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Methods of learning outcomes assessment in the light National Qualifications Framework requirements

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Abstract
In the years 2011–2012 Polish universities were obligated to implement education requirements in compliance with the National Qualifications Framework. First the universities defined intended learning outcomes, a basis on which curricula were drawn up. The most difficult part of the implemented system is the appropriate identification of method(s) to assess whether the expected learning outcomes have been achieved. This article discusses an examination system commissioned by maritime administration for seafarer examining, and indicates possibilities of using the developed solutions in the process of learning outcomes assessment at technical universities and academies.

Introduction

The European Qualifications Framework (EQF) was introduced into the European Higher Education Area by the recommendation of the European Parliament and of the Council of Europe as of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning. The recommendation of the European Parliament binds the EQF and associated documents into an education system common for national education systems in Europe and will allow to compare qualification levels between countries. On the basis of the European Parliament guidelines, countries in Europe create their own systems of National Qualifications Framework (NQF) that determine educational levels comparable with those of other countries.

Each NQF and EQF level is defined by a set of descriptors. These indicate the learning outcomes achieved at that particular level of education corresponding to qualifications at that level in any European country qualifications system. EQF comprises the entire educational spectrum: general, vocational education and training, higher education and adult education. It has been assumed that each of the eight levels should be achievable via various educational paths, including non-formal education. EQF provides three groups of descriptors for conforming whether the expected outcomes have been achieved [1]:

- knowledge (effect of the assimilation of information through learning; knowledge is the body of facts, principles, theories and practices that is related to a field of work or study);
- skills (cognitive – involving the use of logical, intuitive and creative thinking, and practical – involving manual dexterity and the use of methods, materials, tools and instruments); the term skills means the ability to apply knowledge and use know-how to complete tasks and solve problems;
- competence (means the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development.

It was agreed that from 2012 each officially issued qualifications certificate should contain a clear reference by way of national qualifications systems, to the appropriate European Qualifications Framework level [1].

In Poland, higher technical studies can be undertaken in three cycles: 1st cycle leads to a profes-

sional title of engineer, 2nd cycle leads to a master's or master of engineering degree, while the third cycle means doctoral studies. They are referred to EQF as the sixth, seventh and eighth level, respectively. Polish universities took no time to implement NQF. However, the question arises whether this implementation is complete. Can NQF be fully implemented at universities considering the present condition of the remaining part of the educational system and regulations in force? For the time being the answer is *no*. The regulations are not consistent and do not permit to precisely define the methodology and procedures for the verification of qualifications achieved. The development of preliminary guidelines for validation system solutions and recognition of learning outcomes in the higher education system is in progress. The following arrangements are under consideration [2]:

1. The learning outcomes validation will be conducted by specialized university units.
2. These units will offer advice to learners comprising the identification of achieved learning outcomes and their documentation. The learning outcomes will be verified and confirmed by issuance of a relevant document. A document confirming the learning outcomes will include their detailed description and a description of methods and scope of verification.
3. These units will have to comply to their own quality assurance system for the process of validation and will be subject to periodical external audit by the National Accreditation Committee (*PAKA*).
4. Learning outcomes confirmed by a validation centre of one university may be recognized by another institution of higher education in Poland, however, such decision on recognition will be an autonomous decision of the university hosting the learner.
5. Learners will be able to make use of the confirmed learning outcomes in graduate and postgraduate programs, and in any types of training undertaken for qualifications.
6. If a validation process attests all learning outcomes expected to be achieved for a given qualification, on its basis a university may award this qualification – a diploma of completion of first or second cycle studies.
7. At a national level, an advisory body will be established to run audits of learning outcomes in cases where learners will not find an appropriate validation unit. As a result of such audit, the learner will be directed to a validation unit competent for the scope of learning outcomes being validated.

In order to achieve this aim, the system of examining in Poland, including universities, has to be completely remodeled. One of the arguments for it is that there are a number of academics who will not change their skeptical thinking and attitudes about effective education within system changes enforced by NQF. That unwillingness is even more visible in people engaged in lower levels of education [2]. Implementation of standardized methods of verification of achieved learning outcomes may be inconvenient for poor educational institutions.

Examinations

An exam (Latin *examen*) – till recently was perceived as a form of checking one's knowledge. At present, when it comes to verifying one's competences that involve practical skills the term *assessment* seems more proper, as it refers to both knowledge and skills. Accordingly, the scope of examining has been extended to include practical tasks, so that the term examination evaluates skills an applicant has at a required level of competence. Competence is understood as theoretical knowledge and practical skill distinguishing a person by his/her ease of efficient, effective and quality-satisfying performance of tasks. Additionally, the above definition of competence is broadened with expected attitudes and personal qualities of the applicant. Actions of a person competent in a given field should meet criteria adopted in a given community / organization [3]. According to the National Qualifications Framework adopted in Poland, the process of assessment should confirm that the assumed learning outcomes have been achieved [4].

An academic team established at the Maritime University of Szczecin, to respond to the request of maritime administration to work out a concept of seafarer examination. The concept utilizes long experience of the authors in this respect [5, 6, 7, 8], and takes into account national and international trends and STCW Convention requirements for the verification of skills [3, 9]. Adoption of such exam model will allow to assess examinee's competences and to assess and verify training standards applied at various training centres for seafarers. The authors' intention concerning the examination system was to separate a theoretical exam of knowledge from a practical exam assessing skills and to formulate objective assessment criteria [1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. The examination form and structure were based on an assumption that they have to assure:

– transparency of exam principles and requirements,

– clear user-friendly form,
– objectivity ensured by system-enforced supervision and elimination of personal subjectivity.

An exam in course units (subjects) comprising a wide scope of knowledge and skills and several learning outcomes subject to evaluation was divided into modules. Depending on the specifics of a course unit module, all or selected forms of examination are used, as defined in attached exam sheets. Each module has functions assigned to it, which result from the learning outcomes of the course units covered by an exam.

The following exam forms are used in the proposed assessment process:

1. A theoretical exam, divided into:
   a) a multiple choice test;
   b) a written exam.
2. A practical exam, divided into:
   a) exam on real objects;
   b) exam on a simulator.

Each course unit making up part of a function and module has a defined method of testing knowledge and skills, that is it has an assigned form of exam(s) conducted within a module. An example structure of a module is shown in figure 1, while figure 2 depicts an organization of a one-day exam for a recognition of competences as required in a training program. Exams in case of more extensive programs may take two or three days.

The structure of exams may include various modules, depending on the scope of assessed skills and knowledge. To ensure that the exam result is reliable and the education or training is appropriate, the exam methods have to be clear and known to both examiners and examinees alike, and assessment criteria should be such that any distortion of exam results by the "human factor" will be impossible. For these reasons, the exam system developed at the Maritime University of Szczecin is characterized by a system-based solutions instead of personal decisions, that are reduced to a minimum. Examinees will have access to an electronic data base, a bank of test items, written tasks and scenarios for practical exams on real objects or simulators.

Four basic forms of exams have been used: multi-choice test and written exam, making up a written part of the exam; exam on real objects and on a simulator or ship, a practical form of assessing trainee's ability to use skills and knowledge in practice.

Theoretical exam

A multiple choice test

The test may have either of two forms:

a) computer-based, conducted in a room equipped with single user computer stations, one for each examinee;
b) recorded on paper exam sheets, organized in a room with traditional desks for applicants, a computer with an access to exam task base and a fast printer.

Written exam

Two methods of written exams can be implemented:

a) computer-based, conducted in a room equipped with single user computer stations, one for each examinee;
b) recorded on paper exam sheets, organized in a room with traditional desks for applicants, a computer with an access to exam task base and a fast printer.

Both test and written exam in a transition period may be prepared outside the exam room, printed under a supervision of an examination board.

Practical exam

Exam on a real object

The exam is conducted with the use of a real object specified in tasks covering a certain scope of topics, recorded in exam sheets (e.g. AIS receiver, fuel purifier).

Exam on a simulator / ship

The exam is conducted on a ship or a simulator. If the latter is used, it has to satisfy standards of an operational simulator. If a practical exam takes place on a ship, it has to carry equipment the handling of which is to be examined.

Figure 2 illustrates a serial arrangement of exams in each module, such that passing each exam form in a module allows the applicant to take the next exam component within that module. If the overall examination consists of more than one module, failing one module does not exclude the examinee from taking exams in other modules.

The first part of the overall examination, a theoretical exam, consists of a test and a written exam. If the theoretical exam (test and written) is conducted in a room equipped with individual computer exam stations, the examinee gets a set of questions / tasks drawn at random by a dedicated computer program, started by an exam board member that supervises the exam. If this exam takes place in a room equipped with traditional separate exam tables and a computer electronically connected to a data base of exam tasks and an efficient printer, exam participants will get exam sets printed on paper. The sets of exam questions and written tasks, like above, are drawn by a computer program

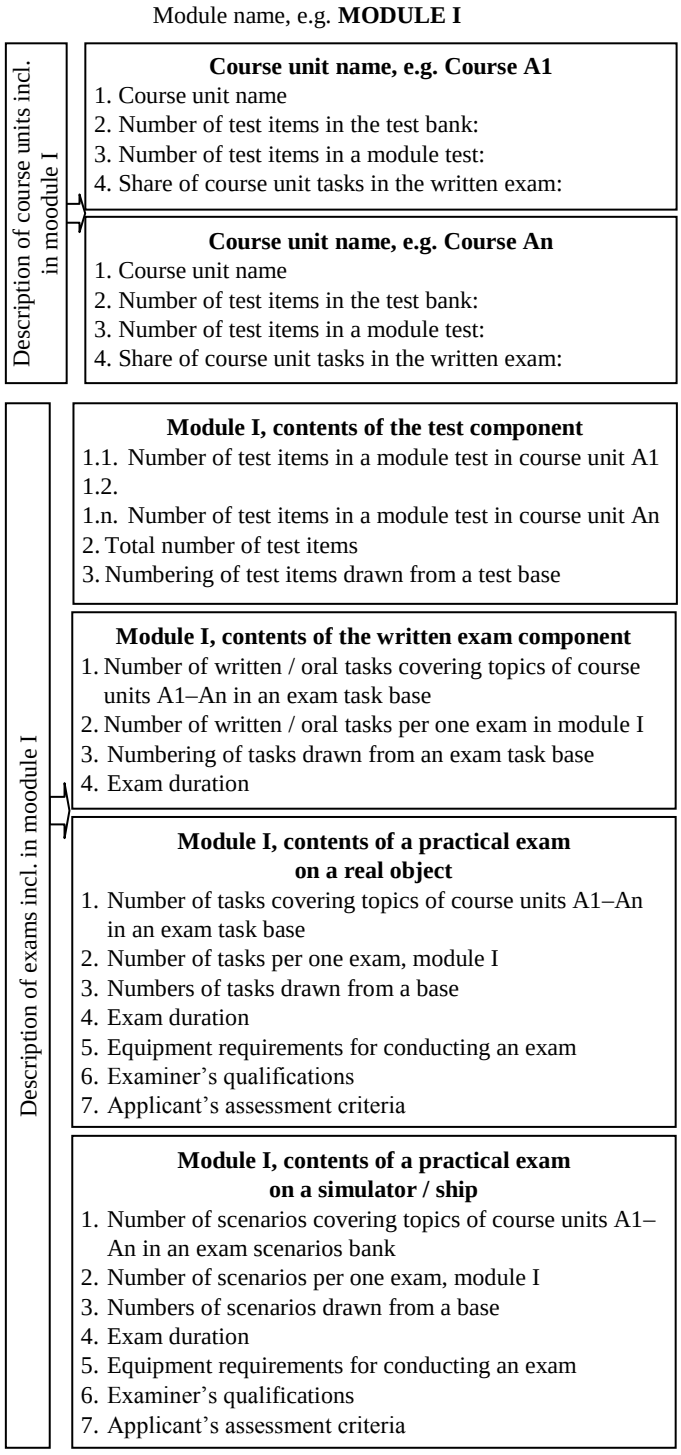

Fig. 1. Model of an exam module

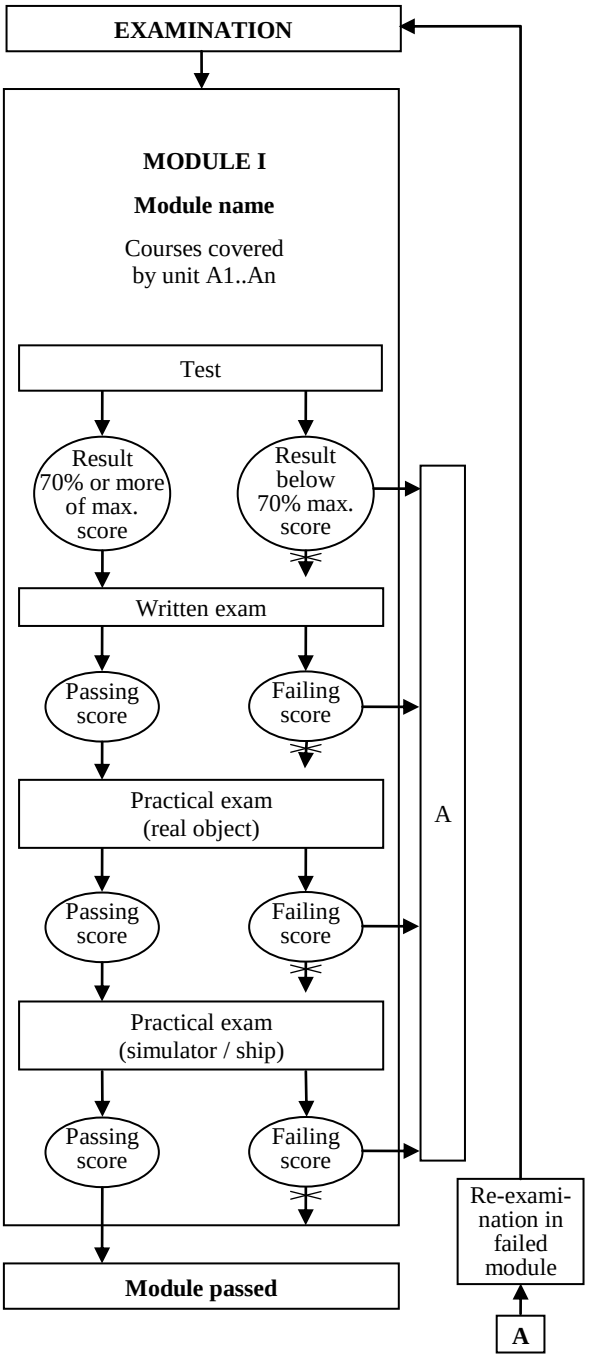

Fig. 2. Block diagram of a one-module exam

activated by an examination board member who supervises the exam. It is assumed that exam sets should be coded.

The test results are only the first element of verifying examinee's knowledge and skills. The test in each module will be regarded as passed, if a preset minimum score is achieved. This is a prerequisite for taking the written exam, where a minimum answer of correct answers has to be given. A result below a preset minimum excludes the examinee from taking the other part of the exam module. Examinees should be informed about the test results not later than three hours after the last group takes the test. The next session is intended for written exams in each module. Exams in each module are divided into sessions, not more than three. Each will take no longer than 90 minutes. There are 30-minute breaks between the sessions. The written

exam in each module contains one theoretical problem (task) that can be solved within allocated time. The written exam time should not exceed 90 minutes. Tasks are solved individually by examinees, who are informed about the results of the written exam not later than one day after the completion of this part of the overall examination. If the written exam is passed, the examinee can proceed to further exam module component.

The last part of the examination (for an examinee it can be the first, third, seventh or any other day counting from the start of the examination session) includes practical exam in particular modules, if such are applicable. The practical exam covers a randomly selected scenario to be implemented on a real object and/or simulator that meets operational requirements. Tasks are at random drawn by an examiner from an appropriate data base of exam problems.

The practical exam on a real object includes one practical task that an examinee is able to solve in allocated time. Tasks are done individually by each examinee, and it should last no longer than 30 minutes. The examiner announces the result to the examinee immediately after the exam.

The practical exam on a simulator or ship includes one scenario that can be executed in an allocated time, assumed to be 60 minutes at the maximum. Scenarios are chosen at random by the examiner from an appropriate data base of exam scenarios. Like in the real object exam, tasks included in a scenario are performed by examinees individually and the result is announced by the examiner right after the exam.

Exams that cover a narrower scope of topics may have subjects grouped within one or two modules, and their forms may be restricted to, for instance, a test and written exam, or only a test and practical exam, as indicated on examination sheets. In such cases, the whole exam will take one or two exam days.

According to EQF and NQF requirements [2, 13] it is assumed that passing a module is equivalent to a recognition that the examinee has mastered the skills and knowledge included in that module and possible re-examination will not comprise the

Table 1. An exam sheet for marine engineering at the management level [10]

6. Engine Department										
Management level – STCW Table A-III/2							Exam form – Type I/Ie (Fig.12/ Fig.15/Fig.20)			
Module	Function	Course unit	Theoretical exam				Practical exam			
			Multiple choice test		Written exam		Real object		Simulator	
			number of items in a test	time min.	Tasks per exam	time min.	Tasks per exam	time min.	Scenarios per exam.	Time min.
I Type A	Marine engineering, management level	Marine Diesel engines	20	90	1	60	1	30	1	60
		Marine power plants	20							
		Marine machinery and equipment	20							
		Marine boilers	10							
		Marine refrigeration, ventilation and air conditioning	5							
		Thermodynamics	5							
		Working fluids	10							
II Type A	Electrotechnology, electronics and automation, management level	Marine electrotechnology and electronics	30	90	1	60	1	30	1	60
		Marine automation	20							
	Maintenance and repairs, management level	Mechanics and strength of materials	5							
		Repair technology	25							
		Ship building theory	10							
III Type H	Care for the ship and personnel, management level	Safe operation of the ship	10	50	1	60	none	30	1	60
		Marine environment protection	10							
		Law and marine insurance	10							
	Marine engineering	English	20							

module already passed. If the examinee fails re-examination, the next exam will cover the complete scope of knowledge and skills assessed by the given examination.

An example examination sheet

The transparency of the examining process strictly depends on the transparency of the exam forms and the associated scope of subjects, available to examiners and examinees alike. Examination sheets have the same form for each component required for a given level of competence. Table 1 presents an example examination sheet for engine department management level candidates.

Verification of learning outcomes at universities

One of the basic factors allowing to implement NQF (following its logic) at higher education institutions is the transformation of academic teachers' awareness concerning methods of achieving assumed learning outcomes, and first and foremost, assessment of competences students have acquired. For this to happen, it has to unequivocally and precisely formulate learning outcomes and corresponding assessment criteria. The appropriate identification of learning outcomes for many authors of syllabuses, making up a curriculum for a field of study, is difficult, and consequently these outcomes are defined improperly and superfluously. Competences and learning outcomes are a basis for exam requirements, sets of problems and tasks, also practical ones, or test item data banks. Therefore, they determine the equipment of an exam centre, choice of exam procedures and vocational training programs.

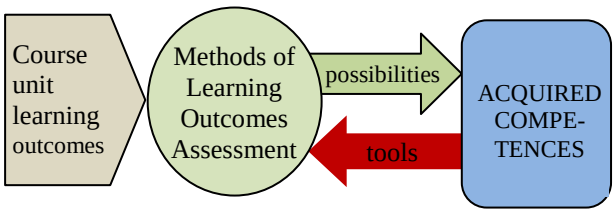

Fig. 3. Relations between competences, learning outcomes and methods of their assessment

Assessment at a university is a continuous process, composed of various forms of verifying learning outcomes, with a diversified scope within a course unit or module, from laboratory classes, through tutorials, lectures and seminars to vocational in-company training. Before receiving a diploma of qualifications, the university under/graduate has to pass all exams indicated in the study plan, as well as a diploma exam.

An exam model commonly used in Polish universities is the testing of knowledge or skills excluding the practical component. Besides, the preferred forms of written or particularly oral exam inevitably lead to the subjective assessment of the examiner. In many cases the exam mark is stained with based selection of questions, or even questions improperly formulated by examiners. Non-substantial factors, for instance examinee's appearance, may have an impact on the evaluation by the examiner. The methods of examining used to date are very traditional and do not meet standards of modern methodology of competence verification, and, undoubtedly, do not satisfy the EQF requirements in this respect, which is particularly visible when it comes to the verification of competences acquired through non-formal methods [2]. Professor Macukow of Warsaw University of Technology, an expert in NQF implementation in Polish higher education institutions, in his talk at the meeting of deputy rectors responsible for education in technical universities, emphasized the importance of developing the methods of verifying whether the intended learning outcomes have been achieved.

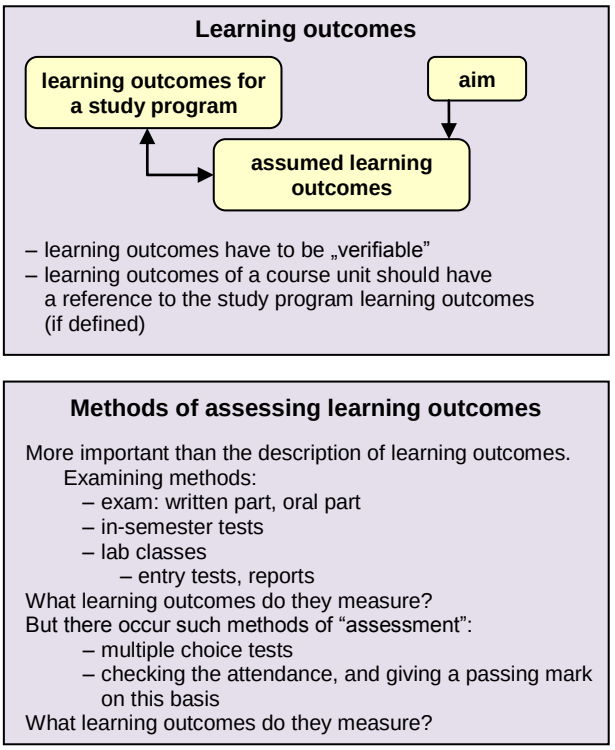

Fig. 4. Methods of learning outcomes assessment [13]

Assessment should start at a level of lab classes. These should be remodeled so that their objective will be measurable effects or competences, not just activities determined by the class topic. The study program should differentiate between "knowledge and skills" exams and competence exams. The latter often require more complex "instrumentation" for the examining process. This means that the

methods of competence demonstration on real objects or simulators should be assigned to teaching / training, as well as examining. The selected demonstration method, in turn, determines what examiners should have to appropriately conduct an exam: assessment criteria, sets of exam tasks, exam procedures and technical equipment, the latter sometimes unavailable at a given institution. Therefore, maritime universities, too, even if fully equipped with simulators and real objects, should partly assess the learning outcomes on real objects during vocational training. In the light of NQF requirements, practical training should become integral to education at all technical universities.

Such approach to examining may necessitate and lead to a system of verifying learning outcomes similar to the one discussed earlier. The system developed at the Maritime University of Szczecin for education via training courses may to a large extent be implemented in higher education institutions, including maritime universities or academies. One obstacle for many technical universities is that they have no possibility to carry out the practical part of exam in course units involving lab classes.

Conclusions

The implementation of the National Qualifications Framework cannot be completed just by determining the expected learning outcomes and developing a program leading to their achievement. One of the most important components, if not the most important, is the definition of methods of learning outcome evaluation. The system of exams originally developed for specialized course-based training, may provide a basis for adopting similar solutions at technical universities. One advantage of such solution is that some components of overall examination may be incorporated into e-learning system, which sooner or later will become a common approach.

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