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Methods for demonstrating a competence and criteria for evaluating a competence in STCW Convention

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ABSTRACT

STCW Convention has defined competences needed for jobs onboard, methods for demonstrating competences and criteria for their evaluation. Every MET institution has to include minimal standards, prescribed by STCW Convention, in programmes for seafarers they have been carrying out. Apart from the obligatory STCW regulations, every institution carrying out STCW Convention based programme can include IMO Model Courses in the programme as well. In STCW Convention, competences and methods for their demonstration as well as criteria for their evaluation have been divided on the basis of ship's departments. The paper is about standards that refer to deck department. Methods for demonstrating competences and criteria for their evaluation defined by STCW Convention, and the ones defined by IMO Model Courses were compared. They depend on well-defined learning outcomes. In order to determine whether learning outcomes, defined by both, STCW Convention and IMO Model Courses, are in accordance with Bloom's Taxonomy, a lexical analysis for STCW A-II/1, column 2, A-II/2, column 2, Model Course 7.01 – Part C and Model Course 7.03 – Part C was done. Software Wordsmith 7.0, produced and delivered by Lexical Analysis Software and Oxford University press, was used in the research. The results of the research show that methods for demonstrating competences and criteria for their evaluation have not been written clearly enough. It was found out that methods for demonstrating competences and criteria for their evaluation defined by STCW Convention are not in accordance with Bloom's Taxonomy and commonly used methods and criteria. On the other hand, they are defined precisely in IMO Model Courses. Furthermore, there still exists a problem of IMO Model Courses being non-mandatory.

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1 Introduction

Competence – based education (hereinafter: CBE) has appeared as an answer to employers' criticisms that graduate students are frequently not competent for the jobs they were educated for [31]. It was found out that students have enough knowledge, but they lack skills and attitudes to perform successfully in a working environment [4]. CBE makes the adjustment of students to future working environment easier [6, 20]. Making competences a part of the curriculum, i.e. development of competence – based education programmes, has enabled that process. It is the major characteristics of CBE [29].

A person is competent when he/ she can perform the tasks he or she is entrusted with responsibly and efficiently. A person is not competent when, he/ she cannot apply competences he/ she possesses, in a working environment [31].

Competence concept has been formalised by the European Qualifications Framework and the National Qualifications Frameworks of the countries, members of EU [19]. In order to meet the employers' demands and to establish competence – based education, it is of utmost importance to provide answer to these three questions [31]:

1. What does a student have to be capable of in order to perform a task successfully?
2. What knowledge does a student need to possess in order to perform a task successfully?
3. How to determine if a student is capable of performing tasks?

Therefore, competence – based education programmes have to specify and explain in detail generic and professional competences gained upon completion of a programme [25]. Characteristics of competence-based education are:

1. Focus is on learning outcomes,
2. The importance of developing a competence is emphasized,
3. Number of hours needed to develop a competence is not prescribed,
4. Learning outcomes are defined precisely,
5. Focus is on individual learning [11].

STCW Convention regulates standards for seafarers' education internationally. Although the Convention was adopted in 1978, the number of maritime accidents whose cause was human factor did not diminish. Therefore, ideas started spreading in eighties, that Convention did not fulfil its purpose. The objections were the following: Convention's regulation were too general, different interpretations of the rules were possible and Convention itself did not follow technological development of ships. It is important to emphasise that two maritime accidents whose cause was human factor happened at that time, fire on the ro-ro passenger ship Scandinavian Star in 1990 and sinking of the ro-ro passenger ship Estonia in 1994. Therefore, the Diplomatic Conference in London adopted changes and a thorough revision of the Convention in 1995. Technically speaking, changes referred to STCW Code, which became an essential part of the Convention. It now consists of two parts, Section A, which is mandatory and contains minimum of standards and regulations, and Section B, which is only a recommendation and contains guidelines to assist when applying the provisions of the Convention. The rest of the changes refer to MET institutions, shipping companies and countries parties to the agreement. As far as this research is concerned, the most important changes refer to introduction of CBE approach in the Convention.

The 1995 amendments to STCW Convention introduced CBE approach, which was later upgraded (improved) by Manila Amendments. Competences, seafarers are expected to master are described in STCW Code A. Competences, knowledge, understanding and proficiency, methods for demonstrating a competence, and criteria for evaluating a competence are listed in form of tables [27] in STCW Code A.

Different countries' maritime educational institutions have different views on interpretation of the minimum level of formal education for ship officers at management level. What all institutions have in common is the fact that they all meet the standards of STCW Convention. However, the emphasis of this paper was put on MET that is a part of higher education system, i.e. education leading to STCW Certificates and academic degree.

2 Learning outcomes

In higher education (HEI), learning outcomes are defined as statements that describe what a student has to know, understand and be able to do after a successful completion of the process of learning [26, 22 and 1]. Such an approach is student centred approach [30] and it focuses more on the objectives of the teaching-learning process [9]. Based on learning outcomes, contents of a programme can be determined, learning opportunities and methods for determining student's achievements as well [26].

Learning outcomes can refer to a whole study programme, a subject or a topic. There are two types of learning outcomes, marginal and aspirational (desirable) ones. Marginal learning outcomes define only the passing rates, whereas, aspirational ones, which are used more frequently, define what is actually expected of a student. Learning outcomes are based on 1956 Bloom's Taxonomy (Taxonomy of Educational Objectives) which divides levels of achievements into three domains, cognitive, psychomotor and affective domain [21, 16]. Cognitive domain refers to knowledge and understanding; psychomotor domain refers to skills and abilities to do something easily and well; affective domain refers to attitudes and beliefs. Bloom's Taxonomy has been changing and upgrading structurally and terminologically over the years. At the very beginning, it consisted of only cognitive domain, with additional introduction of psychomotor and affective domains. Each domain is presented hierarchically based on complexity i.e. from the simplest to the most complex level. Verbs that refer to simple cognitive processes should be used at lower levels of education whereas verbs referring to more complex cognitive processes should be used at higher levels of education [32].

Every domain consists of the list of verbs that help to define learning outcomes [7]. The above-mentioned levels, definitions and verbs referring to cognitive, psychomotor and affective domains are shown in Tables 1, 2 and 3.

Learning outcomes and learning objectives are very frequently used as synonyms [12, 18], even in IMO Model Courses i.e. there is no clear distinction in meaning between learning outcomes and learning objectives. For instance, the following is written in IMO Model Course 1.29: "The detailed teaching syllabus has been written in learning objective format in which the objective describes what the trainee must do to demonstrate that knowledge has been transferred." Then, in the same IMO Model Course: "A training outcome is specific and describes precisely what a trainee must do to demonstrate his knowledge, understanding or skill as an end product of a learning process… The outcome of the process is an acquired "knowledge", "understanding", "skill"; but these terms alone are not sufficiently precise for describing a training outcome. Verbs, such as "calculates", "defines", "explains", "lists", "solves" and "states", must be used when constructing a specific training outcome, so as to define precisely what the trainee will be enabled to do" [15]. However, there is a signifi-

Table 1 Cognitive domain

	Level	Definition	Verbs
6	To create	Ability to apply knowledge to achieve new results and efficiency.	Asses, evaluate, judge, decide, validate, standardize, reassess, value, conclude, score, support, etc.
5	To evaluate	Ability to apply knowledge to make judgement about information.	Arrange, argue, construct, propose, formulate, organise, prepare, create, assemble, manage, set up, summarise, revise, etc.
4	To analyse	Ability to break down information or concepts into components for better understanding.	Distinguish, analyse, divide, investigate, compare, separate, connect, solve, categorise, inspect, criticise, etc.
3	To apply	Ability to use the information or a concept to solve the task.	Apply, use, demonstrate, show, schedule, choose, prepare, examine, calculate, predict, interpret, etc.
2	To understand	Ability to interpret the concept.	Recognize, report, describe, distinguish, explain, express, identify, report, select, etc.
1	To remember	Ability to recall facts from memory.	Define, identify, repeat, label, name, describe, reproduce, recall, list, etc.

Source: Authors according to [8, 21, 33, 17 and 10]

Table 2 Affective domain

	Level	Definition	Verbs
5	Characterization	Acting in accordance with new values.	Verify, etc.
4	Organization	Putting together new concepts and information and relating them into general beliefs of one's own value system.	Display, order, organize, systematize, etc.
3	Valuing	Behaviour that shows integration and attachment to something.	Accept, defend, devote, pursue, seek, etc.
2	Responding	New behaviour that is the result of an experience.	Complete, comply, cooperate, discuss, examine, obey, respond, etc.
1	Receiving	Being aware of feelings and elements in one's surroundings.	Accept, develop, recognize, etc.

Source: Authors according to [23, 13]

Table 3 Psychomotor domain[1]

	Level	Definition	Verbs
7	Origination	New movements or new ways of performing are created.	Create, design, develop, formulate, invent, combine, arrange, etc.
6	Adaptation	Modifying movements to new situations and demands.	Adapt, change, alter, correct, integrate, order, standardize, reorganize, etc.
5	Complex overt response	Performing without special preparation and with little effort.	Fix, build, demonstrate, etc.
4	Mechanism	Individual performance of an action with desired precision leading to expected level of proficiency.	Assemble, attach, mix, organize, set, perform, lift, execute, etc.
3	Guided response	The early stage in managing a complex skill; a student performs a part of it.	Adapt, correct, imitate, revise, simulate, separate, divide, connect, etc.
2	Set	Mental, physical and emotional readiness to act.	Adapt, organize, recognize, find, respond, choose, etc.
1	Perception	The first step when performing an action that includes sensory cues to guide physical activity.	Compare, listen, recognize, observe, etc.

Source: [28, 33]

[1] Simpson's Taxonomy

cant difference between learning outcomes and learning objectives. Objectives refer to plans the instructors want to fulfil whereas outcomes refer to what the students will be able to do upon completion of a study programme [32, 24].

As mentioned before, competences are prescribed in the STCW Code A. Some additional descriptions could be found in STCW Code B and in associated Model Courses. For the purpose of this paper, it was important to analyse IMO Model Course because learning outcomes are their integral part. Learning outcomes have to be in accordance with a qualification level awarded upon completion of the programme. Moreover, learning outcomes of MET carried out at higher educational institutions should be in accordance with qualifications awarded by HEI institutions. When creating a study programme for seafarers, HEI institutions usually use IMO Model Courses as the basis. Therefore, it is important to analyse IMO Model Courses and their learning outcomes in order to determine if they are in accordance with a level of academic qualification awarded upon completion of a programme.

3 Research methodology

The research was divided in two parts. Qualitative analysis of methods for demonstrating competences and criteria for evaluating competences, which are the essential part of STCW Code A, was carried out in the first part.

In the second part of the research, it was established to what measure and level, learning outcomes are present in STCW Convention and IMO Model Courses. In other words, the analysis of outcomes for onboard position, Master and Chief Mates on ships of 500 gross tonnage or more, was carried out. The method used was the empirical approach (or method), i.e. corpus linguistics method. Corpus linguistics method (or corpus analysis tool) implies the usage of corpus, which is, actually, a body of text. This method is very frequently used in linguistics research. Its efficiency depends on tools used [2]. Corpus analysis tool counts rapidly and simply the number of words (tokens) and different words (types) in the corpus [5]. The software used for the analysis in this paper is Wordsmith 7.0. The language used is English. The software is produced and delivered by Lexical Analysis Software and Oxford University Press, and it represents corpus analysis tool developed by Mike Scott. It consists of three tools: the WordList tool, Concord and Keywords [14].

It is assumed that the most important words are the most frequently mentioned ones in the relevant lexical corpus, i.e. the importance of a word is the equivalent to its frequency (occurrence) in the text. Data on frequencies are not satisfactory enough as they cannot be considered thoroughly explained. They show what forms need to be additionally analysed and explained in the text [14]. Besides, frequency lists of two corpuses can be compared, regardless of their largeness [3]. In order to determine levels of learning outcomes for on board position Master and Chief Mates on ships of 500 gross tonnage or more, the study focused on the following corpus of texts:

1. Table A-II/1, column 2 of STCW Convention,
2. Table A-II/2, column 2 of STCW Convention,
3. Detailed Teaching Syllabus in IMO Model Course 7.01 and
4. Detailed Teaching Syllabus in IMO Model Course 7.03.

4 Results and discussion

4.1 Methods for demonstrating a competence and criteria for evaluating a competence

A part of methods for demonstrating competences listed in STCW Convention, has not been elaborated clearly enough. For example, a method "approved in service experience" has been listed, however, it has not been specified how to demonstrate the competence on the basis of in service experience. Every method listed in STCW Convention has to be defined more precisely. This implies a description of the way to demonstrate a competence, and exploring the evidence obtained from: approved training ship experience, approved simulator training, approved laboratory equipment training, etc. Onboard service or other in service experience can be the reasons why possessing a competence is not verified. Before acknowledging an onboard service or other in service experience, which is the reason why verification of competence possession is not necessary, the on shore personnel has to gather the answers to the following questions (for every competence when renewing or issuing a certificate):

1. Is the acknowledged competence used when doing a task?
2. How frequently is the competence used when doing a task?
3. Who was supervising the usage/application of a competence?
4. Has the usage of a competence been evaluated and who has evaluated it?

STCW Convention has prescribed criteria for evaluating a competence. Some of the criteria listed are "actions taken and procedures followed correctly apply and make full use of advice available", "training objectives and activities are based on assessment of current competence and capabilities and operational requirements", "the plan for coordinating search and rescue operations is in accordance with international guidelines and standards", etc.

Methods of prescribing criteria for demonstrating a competence as written in STCW Convention are not in accordance with Bloom's Taxonomy and contemporary methods used for prescribing the criteria. Methods of prescribing the criteria have to be based on learning outcomes, i.e. on criteria referring to cognitive and psychomotor domains.

Methods for demonstrating competences listed in STCW Convention are not in accordance with standard methods for demonstrating them. Standard methods used for competence demonstration are written exams (short answers, multiple choice, alternative choice questions, explanation and interpretation, essay tasks, solving a problem etc.), oral exams, seminar tasks and presentations, reports on simulator training and training on school ships and other types of outdoor training, reports on project tasks, reports on research-work, reports on training i.e. successful training on the appropriate equipment and reports on laboratory training.

IMO Model Courses, on the other hand, define methods for demonstrating competences more clearly and more precisely: observation (in oral examination, simulation exercises, practical demonstration), questions, test, project, tasks, case studies, etc. Each of the methods for demonstrating competences has its advantages and disadvantages, and they cannot be applied to all competences. This is the problem that has to be dedicated more effort to and that has to be taken into consideration when defining methods for demonstrating every single competence. When the process of demonstrating a competence is evaluated by exams, a special attention has to be paid to tasks that can be solved by an average population, bearing in mind the specifics of the profession and of prescribed competences.

4.2 Learning outcomes

The corpus of text, created on the basis of column 2 of Table A-II/1, column 2 of Table A-II/2, detailed Teaching Syllabus in IMO Model Course 7.01 and detailed Teaching Syllabus in IMO Model Course 7.03, consisted of 94,718 words. There were 6,540 different words in the corpus of text. Figure 1 represents action verbs that occurred more than 100 times in the corpus of text.

Table 4 Percentage of the most frequent verbs used in STCW Convention and IMO Model Courses 7.01 and 7.03

Verb	Bloom's Level	%
Determines	Level 4 – Analyse	0,895
Identifies	Level 2 – Explain	1,194
Demonstrates	Level 3 – Apply	1,953
Calculates	Level 3 – Apply	2,659
Lists	Level 1 – Remember	3,364
Defines	Level 1 – Remember	4,531
Explains	Level 2 – Explain	24,579
Describes	1 – Remember	26,397
States	1- Remember	34,428

Source: Authors

The results of the research show that learning outcomes, as defined by STCW Convention and IMO Model Courses, are usually a part of the level 1 and level 2 of Bloom's Taxonomy. The verbs belonging to the first and to the second level of Bloom's Taxonomy make 94,031% of the most important verbs. It can be concluded that programmes based on only STCW Convention and IMO Model Courses, are the programmes that do not meet the requirements needed at the undergraduate level of a study.

Learning outcomes referring to affective and psychomotor domains are significantly less represented in STCW Convention and IMO Model Courses than learning outcomes referring to cognitive domain. In fact, learning outcomes that describe affective and psychomotor domains are not clearly specified in STCW Convention and IMO Model Courses.

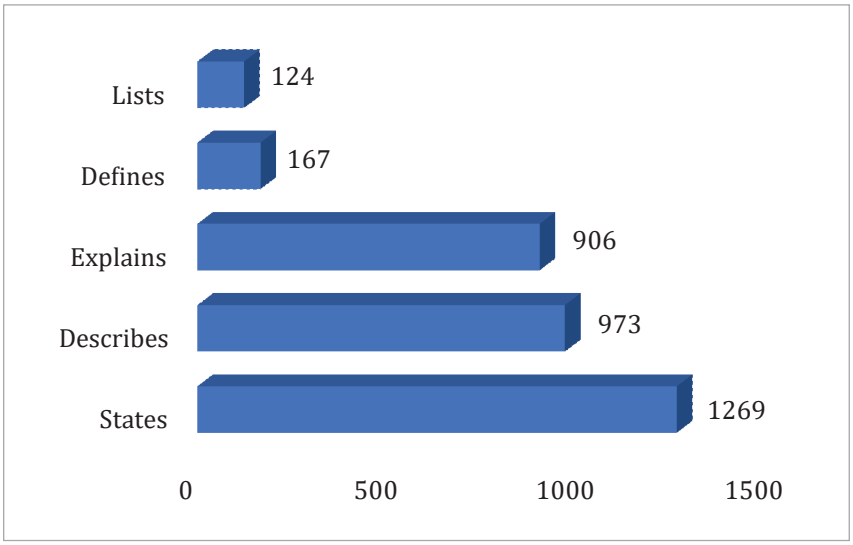

Figure 1 Action verbs with occurrence more 100 times in the corpus of text

Source: Authors

5 Conclusion

Prescribing competences needed for jobs onboard, without adequate methods for demonstrating competences and criteria for evaluating competences, cannot ensure an efficient system of seafarers' education. This research has shown that:

1. A part of methods for demonstrating competences and criteria for evaluating competences should be elaborated and explained additionally (for example, methods for demonstrating competences – "examination and assessment of evidence obtained from approved in service experience" or criteria for evaluating competences – "actions taken and procedures followed correctly apply and make full use of advice available");

2. Verbs referring to elementary levels of Bloom's cognitive domain are used to describe learning outcomes in STCW Convention and IMO Model Courses. The aforementioned refers primarily to level 1 – to remember, level 2 – to understand and level 3 – to apply. Therefore, the results indicate that STCW Convention does not anticipate higher levels of Bloom's cognitive domain, to analyse, to evaluate and to create for jobs at management level.

3. The usage of terms learning objectives and learning outcomes is not clear.

Therefore, it is suggested: to transform learning objectives into learning outcomes; to use more methods for demonstrating competences so that that the process itself could be more universal and comprehensive and to use corpus linguistics method to compare IMO Model Courses with study programmes or/and to compare more study programmes.

In this way, it could be possible to determine precisely the extent to which a study programme covers learning outcomes referring to affective and psychomotor domains that are clearly having a direct impact on broad safety, the protection of human lives and the protection of the marine environment. This applies primarily to learning outcomes associated with efficient management (communication styles, management styles, learning styles, use of technology, etc.).

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