TRANSNAV International Journal on Marine Navigation and Safety of Sea Transportation
Volume 6 Number 1 March 2012

A Methodological Framework for Evaluating Maritime Simulation

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ABSTRACT: The application of simulation courses according to STCW conversion is addressed to the education of marine deck and engine officers in order to familiarize with the working environment, emergency contingency training and trouble shooting. This paper presents a framework which evaluates the participants in the courses of simulator, according to their concerns and their level of use. Actually this framework is an innovative concept which tries to identify how the contributors think and work in this virtual environment. The results from the application of this framework are presented in this paper, based on student's concerns, reactions and level of use with respect to the exercise and efficiency of simulation training courses taken place at the Merchant Marine Academy of Engine Officers on Chios Island. The main goal of our research is to promote a general framework which can be easily applied in any marine simulation curses and will be very useful to the instructor for reorganizing, redesigning and finally configurating the Simulation Courses according to their participant.

1 INTRODUCTION

According to STCW section A-I/12"..... the simulator shall be capable of simulating the operating capabilities of shipboard equipment , to a level of physical realism appropriate to the training and assessment objectives.....".

In trying to identify the capability of maritime simulator course, we can say that is multifunction's tool through which special techniques in ships handling either to deck or to engine department can be promote. More specifically, we can say that maritime simulator can work a knowledge accelerator for the seafarer in order to protect the human life at sea and the environment protection.

Actually the simulator course is an interactive course among the machinery, the instructor and the students. But how do those three ingredients interact with each other, under which pedagogic model? And finally who makes the evaluation and the assessment of this course?

Those are some of the main questions which we will try to answer through our research.

The main goal in most of the pedagogic theories is what finally the students take from the course in long term future and not by the end of the course. From literature view the closer pedagogic theories to the virtual learning like maritime simulation are: Problem based learning, Discovering Learning, Learning by exploration, just in time teaching, Case based learning. The main guide line in all this theory is that the evaluation of the course stems from the interaction between the student and the instructor.

Based on this acceptance, in our research we will try to apply the Concern Based Model in Full Mission Engine Room Simulator which has steadily been introduced and corresponded to a fraction of the academic syllabus in the merchant marine academy of Chios. This Study is a part of an expanded research according to the Concerned Based Adoption Model (CBAM) which includes the:

– Stage of Concerned

– Level of Use

Within this paper, the value of simulation along the stage of concern and the Level of Use of simulator taught courses will be examined. Data are extracted from student reactions that have participated and experienced simulator applications. The analysis was based on the theoretical model C.B.A.M. Results are extracted and anticipated to present the perception skills of participating students as well as their reactions and feedback.

The scope of the analysis is to obtain results that will enable the academic staff to ascertain the needs and requirements for improvements in order to develop more resourceful and efficient methods for simulation course education. Thus the application of simulators will be far more productive for the participating students enabling them also to be adapted in the real working environment.

The objective goal of application of simulator courses is the reproduction of virtual reality cases/problems that converge to the real operation techniques and troubleshooting that the officers might encounter during real operation at the ships engine room.

By evaluating the performance of simulator courses it is anticipated and expected to improve the offered education; thus the candidate officers will make a success when they face the "real world". It will be a virtue and success of the academic schools that are associated with the maritime education to graduate qualified officers who are not only qualified graduates but they also bare the knowledge and ability to undertake and effectively execute their duties without any doubt and with the expected professionalism and responsibility.

2 PARTICIPANTS

The participants who took part in the CBAM questionnaire are students of Merchant Marine Academy on Chios Island. The Academy was founded in 1955 and currently the supported by the Greek Ministry of Economy, Competitiveness & Shipping. The duration of studies is 4 years amongst which 12 months are practice on merchant marine vessels. The rest three years consist of a syllabus of theoretical and laboratory courses. The Orientation of Students is both theoretical and technical education according to Sandwich Courses and STCW. Graduates are granted with the diploma of 3rd Engineer of Merchant Marine.

By total of sixty five students that participated in the course of simulation during spring (half-year) period 2008-2009, fifty questionnaires were collected in total. Nine questionnaires were not fully completed thus they were excluded from the analysis.

In order to present a complete picture for the standards and knowledge of the participating students the following are noted:

– The students are in a percentage of 60% of 20-22 years if age.
– Most students came from high school with general education, in a percentage of 46, 3%. This fact determines that they are individuals with high level of theoretical knowledge.
– Those that emanate from high school with technical education represent a percentage of 43, 90%.
– All of them declare that they have been trained in the use of the English language and they evaluate their knowledge as on average level in a percentage of 60%.
– Only a percentage that reaches the 17% is aware of a second foreign language, mainly German also reported to be used at an average level.
– The students that participated in the research have completed the compulsory educational travels, thus they have completed their practical education, therefore, it is agreed that they have a completed aspect with regard to their education as well as the profession they will follow upon successful graduation.
– In the submitted questions to the students referring to the level of education, a percentage of 78% declared satisfied while a percentage of 48% evaluated the level of education as very good.

3 CONCERNED BASED ADOPTION MODEL, (C.B.A.M)

The Concerns-Based Adoption Model- (CBAM) mainly deals with the effort of description, measurement, and explanation of process of change in education.

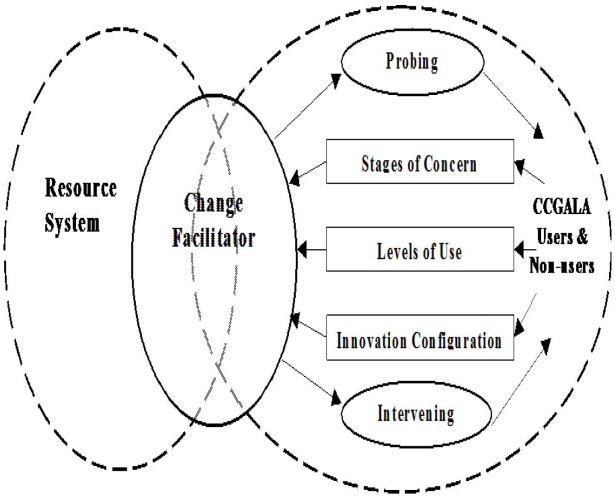

Figure 1. Concern Based Adoption Model

The CBAM, is experienced both the instructors and their students that try to apply and follow new procedures in teaching and studying as well as the implemented educational material and practices. With the assistance of figure 1, it is shown that CBAM is a framework designed to help change facilitators indentify the special needs of individuals involved in the change process and address those needs appropriately based on the information gathered through the model diagnostic dimensions.

With those diagnostic data, the instructor could then develop a policy for any required interventions in order to facilitate the change effort. Together the SoC and LoU provide a powerful description of the dynamics of an individual involved in change; one dimension focusing on feelings, the other on behaviorural patterns.

4 STAGE OF CONCERN

Stages of Concern provide a framework from which to understand the personal side of the change process. According to this we assign different priorities and level of interest the things we perceive, individually and in various combinations, but most of the time we have little or no interest in most stimuli. Concerns are an important dimension in working with individuals involved in a change process like the simulation course in the maritime education.

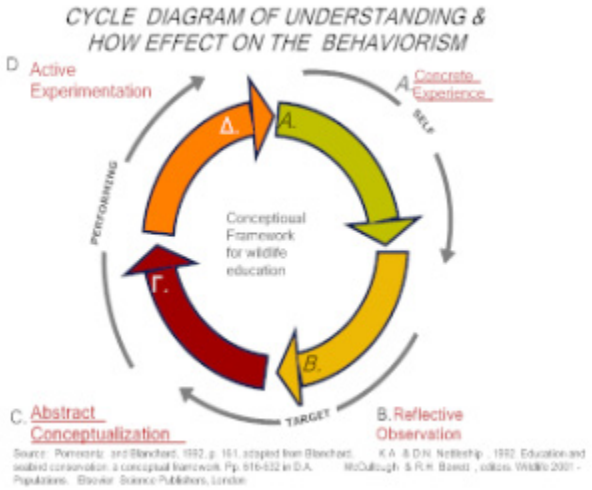

Figure 2 : Cycle Diagram of understanding

Seven Stages of Concern about an innovation have been identified (see figure 2).They are called stages because usually there is a development movement through them. The participants of a simulator course may experience a certain type of concern although in the process they may experience another kind of concern. Another type of concern may emerge. The Stage of Concern about a simulator course appears progressively from little or no concern, to concern about the task of adopting by simulator, and finally to concern about the whole impact of the simulator course. The Stage of Concern Questionnaire (SoCQ) is the primary tool for determining in which stage the individual is.

5 THE LEVEL OF USE

The levels of use represent models of behavior which are classified in eight separate categories. The focus is on what the individual is doing or not doing. Those behavior models mainly focus on the actions of individuals which have completed the course regardless if the outcome is successful or not (see table 2). Each model is recorded and analyzed as well as a series of individual reactions that are also connected with the particular behavior. The result is drawn on a table 5 that consists of the levels of use along with the seven categories which we are examining and the predetermined behaviors

6 METHODOLOGY-ANALYSIS

The methodology utilized in this research is the *focused interview*. A typical questionnaire contains questions in which we usually anticipate answers that are related to questions asked during each structure of object.

6.1 *MEASURING THE STAGE OF CONCERN*

The Stage of Concern Questionnaire (SoCQ) are developed in order to measure the concern of the individual. The data analyses were based on the following:

1 Determine the highest perceived concern for each participant, along with one or two also high concerns. The remaining stages are characterized by default, of lower concern.
2 SoCQ percentile stage scores (seven plus total)

The validity of the stage of concern questionnaire is investigated by examining the highest and the lowest scores at each stage separately and related to one or another stage. In the duration of the investigation all the other variables as concerns theory seizes are taken into consideration.

The participants in this study used a 0-7 scale to respond each item. The highest response indicated that the person considered items in its scale; the sum of the scale scores constituted the total score. Examining both the highest and the second highest a more detailed interpretation is possible. Analyzing the complete profiles allows us the most sensitive interpretations of responders.

6.2 *MEASURING LEVEL OF USE*

As a definition, the Levels of Use are the sequence a user which follows during his progression while using an innovation. It is addressed to the adapted methodology by the user while he gains his confidence with his developed skills in order to ascertain the use of the educational innovation. Following the same logic, however, a different individual may remain unchangeable during the duration of process of change.

Table 1. STAGE OF CONCERN

Stage of Concern	Expression of Concern
6. Refocusing	I have some ideas about something that would work even better.
5. Collaboration	How can I relate what I am doing to what others are doing?
4. Consequence	How is my use affecting learners? How can I refine it to have more impact?
3. Management	I seem to be spending all my time getting materials ready.
2. Personal	How will using it affect me?
1. Informational	I would like to know more about it.
0. Awareness	I am not concerned about it.

Table 2: The level of use of the innovation

Levels of Use of the Innovation: Typical Behaviors

Levels of Use	Behavioral Indicators of Level
VI. Renewal	The user is seeking more effective alternatives to the established use of the innovation.
V. Integration	The user is making deliberate efforts to coordinate with others in using the innovation.
IVB. Refinement	The user is making changes to increase outcomes.
IVA. Routine	The user is making few or no changes and has an established pattern of use.
III. Mechanical	The user is making changes to better organize use of the innovation.
II. Preparation	The user has definite plans to begin using the innovation.
OI. Orientation	The user is taking the initiative to learn more about the innovation.
0 . Non-Use	The user has no interest, is taking no action.

From *Taking Charge of Change* by Shirley M. Hord, William L. Rutherford, Leslie Huling-Austin, and Gene E. Hall, 1987. Published by the Association for Supervision and Curriculum Development (703) 549-9110 Reprinted with permission.

Table 3: Result Table of stage of concern

Stage	Percent %	Group
0 Awareness	12.75%	SELF 39,25%
1 Informational	13.79%	
2 Personal	12.71%	
3 Management	11.42%	TASK 23,92%
4 Consequence	12.50%	
5 Collaboration	13.93%	PERFORMING 27,43%
6 Refocusing	13.50%	

The adopted methodology is outlined in the following 3 points:

- The questionnaire developers investigate the validity of the LoU by examining the relation of scores on the seven stages scales amongst each other as well as amongst variables suggested by theory of Level of use.
- The behaviors that are described at each intersection in the LoU Chart are derived from combining the described of a category of this level. Overall the Lou chart is describe and reliably measured. Each level of use represents a different approach in using a simulator.
- Each LoU is described in terms of the types of behaviors represented in the intersections in the chart of each category with a particular Level.

Table No 1 shows the levels of use according to model C.B.A.M. The individuals that participate in the educational innovation take for granted that they function in higher level than the level of routine IVA, so that the innovation is maintained and its use is adopted.

In the case of Levels of Use it is assumed that the inquired person has a good comprehension of the theoretical frame Level of Use and then direct himself accordingly and proceeds by answering the questions. Even if the questionnaire is drawn with various types of discriminations so that it facilitates the user but also us, a lot of points exist where discrimination between the formal responses is sensitive, thus the inquired person will have to reply in a consistent and reliable way in order to be effectively evaluated.

In order to access and mark the usefulness of Engine Room Simulation, always according to the theory of Level of Use the behaviors of individuals were developed and delimited in the seven categories (see Table 4).

7 RESULT ACCORDING THE CONCERN

Towards classified the percentile result which obtained and following the theory of high and low stage of concern table 3 coming up. The results which can be extracted about the concern of participants according to the highest percentiles is that 13.95% indicates a great concern about collaboration between the participant and the relation which has been developed during the simulation courses. The interpretation for this result can be considered very logical, if we compare it with the real work environment in the engine room of a ship. The second highest percentage is 13,79% and indicates concern about the collecting of information and knowledge for the simulation course and the definition of all this process.

In whole process of simulator courses the way which cope the 13.50% present of participant is very interesting. That indicates participants who are interested in learning more from the whole procedure of the task. They focus on exploring ways to reap more universal benefits from the simulation courses, including the possibility of making major changes to it.

Table 4: Result table for Level of Use & categories

LEVEL OF USE		CATEGORIES						
LEVEL	CHARACTERISTIC	KNOWLEDGE	ACQUIRING INFORMATION	SHARING	ASSESSING	PLANNING	STATUS REPORTING	PERFORMING
VI	RENEWAL							
V	INTEGRATION			LoU V	LoU V			
IVB	REFINEMENT							
IVA	ROUTINE		LoU IVA				LoU IVA	
III	MECHANICAL USE	LoU III						
II	PREPERATION					LoU II		
I	ORIENTESION							LoU I
0	NONUSE							

8 RESULT ACCORDING THE LEVEL OF USE

Based on the theory of Level of use and the response of participants the result of our research is classified between level of use and categories coordinates at the table No4. The highest percentage is in the category of sharing and at the category of assessing which is classified at the level of use V (integration).

Integration indicates that our participants combining their own efforts to use the simulation course with the related activities of colleagues to achieve a collective impact for their own common sphere of influence.

As for the category of assessing, participants indicate that they appraise collaborative use of the innovation in terms to increasing his own outcomes and strengths and weakness as the integrated effort.

At the categories of Status Reporting and at the Acquiring information the users indicated Level of Use IVA Routine: that means they determine the use of simulator and few changes take place in ongoing use.

The weaknesses of the users indentified on the knowledge, planning and performing category. Actually in this category the instructor must be given more attention in order to enhance the output of simulator course.

9 PEDAGOGICAL VIEW

From pedagogical view the simulator courses can be used under cooperation of cognitive theories based on virtual reality learning. As mentioned at the beginning of our research many theories can be adapted in order to enrich the whole procedure. The final choice of correct theory must be a combination of the simulation task and the following correct theory. The correct approach of pedagogical theory during the course can be defined from the category of knowledge and performing at level of use. During our research we investigate and compare the closest pedagogical theory which can be adapted to simulation course the result can be found in table 5. The main purpose of adoption of the pedagogical theory in simulation course is to engage the participant in the role of transferring and generating cognitive inside from the hall procedure of simulation curses as much as possible. In an effort to indentify in which stage of learning our participant are; we adapted the theory learning theory of Kolb. According to this theory typically expressed as four-stage cycle of learning,

1 Concrete Experience - (CE)
2 Reflective Observation - (RO)
3 Abstract Conceptualization - (AC)
4 Active Experimentation - (AE)

Furthermore we are trying to assign the results from the stage of concern with the ones from the stage of learning of Kolb theory. As the theory of concern says we categorized the seven stages of concern into three groups (see table 4). Those groups are: from stage 0 to stage 2 called Self Group. Stage 3 and 4 called Target group. Stage 5 and 6 called Performance group. We summarized the percentile score for each group and the result is for Self concern group 39.25%, for Target concern group 23.92%, and for group of performance 27.43%.

Finally we pair the data from stage of concern with the stage of learning (see figure 2) and the findings are that our participants in 39.25% are between the concrete experience and the observations. The 23,92% percent is between reflective observation and abstract conceptualization. Respectively the 27,43% are between the abstract conceptualization and active experimentation.

10 CONCLUSIONS

The conclusion of the research is the fact that the surveyed students experienced and accepted the introduction of simulation in training positively by ex-

pressing an interest to learn more about the application. One of the most important outputs, is the expression of strong concern on the basis of the developed collaboration amongst students, during the simulation.

This findings probably are the main outcome of our research given that:

1 The simulator course works like knowledge accelerator and transfer knowledge.
2 The purpose of the engine simulator is to duplicate activities carried out in the engine rooms of ships.
3 In the engine rooms of ships there should be established and imposed conditions of teamwork and cooperation, rather than surface level and should actually include exchange of views and knowledge amongst the crew.
4 27.43% participants fell comfortable with the simulation course and they are ready to apply their knowledge in order to learn by trial and error and ensure their thoughts about the operation of engine room.

It seems that the students are fully aware of the role and importance of simulation and begin to seek partnerships and relationships that would assist them to cope with the theoretical exercises that might also experience the simulator in practice. In conclusion, the findings that the instructors received on the reactions and concerns of students on the receptivity of the implementation of the simulator as part of their basic education could be positively described.

Also encouraging data for the full and smooth acceptance of simulation in education process have been addressed.

– At the end of the course the 39,25% of participants are between of concrete experience and observation which means they don't realize what exactly happened or they don't have enough time to react .
– Not given or there are not enough incentives from the instructor to the participants for planning or to performing during the course.

The participants indicate a low concern to organizing, managing and scheduling the simulation course.

11 THE EFFECT OF OUR RESULT

– The instructor decides to corporate more closely with the manufacture company to readjust the simulation course in the specific needs of student.
– The syllabus of Academy reorganized according to the needs of simulation course.
– The instructor decide to devote much more time at the stage of debriefing and more general to inform the participant for the main purpose of simulation course.

It is the first time that the C.B.A.M. "framework" is used as a tool to measure the outcome of the application of marine simulation in a merchant marine Academy. It was anticipated to provide an output related to the concerns and aptitude not only from the users but also the instructors. It could be used as a tool to measure the effectiveness between the investment of simulation and the knowledge which the students acquire.

12 FUTURE RESEARCH

This paper is an initial part of our research. It is in our future plan to apply the CBAM model in as much as possible maritime simulators applications, in Europe but further more in Asia. Our main proposal is to create a flexible tool which can be adapted in each maritime simulations course in order to determine the effects of the courses to the seafarers. From the other point of view, according to the response of the seafarers, it will determine the evaluation of the teaching and the pedagogical method which can be applied.

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