GLOBAL MARITIME PROFESSIONAL: UNIVERSITY COURSE OF RISK ASSESSMENT - CASE STUDY OF CADETS ACADEMIC PERFORMANCE BASED ON BLOOM'S TAXONOMY

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Abstract

The International Association of Maritime Universities (IAMU) in 2019 submitted to IMO its publication under the title of «Global Maritime Professional: Body of Knowledge» [1], which proposes the implementation of structured approach to education and training of seafarers based on well-known Bloom's taxonomy. There is no doubt that the term Global Maritime Professional (GMP), which by its meaning is a powerful social, political and academic driver, gives the great cumulative significance and sense for developing the profession of seafarer.

Along with the rapid changing in industry, new trends and mainstreams, reflecting in development of new standards, new threats, hazards and risks appear that were not predictable before and to which seafarers must be professionally ready to respond adequately and sometimes immediately. All of this requires well timed management of changing in education and training process of seafarers based on research of up-to-date reality and trends to find the ways for development of new normal, keeping in line with such time-honored rule of seafarers as "safety first".

Risk Assessment is the core component of all STCW'78 standards intended to ensure safety at sea, against which prospective officers are to be trained and which should be implemented onboard as per ISM Code provisions. It is the basis for achieving the adequate level of situation awareness and decision making onboard ship in a lot of critical situations and the use of Bloom's taxonomy can be one of the keys to make the educational course of Risk Assessment more effective.

The paper presents some case study preliminary findings of cadet academic performance in perception and mastering the university course of “Risk Assessment in Seafaring” (RAS) delivered at the Faculty of Navigation and Communication of AMSU-MIS.

The study identifies difficulties cadets face in the process of learning the RAS course to follow each Bloom's level. It also outlines the relationship among Bloom’s levels in cognitive domain and steps of hazard analysis SWIFT, «Structured What If Technique» [2-3] used for risk assessment and gives recommendations for improvement the course.

Keywords: safety, risk assessment in seafaring, Bloom’s taxonomy.

Introduction

The GMP publication, designed by IAMU, is timely and relevant guidelines that encourage the use of Bloom's taxonomy in the MET field and intended to ensure the designing the educational trajectories and more efficient mastery of knowledge and skills required primarily for career development at sea. It additionally includes consideration of possible other career paths that can be promoted by MET institutions for shipping industry. The issue provides flexible recommendations that may exceed the running STCW'78 Convention standards but they are justified by contemporary trends in industry, signaling the need of review of STCW’ 78 Convention and Code.

The nuances of application of action verbs recommended in Bloom's taxonomy for the educational process depend on the working language used for teaching and learning the subject, but there are a fairly large number of action verbs that could be accurately interpreted to a specific field of knowledge in any language.

The IAMU publication proposes the hierarchy of training levels for seafarers based on STCW 78 certificates of competency and aligned with academic degrees. The proposed hierarchy could not directly be embedded in all national standards for MET purposes and STCW certification process, but it could be easily adaptable. As per the Russian Federation standards, the AMSU-MIS graduates are awarded by the national academic degree of an “Engineer in Navigation”, which is roughly equivalent to Master of Science and also they are issued the STCW Certificate of Competency at operational level. The graduation thesis

contains a mandatory research part. So, the learning outcomes of graduates can be positioned between Tiers “A” and “C” by GMP classification.

Principally, the university RAS course curriculum was built on the same Bloom's taxonomy ideas, but they exist implicitly in it. The main task of the case study is to highlight these levels in the course and evaluate the consistency of its learning objectives are in line with Bloom's taxonomy [4-6].

The Course “Risk of Assessment in Seafaring”

The main seafaring motto «safety first» is to be included in each professional competence of seafarer. Maritime safety is a serious concern for shipping industry, that is why the risk assessment is the key part of all core STCW competencies. The incorporation of risk assessment in the STCW Code by the Manila amendments could be considered as an effective and wise decision of the maritime community, aimed to have a significant impact on enhancing the performance of ships' officers and strengthen the safety at sea that is completely in line with safety concept of ISM Code.

Risk onboard is assessed by seafarer and his/her foremost proficiency in this process is the ability to identify and analyze hazards for safe planning of forthcoming shipboard operations. At the same time it should be noted that rising implementation of new technologies creates the new hazards that were previously unknown to seafarers.

Adequate risk perception, knowledge and understanding of risk assessment and management algorithms, as well as adequate projection of the impact of associated hazards on safety of forthcoming shipboard operations positively influence the seafarers' level of situation awareness, helping to focus their attention on core points and find effective solutions in critical circumstances. Risk assessment is one of the disciplines included in the IAMU GMP publication.

The course of "Risk Assessment in Seafaring", which is one of the academic subjects taught at Navigation & Communication faculty of the AMSU-MIS, is built on the concept of Formal Safety Assessment (FSA) and includes the SWIFT methodology (Structured What If Technique, SWIFT) [2-3].

The chronology of mastering the Bloom's taxonomy for the RAS course was as follows: having consultations with shipping companies, we came to the conclusion that SWIFT, as a expert evaluation and analysis method, could be used not only for hazards identification and developing risk assessment forms, but it is also an efficient tool for conducting educational workshops for cadets on risk assessment in ship operations. Later, it became clear that Bloom's taxonomy fits well with the SWIFT process for setting the structure of workshops, and we began to implement it by default.

The combination of SWIFT algorithm and Bloom's Taxonomy in the RAS course for conducting the workshops and the nomination of cadets to roles of acting experts during this workshops significantly encouraged their activity, motivation and interest to the course. Then it was decided to carry out some study with the target group of cadets to understand the degree of presence and impact of Bloom's ideas on the theoretical learning objectives of the RAS course.

The Bloom's levels, which were included in SWIFT consequent steps for conducting the RAS workshops, are presented in Fig.1. The following notations are used here: Re (Remembering), Un (Understanding), Ap (Applying), An (Analyzing), Ev (Evaluating), Cr (Creating).

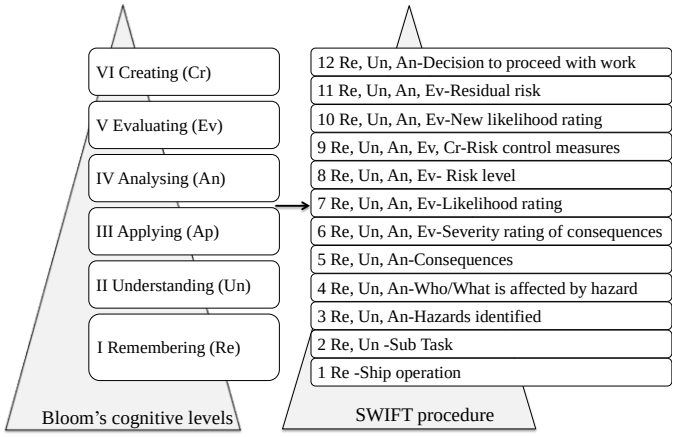

Figure 1. Links of Bloom's taxonomy levels with SWIFT algorithm steps

Then it was decided to carry out the empirical study with the target group of cadets to check if the theoretical learning objectives of the RAS course are in line with Bloom's levels recommendations in cognitive domain.

The inclusion of Bloom's cognitive domain levels in the RAS course based on FSA and SWIFT algorithms gave the opportunity to outline and understand the weak points of it and allowed to work out the original structured approach to delivering the course.

The course content has the following sections:

1. The general concept of risk in seafaring: likelihood and consequences of accidents. Requirements of the international instruments for risk assessment in ship operations.
2. Qualitative, quantitative and hybrid approaches to risk assessment onboard ship: terms and methods.
3. Classification of risk types assessed onboard ship. Ship's forms of risk assessment.
4. Hazard analysis and mathematical modeling of ships collisions likelihood.
5. Hazard analysis and mathematical modeling of ship groundings likelihood.
6. Heinrich's Law and investigation in onboard near misses as per ISM Code.
7. Assessment of the total risk from accidents using fault tree/event tree techniques.
8. IMO Formal Safety Assessment (FSA) overview.
9. Analysis and assignment of tasks in FSA process.
10. Incorporation of Human Reliability Analysis (HRA) into the FSA process.
11. Managing and reducing the risk of fatigue at sea.
12. Hazard Identification technique.
13. Risk control measures and risk control options.
14. Cost-benefit assessment of risk control measures and options.
15. Recommendation for decision-making in ship operations.
16. The overview of IMO FSA studies.

The competency as per the RAS course curriculum covers a wide range of KUPs'[1] requirements, including those necessary to:

- know the general approaches and algorithms of risk assessment and management and those implemented in seafaring to ensure the safe ship operations;
- know and implement the hazard identification, risk assessment and risk control measures techniques and also be aware with principles of analyzing and ranking the potential hazards related to ship operations;
- be familiar with implementing the risk-based procedures of decision-making, ensuring the proper level of the situation awareness;
- be familiar with implementing the methods of elementary research in the field of risk assessment.

The RAS course causes certain difficulties for cadets in achieving the educational objectives. The reasons for the difficulties arise from the very concept of the term "risk", which is based

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on the probabilistic analysis of information, including a large number of associated uncertainties and various interpretations of the basic concept [7-10], as well due to a wide option of data analysis methods [11].

Uncertainties arise due to inaccuracy and incompleteness of data, their absence or redundancy, which is not always adequately perceived by cadets, precisely for solving practical tasks of risk assessment in ship operations. This is compounded by the lack of verification technique at the time of risk assessment and the use the a priori data. All of this motivates the instructor to adapt the methodology for delivering the educational material in order to increase the efficiency of the course mastering by cadets using clear structuring educational objectives.

Description and results of the case study

As mentioned above, the Bloom's levels are not reflected in the curriculum of the RAS course directly. The purpose of the study is to understand if they implicitly exist in the course and can be extracted for evaluation of achievement of educational objectives.

To carry out the study two types of assessments were developed:

1. Cadets' self-assessment test reflecting level of difficulty that cadets faced with in learning the RAS course. Results are shown in Figure 2, where the number of responses is shown in black and the percentage of the total number of responses in gray. Total results are presented in Figure 3.
2. In addition to self- assessment test, a written survey was conducted on the RAS course, the total results of which are shown in Fig. 4. Cadets were asked 30 questions on the course, which were structured by Bloom's levels. Each level included 5 questions using appropriate action verbs. The target group consisted of 52 participants.

The cadets preliminary were introduced to the modified Bloom's taxonomy and they were asked to answer anonymously to questionnaire of a 5-point Likert scale to clarify the difficulties they faced in mastering the course in terms of Bloom cognitive levels (see Table 1). Difficulties were interpreted as hazards, which could lead to the failure of exam. Levels of difficulty as per Likert scale were as follows: 1 – very difficult, 2 – difficult, 3 – neutral, 4 – easy, 5 – very easy. Before the test the target group of cadets completed their assignment under the title "Assessing the risk of failure the exam", using their individual statistic data.

Sample questions were presented to cadets to clarify links with Bloom's levels to assess the individual level of difficulty.

Table 1. Bloom's levels and types of sample questions concerning the course content

Bloom's levels	Sample questions
Remembering	Define the term «risk» used in seafaring.
Understanding	Can the risks from two types of accidents in different shipboard operations be equal, if the likelihood of these accidents varies?
Applying	What decision should be made on planning the ship mooring operation if the risk of mooring lines break is assessed in the ALARP zone of the risk matrix?
Analyzing	Decompose the processes of risk assessment and control in the form of a consistent algorithm of actions.
Evaluating	Under which circumstances the second iteration cycle might be required in assessing the risk of a shipboard operation?
Creating	Suggest the ways, which can reduce the impact of uncertainties in risk assessment process.

Self-assessment test results can be seen in Figure 2 below.

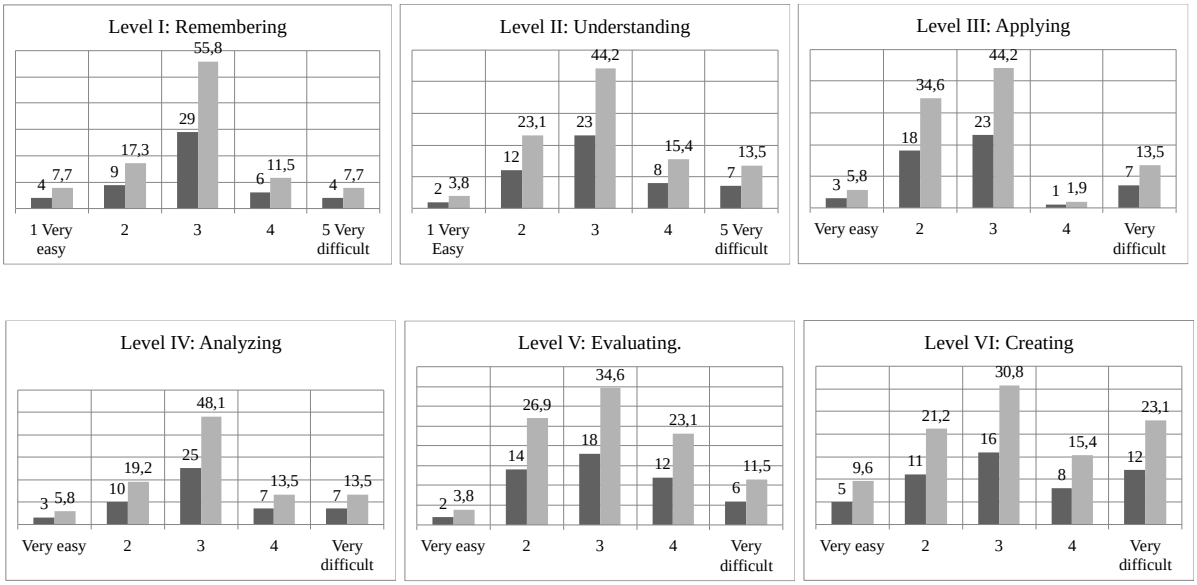

Figure 2. Difficulties of the RAS course mastering: the results of self-assessment test as per Bloom's levels

The summation of self-assessment and written review results are shown in Figures 3-4.

Figure 3 represents the sum of self-assessment results in number of responses (points) on each Bloom's level as per data that shown on Fig. 2. The number of points is interpreted as a degree of difficulty to master the Bloom's level. The neutral responses were excluded. So, the less points, the more easy to master a Bloom's level.

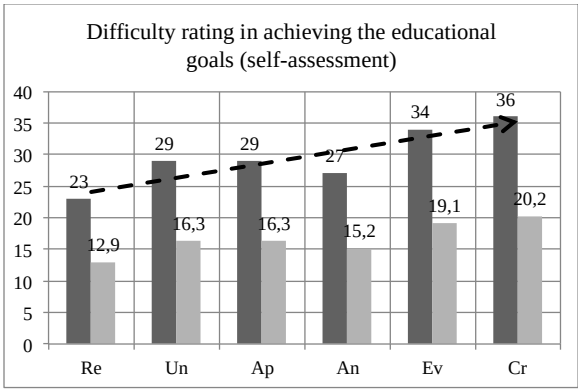

Figure 3. Summation of self-assessment results

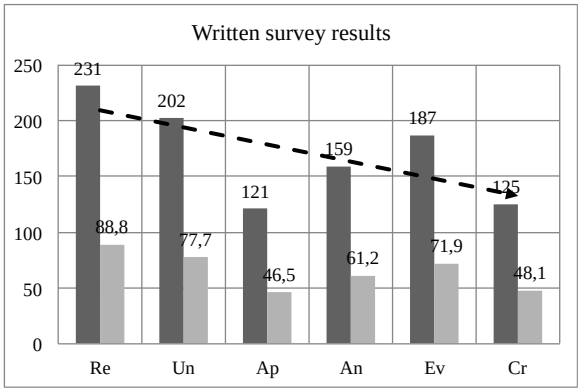

Figure 4. Written survey accepted results

Discussion

Self-assessment test

The results of cadets' self-assessment are quite obvious. As can be seen from all 6 graphs in Figure 2, the highest percentage of responses for each category shows their neutral self-assessment position in terms of the degree of difficulty of learning, as it is easier to be justified psychologically. All of this also reveals the uncertainty in responding the questions at all Bloom's levels.

If to take the average value of the results as an expression of a certain degree of difficulty in forming the student's opinion, then the sum of the results for difficulties with Likert indices 4-5 for all levels of Bloom's taxonomy clearly exceeds the sum for difficulties with indices 1-2.

Written survey

As can be seen from the total written survey results, cadets experienced the least difficulty is observed in mastering Bloom's levels I-II (Re-Un) and the greatest difficulty, when working at levels III-VI (Ap-Cr) that is similar to self-assessment test findings.

The written survey results show that of the target group: 11,2% have difficulties in *remembering* the material, 22,3% - in *understanding*, 53,5% - in *applying*, 38,8% - in *analyzing*, 48,1% - in *evaluating* and 51,9% - in *creating* new ideas based on the material studied. Total outcomes are as follows: the largest number of accepted answers relates to the

level of *remembering*. Here the level of *understanding* of the course is lower than the level of r*emembering*, which is quite evident, as to remember the material in a lot of cases is more easy than to understand it.

Totally, the worst results were obtained at the Bloom's level of *applying*. The level of *evaluating* is higher compared to the levels of *analyzing* and *creating*, but everywhere the level *creating*, showing the creativity of cadets, is quite low. It should be borne in mind that any cadets' suggestions on new ideas, even fantastic or absurd ones, were accepted to encourage their creative activity.

This generalized self-assessment and the written survey results revealed that Bloom's ideas were used implicitly in delivered RAS course. However, these results are the clear signal for the educator to improve the methodology of the educational process to be in line with educational objectives. The foregoing undoubtedly has an impact on the process of forming cadets' individual competencies, as prospective officers.

Comparison of the results of self-assessment and the written survey confirms the intuitive idea that the degree of difficulty in mastering the learning material by cadets increases in accordance with the hierarchical order of Bloom's levels.

Conclusion

The combination of SWIFT algorithm and Bloom's Taxonomy in the RAS course for conducting the workshops and the nomination of cadets to roles of acting experts during these workshops significantly encourage their activity, motivation and interest to the course.

There is an obvious inverse relationship among the levels of Bloom's educational objectives in cognitive domain and the degree of difficulty in their mastering by cadets, which grows in a hierarchical order of Bloom's levels. This suggests that developing the curriculum, it would be appropriate to pay more attention to Bloom's levels II-VI to make the course more efficient, taking into account that the RAS course is the applied one and the risk assessment is a forming part practically of all seafarer competencies that regulated by the STCW 78 Convention provisions and also by appropriate procedures onboard ship as per the International Safety Management Code.

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