesis, considering the perceptions on the causes of ship fires is given in **Figure 2**. To support $\mathbf{H_1}$, the following sub-hypotheses are stated applying both for the Engine and Deck Officers.

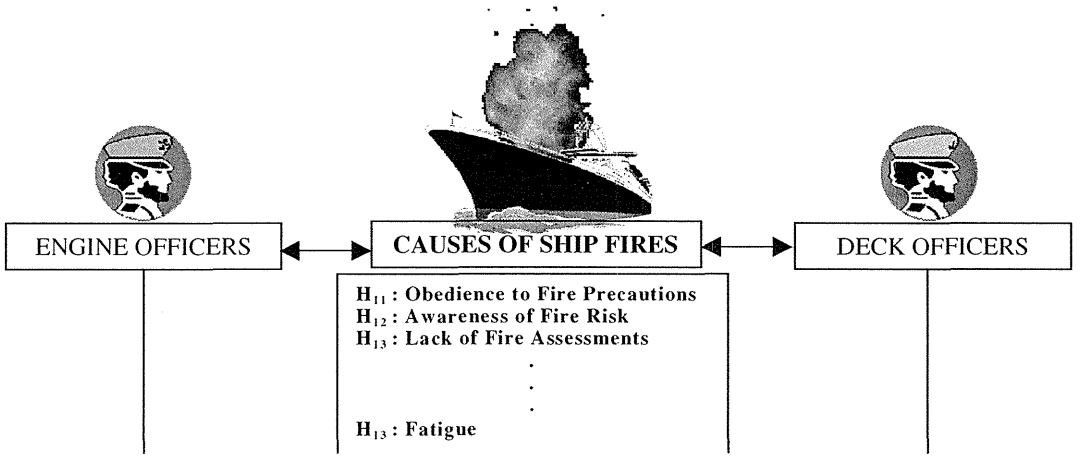

Fig. 2 Comparative Analysis for Perception of Causes of Ship Fires

6. Methodology

6.1. Questionnaire Development

To test the hypotheses of the research, a questionnaire consisting of 4 different parts is developed. The first part covers 5 open-ended and multiple-choice questions on the general information about the officer, for the purpose of profile establishment. The second part covers 6 questions on the fire risk on the board. . The third part covers 9 questions on the fire risk in the engine room. The fourth parts focus on the causes of ship fires measures stated in **Figure2.**

A set of totally 20 statements is formed on a 5-point Likert-scale (1= completely disagree, 5= completely agree) and the opinions of the respondents are proposed to be collected.

6.2. Sample

the sample is chosen among the trainees who have received STCW 95 section A-V1/3 advanced fire fighting courses. The respondents are the trainees who attended the Advanced Fire Fighting course at Dokuz Eylül University, School of Maritime Business and Management., totalling 72, which are all have been working as an officer (deck and engine). All of the respondents nationality is Turkish. The courses were realized during the interval from 15.05.2002 from 15.05.2002 to 26.07.2002. The questionnaires were collected at the beginning of the cources. Participants' profiles are given in **Table 1**. The 30 trainees are deck officers or captains. Others are engineers or chief engineers.

Table 1. Profiles of Respondents

	Age	Experiences (year)	Level of Education		Officer & Engineer & Captain	
			Bellow HE.	HE.*	Deck	Engine
N of Valid	72	69	40	32	30	42
Missing	0	3	0	0	0	0
Mean / Percent	37,93	13,32	55,6%	44,4%	41,7%	58,3%

HE* : Higher Education

6.3. Data Analysis Procedures

The research covers a comparative hypothesis. The questionnaire consists of different types of statements, Data processing is maintained by the SPSS (Statistical Package for the Social Sciences) Program. The hypothesis that is based on Likert-scale questions, ending in interval data, are comparatively analysed for perceptions of ship fire causes for Engine officers and deck officers using t-tests. Means for the sample sizes and the standard deviations are also calculated to support the t-tests. The results of the t-tests are used as a basis for the factor analysis, a factor analysis on couses as ship fires is accomplished and, finally, to test the reliability of the factor groupings reliability analysis is applied.

7. Evaluation and Results

The perceptions of the fire risk on the board is measured by the second part of questionnaire as shown **table 2.**

Table 2. Fire Risk on The Board

	Engine	Accommodation	Bridge	Holds	Deck	Galley
N of Valid	71	69	65	68	67	70
Missing	1	3	7	4	5	2
Mean*	**4,5352**	3,4348	**2,1692**	3,4853	2,4328	4,2286

*5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree

The perceptions of the fire risk in the engine room is measured by the third part of questionnaire as shown **table3.**

Table 3. Fire Risk in The Engine Room

	Workshop	Generator	Boiler Boiler Room	Bilge	Funnel	Exhaust valves and manifold	Main Engine Space	Engine Cont. Room
N of Valid	65	65	66	68	68	69	67	68
Missing	7	7	6	4	4	3	5	4
Mean*	3,0000	3,0000	3,8182	3,7059	3,8676	3,9565	3,3582	2,4412

*5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree

7.1. Results of the Hypotheses Tests

The main hypothesis of the study aimed searching for the causes of ship fire with respect to differing approaches in the complete populations of the Engine Officers and the Deck Officers.

Tests for H_1 :
The hypothesis, $\mathbf{H_1}$ was based on the comparison between perceptions of the Engine Officers and the Deck Officers considering causes of ship fires. The results of the tests are summarized in **Table 4.**

Table 4. Comparative Analysis of Perceptions Measures for the Cause of Ship Fire by the Engine and Deck Officers: Results of the Hypothesis Tests for H_1

Hypothesis	Method of Analysis	Support
$\mathbf{H_{11}}$: Lack of obedience to fire precautions is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{12}}$: Lack of awareness of fire risk is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported t=2,6372 p<0.05
$\mathbf{H_{13}}$: Lack of officers training on assessment of fire risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{14}}$: Failure of the ship owner is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{15}}$: Lack of information on fire causes is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported t=3,3004 p<0.05
$\mathbf{H_{16}}$: Lack of regular maintenances on board is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{17}}$: Carelessness by dissatisfactions is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported t=2.0730 p<0.05
$\mathbf{H_{18}}$: Lack of ratings training on assessment of fire risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{19}}$: Lack of proficient in operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported t=2.5661 p<0.05

H_{110}: Focusing only on fire fighting not causes of fire is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{111}: Non-compliance with SMS is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{112}: Fatalistic Approach is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{113}: No evaluation of the fire evidences is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{114}: Lack of training on causes of fire is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{115}: Lack of tidiness and cleanliness is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Supported t=2.1471 p<0.05
H_{116}: Owner pressures for risky operations is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Supported t=2.9338 p<0.05
H_{117}: Keeping some evidence operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{118}: Unawareness of Cargo Risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{119}: Unrecognised the fire risks in the ship operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{120}: Fatigue is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported

7.2. Factor Analysis

Reliability coefficient which is measured causes of ship fire is 0,8569. **Table 5** analyzes the six sets of factors obtained for the causes of ship fires through the factor analysis. The six factor groupings in the order of their reliability are respectively (1) lack of training and lack of fire risk assessment, (2) Human Element, (3) Management Failure, (4) Operational Failure (5) Owner Failure, (6) Tidiness and Cleanliness.

Highest factor loadings are:

In terms of the frequencies of the responses given to the Likert-type statements, Non-obedience to precautions (4,4028) emerge as the most important cause of ship fires. The second most important Cause of ship fire is unawareness of cargo risks (4,2754) followed by the lack of training on causes of fire (4,2286), Non-compliance with SMS (4,2254) and lack of ratings training on assessment of fire risks (4,1127). As can be noticed, statements relating to lack of training and lack of risk assessment in general have received the highest attributes.

Tablo 5 : Factor Analysis in Causes of Ship Fire

Factors CAUSES OF SHIP FIRE	Alpha	Mean*[1]	SD*[2]	Factor Loading I	II	III	IV	V	VI
	0,8569								
LOT*[3] & FRA*[4]	**0,8543**								
LOT Officers on FRA		3,8889	1,3006	**0,6408**					
Fire Causes & Precautions		4,0833	1,2190	**0,5929**					
Lack of Regular Maintenances		3,7917	1,1979	**0,6219**					
Carelessness by Dissatisfactions		3,7222	1,3132	**0,4802**					
LOT Ratings on FRA		4,1127	1,0630	**0,8055**					
Lack of Proficient in Operations		3,8857	1,2688	**0,8094**					
Focusing Only on Fire Fighting		3,8592	1,17468	**0,4493**					
LOT on Fire Causes		4,2286	1,8710	**0,8502**					
Human Element	**0,7442**								
Fatalistic Approach		3,1549	1,6958		**0,6026**				

Keeping some evidence		3,3380	1,2789	**0,4964**				
Unrecognised fire risks		3,6056	1,1146	**0,8229**				
Fatigue		3,4507	1,2281	**0,7965**				
Management Failure	**0,5051**							
Non-compliance with SMS		4,2254	1,0447		**0,6665**			
Unawareness of Cargo Risks		4,2754	0,9983		**0,8265**			
Operational Failure	**0,5533**							
Non-obedience to Precautions		4,4028	0,8502			**0,7189**		
Unrecognised Risks of Operation		3,8194	1,2256			**0,7787**		
No evaluation of the Evidences		3,8873	0,9706			**0,4624**		
Owner Failure	**0,4127**							
Responsibility of Owner		3,3333	1,3531				**0,7263**	
Owner pressure for risky opera.		3,4783	1,2789				**0,6813**	
Tidiness and Cleanliness								
Tidiness and Cleanliness		3,8873	1,7636					**0,8011**

*[1] 5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree *[2]Standard Deviation
*[3] LOT : Lack of Training *[4] FRA : Fire Risks Assessment

8. Conclusion

Some hypothesis which are Lack of awareness of fire risk ($\mathbf{H_{12}}$), Lack of information on fire causes ($\mathbf{H_{15}}$), Carelessness by dissatisfactions ($\mathbf{H_{17}}$), Lack of proficient in operations ($\mathbf{H_{19}}$), Lack of tidiness and cleanliness ($\mathbf{H_{115}}$), Owner pressures for risky operations ($\mathbf{H_{116}}$) are perceived different for cause of ship fires by Engine and deck officers. According to factor analysis, statements, which are "lack of training" and "fire risk assessment", are grouped in the first factor, which is the highest loading factor. Considering deck officers and engineers are responsible and in charge of different operations, risk management must be held separately for each operation and also methods of fire training should differ. The differences may be applied to the training of the operations, which the learners are going to be responsible for. All the training related to shipboard operations must contain risk management. Contemporary training methods should be based on trainee based proactive training with multi-disciplined applications instead of trainer based reactive training with single-disciplined applications, which are the basics of the traditional educational system. Problem Based Learning seems to be an ideal tool for the achievement of such radical changes.

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