

# GROUP EXPERT EVALUATION OF QUALITY CRITERIA OF THE EDUCATIONAL PROGRAM FOR THE FIELD OF METROLOGY AND INFORMATION-MEASURING TECHNIQUE

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**Abstract.** The article's urgency of researching the importance of the applied national criteria for the quality of the educational program (CQEP) for higher education institutions (HEI) was established. The approach to group expert assessment of the weight of CQEP for the educational program (EP) in the field of metrology and information-measuring technique was studied. Members of one of the sectoral expert councils on technical specialties are involved in carrying out such assessments. To achieve this goal, the composition and requirements of the CQEP sub-criteria are analyzed, the algorithm of group expert assessment of the CQEP weight was proposed and substantiated, and the priority of the CQEP sub-criteria based on the conducted assessment was established. Conducting a quality assessment of EPs by experts and the National Agency for Quality Assurance in Higher Education according to clearly established criteria and sub-criteria helps to improve the quality of EPs of HEI. Although the HEI should pay attention to all the established criteria (sub-criteria), more attention should be paid to those identified by experts as the most important and those that significantly affect the quality of EP. It is established that such criteria include, first of all, training through research, human resources, teaching, and learning in the educational program. At the same time, the experts of technical specialties have the most doubts about the sub-criteria of the CQEP for internal quality assurance of the EP (K8), and this criterion itself is not considered important by them. At the same time, a large number of CQEP sub-criteria regarding the structure and content of the EP are also questionable, although they consider this criterion to be important. Therefore, these sub-criteria of the CQEP need special attention during the next revision of the set of CQEP to better balance the system of sub-criteria of the CQEP.

**Keywords:** Metrology, Information technologies, Quality criteria, Educational program, Higher education institution, Sectoral expert council.

## 1. Introduction

The International Standard Classification of Education (ISCED) was developed by UNESCO as a comprehensive statistical description of national education systems and a methodology for assessing national education systems against comparable international levels [1]. ISCED is the main international classification system of education [2]. The basic unit of ISCED classification is educational programs (EP), and the classification of EP is carried out by sectors of knowledge, orientation, and purpose of EP. In Ukraine, the list of sectors of knowledge and specialties for which higher education is provided (a total of 29 sectors) does not fully comply with ISCED (a total of 10 sectors). Therefore, the Resolution of the Cabinet of Ministers of Ukraine equates the existing national fields of knowledge and specialties to the international classification [3].

The European Higher Education Area (EHEA) [2, 4–6], the higher education area of the Bologna Process countries pursuing a coherent and transparent education policy, has established a research-based higher education paradigm. The main instruments of the EHEA are the European Community Course Credit Transfer System (ECTS) and the National Qualifications Framework. The Cabinet of Ministers of Ukraine has approved the

National Qualifications Framework, including the relevant dictionary to this document [2, 7].

The purpose of accreditation of EP for National Higher Education Institutions (HEIs) [8], which trains higher education seekers, is to establish the quality of EP, provide all stakeholders with information on the quality and educational activities of EP, promote the integration of Ukrainian HEIs into EHEA. Accreditation of the EP is an assessment of the quality of the EP and educational activities of the HEI for this EP in terms of compliance with the standard of higher education, ability to meet its requirements, as well as achieving the declared learning outcomes following the criteria for assessing the quality of EP (CQEP).

The CQEP, each with its own defined sub-criteria, are used by the HEIs to prepare self-assessment information, as well as by the National Agency for Quality Assurance in Higher Education (National Agency), its sectoral expert councils (SEC), and experts during accreditation take account standards-based and quality assurance recommendations in the EHEA. Assessment of EP and educational activities of HEI for EP is carried out according to each criterion according to the assessment scale, which covers four levels of compliance: A (highest level), B, E, F (lowest level).

Conformity of the CQEP is assessed by a special expert – a person who has the necessary knowledge and skills that allow him to effectively assess the quality of EP and educational activities of HEIs under these EPs and develop recommendations for improving the quality of higher education in relevant specialties. This expert is a specialist who is selected from among the scientific and pedagogical, scientific workers, as well as applicants for higher education and carries out the accreditation expertise of the EP in the HEI.

The recommendations on the application of the CQEP [9], approved by the National Agency, help both experts and HEIs in the practical application of the CQEP. They are based on the principles of respect for the autonomy of the HEI, taking into account the context and positions of stakeholders, analytics, and evidence. They provide recommendations for compliance with the requirements of the HEI under each criterion (sub-criterion).

At the same time, given the significant number of CQEP sub-criteria, the issue of prioritizing the preparation of HEIs for accreditation of EPs is actual, meeting the most essential requirements of the CQEP sub-criteria, which are primarily taken into account by experts and the National Agency. This determines the relevance and needs for special research in this area.

## 2. Drawbacks

The main scientific publications on improving approaches to higher education are aimed at developing a global standard for the transfer and accumulation of credits in higher education [10], overcoming the problems and experience of implementing ECTS in the Bologna Process [11–15]. The authors investigated the establishment and application of criteria for expert evaluation of the effectiveness of HEIs [16, 17], as well as the establishment and application of criteria for assessing the competence of experts in higher education [18, 19]. At the same time, no scientific publications have been identified on the establishment and application of evaluation criteria for the EP HEI, which remains an urgent task.

## 3. The Goal of the Paper

The goal of the current article is to develop a method of group expert assessment of criteria for the quality of the educational program.

## 4. Sub-criteria for assessing the quality of the educational program and the algorithm for determining their importance

The SEC of technical sciences includes the following sectors: 12 – information technology; 13 –

mechanical engineering; 14 – electrical engineering; 15 – automation and instrument making; 16 – chemical and bioengineering; 17 – electronics and telecommunications; 18 – production and technology; 27 – transport. The nearest in scope are SEC 12 (specialties 121 – software engineering, 122 – computer science, 123 – computer engineering, 124 – systems analysis, 125 – cyber security, 126 – information systems and technologies), SEC 15 (specialties 151 – automation and computer-integrated technologies, 152 – metrology and information-measuring technology; 153 – micro-and nano-system technology (engineering) and SEC 17 (specialty 171 – electronics, 172 – telecommunications and radio engineering, 173 – avionics).

Only 9 criteria are used in the accreditation of EP of HEI, which contain a total of 54 sub-criteria:

K1 – designing and objectives of the EP (sub-criteria K1.1 – K1.4);

K2 – structure, and content of EP (sub-criteria K2.1 – K2.9);

K3 – access to EP and recognition of learning outcomes (sub-criteria K3.1 – K3.4);

K4 – teaching and learning on EP (sub-criteria K4.1-K4.5);

K5 – control measures, evaluation of higher education seekers and academic integrity (sub-criteria K5.1 – K5.4);

K6 – human resources (sub-criteria K6.1 – K6.6);

K7 – educational environment and material resources (sub-criteria K7.1 – K7.6);

K8 – internal quality assurance of EP (sub-criteria K8.1 – K8.7);

K9 – transparency, and publicity (sub-criteria K9.1 – K9.3);

K10 – learning through research (sub-criteria K10.1 – K10.6).

In [16–19] algorithms of group expert assessment and expert competence assessment are proposed, which can be used to develop an algorithm for assessing the quality criteria of EP in the field of metrology and information-measuring technology.

To carry out any group expert evaluation, it is important to take into account the competence of each of the experts involved in conducting such an evaluation. This may increase the reliability of such an assessment. However, given the involvement in the survey of SEC members who were included in the SEC based on the competition, it can be considered that the competence of all involved experts is high, so taking into account their competence will not lead to significant displacements of the obtained estimates.

To implement the algorithm, the necessary calculations were performed using the following basic indicators:

– the average score  $\bar{x}_i$  for each of the  $N$  CQEP sub-criteria or criteria, taking into account the specific assessments  $x_j$  of all  $M$  experts who participated in the assessment, using the expression

$$\bar{x}_i = \frac{\sum_{j=1}^M x_j}{M}, i=1,2,\dots,N; \quad (1)$$

– reference (average) value of the expert assessment according to all sub-criteria of the CQEP or criteria as a simple average value (in points) for the expression

$$x_{ref} = \frac{\sum_{i=1}^N \bar{x}_i}{N}, \quad (2)$$

and ranking the values obtained for each of the CQEP sub-criteria or criteria in descending order of the scores obtained.

The criterion of weight for the CRR sub-criterion or criterion is the excess of the obtained average score for all CQEP sub-criteria or criteria. The application of such a criterion allowed forming a list of the most important sub-criteria of the CQEP or criteria. For clarity of the received results, their graphic representation in the form of the corresponding histograms is used.

### 5. Group expert evaluation of criteria and sub-criteria for evaluating the quality of the educational program

Group expert assessment of criteria and sub-criteria for quality assessment of EP was carried out with the involvement of members of SEC 15 (automation and instrumentation). To this end, a special questionnaire was developed and disseminated among the members of SEC 15 to assess both the criteria and sub-criteria for assessing the quality of EP. Selected rating scale: from 1 (least important) to 9 (most important) points. Processing of the received questionnaire data is carried out according to the offered algorithm.

The results of the evaluation of the CQEP and their sub-criteria are shown in Fig. 1-2. Fig. 2 presents the results ranked in descending order of score.

The sequence in order of importance of CQEP is as follows: K10, K6, K4, K2, K1, and the sequence of the least important CQEP is as follows: K3, K9, K7, K5, K8.

The sequence in order of importance of 10 sub-criteria of CQEP is as follows: K6.1, K10.1, K4.4, K7.1, K2.3, K8.1, K1.3, K2.5, K3.1, K9.3, and the sequence of the 10 least important subcriteria CQEP is as follows: K2.7, K2.8, K2.9, K3.4, K8.4, K8.7, K2.6, K6.3, K7.3, K8.6.

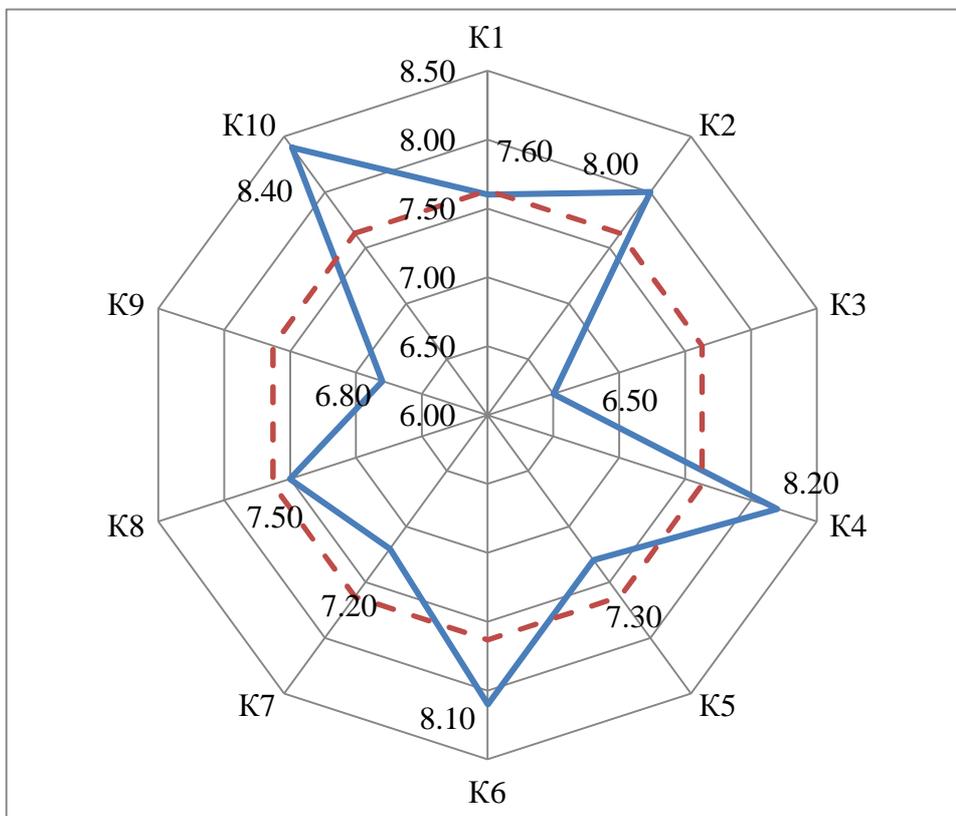


Fig. 1. The weight of CQEP in points

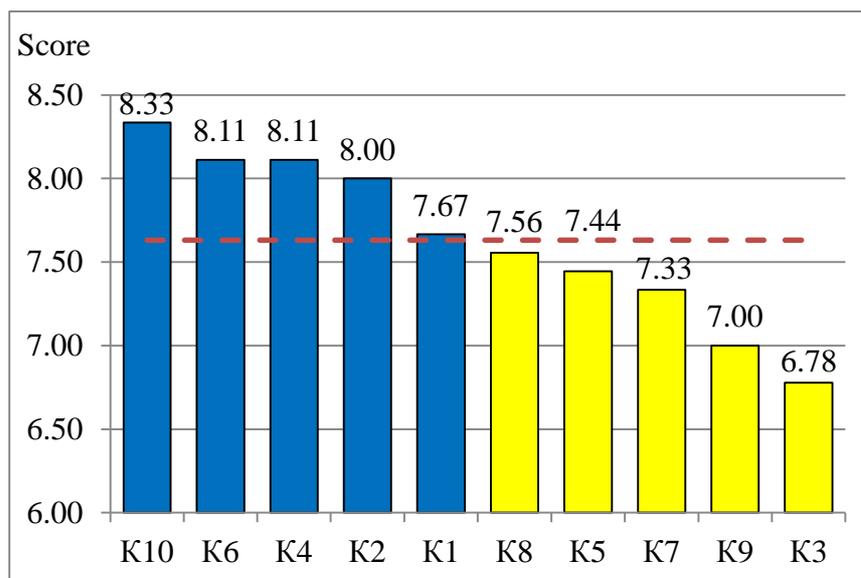


Fig. 2. Ranking of CQEP by weight in points

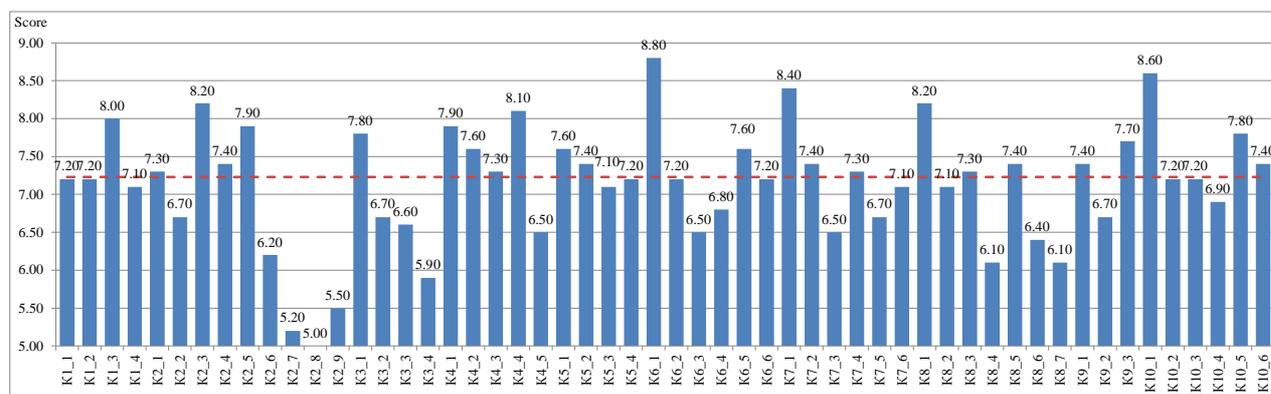


Fig. 3. CQEP sub-criteria by weight in points

## 6. Discussion

In total, 5 (out of 10 – 50%) CQEP and 29 (out of 54–54 %) CQEP sub-criteria were identified.

The most important CQEP (points above the average level – 7.63) are as follows (from 8.33 to 7.67 points):

- K10 – learning through research (8.33 points);
- K6 – human resources (8,11);
- K4 – teaching and learning for EP (8,11);
- K2 – structure, and content of EP (8.00);
- K1 – designing and objectives of the EP (7.67).

It is worth noting that the criterion K10 - learning through research, applies only to the EP of the third level of higher education. That is, for EP of the first and second levels of higher education the most important criteria will be (in descending order of weight) K6, K4, and K2.

Experts in technical specialties had the most doubts about the CQEP sub-criteria for internal quality assurance (K8), and for some reason, this criterion itself

was not considered important. In turn, the identification of inconsistencies and shortcomings on several criteria in most cases indicates the lack of effectiveness of procedures for monitoring and periodic review of EP or that such procedures are formal. A large number of CQEP sub-criteria regarding the structure and content of the EP (K2) is also questionable, although this criterion itself is considered important by experts. Therefore, these sub-criteria of the CQEP (K2 and K8) require special attention in the next revision of the set of CQEP to better balance the system of CQEP sub-criteria.

The most important 10 sub-criteria of the CQEP (points above the average level – 7.23) are as follows (from 8.78 to 7.33 points):

K6.1 – academic and/or professional qualification of teachers involved in the implementation of the EP, ensures the achievement of defined by the relevant EP goals and program learning outcomes (8.78 points);

K10.1 – the content of the educational and scientific program meets the scientific interests of

graduate students (adjuncts) and provides their full preparation for research and teaching activities in the HEI in the specialty and/or field (8.56);

K4.4 – HEI provides a combination of training and research during the implementation of EP following the level of higher education, specialty, and objectives of EP (8,33);

K7.1 – financial and logistical resources (library, other infrastructure, equipment, etc.), as well as educational and methodological support of the EP, guarantee the achievement of certain OP goals and program learning outcomes (8,33);

K2.3 – the content of the EP corresponds to the subject area of the specialty defined for it (specialties, if the educational program is interdisciplinary) (8,11);

K8.1 – HEI consistently adheres to the procedures defined by it for the development, approval, monitoring, and periodic review of EP (8,11);

K1.3 – goals of the EP and program learning outcomes are determined taking into account trends in the specialty, labor market, industry, and regional context, as well as the experience of similar domestic and foreign EP (8.00);

K2.5 – OP and curriculum provide practical training for higher education, which allows acquiring the competencies needed for further professional activity (7,89);

K3.1 – the rules for admission to training are clear and understandable, do not contain discriminatory provisions, and are published on the official website of the HEI (7.89);

Q9.3 – The HEI publishes promptly on its official website accurate and reliable information on the EP (including its objectives, expected learning outcomes, and components) to the extent sufficient to inform relevant stakeholders and society (7,89).

Among the important sub-criteria of the CQEP, experts of technical specialties highlight the sub-criteria for the infrastructure and equipment of laboratories of the HEI, taking into account current trends in the development of the specialty.

The least important 10 sub-criteria of the CQEP (points below the average level – 7.23) are as follows (from 5.11 to 7.22 points):

K2.7 – the content of the EP takes into account the requirements of the relevant professional standard (5.11 points);

K2.8 – the amount of EP and individual educational components corresponds to the actual workload of applicants, achieving goals and program learning outcomes (5.22);

K2.9 – the structure of the EP and the curriculum for the training of higher education in the dual form in

the case of its implementation are consistent with the objectives and features of this form of education (5.89);

K3.4 – defined clear and understandable rules for the recognition of learning outcomes obtained in non-formal education, which are available to all participants in the educational process and which are consistently followed during the implementation of the EP (6,11);

K8.4 – the quality assurance system of the HEI provides a timely response to identified shortcomings in the EP and/or educational activities for the implementation of the EP (6,11);

K8.7 – in the academic community of the HEI a culture of quality is formed, which contributes to the constant development of educational and educational activities for this educational complex (6.22);

K2.6 – EP provides for the acquisition of higher education by social skills that meet the stated objectives (6.67);

K6.3 – HEI involves employers in the organization and implementation of the educational process (6,67);

K7.3 – the educational environment is safe for the life and health of higher education students studying for EP, and provides an opportunity to meet their needs and interests (6.67);

K8.6 – the results of external quality assurance of higher education (including comments and suggestions made during previous accreditations) are taken into account during the review of the EP (6.67).

It should be noted that at least one of the sub-criteria for all 10 CQEPs is assessed as significant. The largest number of subcriteria CQEP refers to the criteria: K2 (K2.1, K2.3-K2.5), K4 (K4.1-K4.4), K 6 (K6.1, K6.2, K6.5, K6.6) – according to the 4<sup>th</sup> sub-criteria of the CQEP; K5 (K5.2-K5.4), K7 (K7.1, K7.2, K7.3), K8 (K8.1, K8.3, K8.5) – according to the 3<sup>rd</sup> sub-criteria of CQEP; K1 (K1.1, K1.3) – 2<sup>nd</sup> sub-criteria of CQEP; K3 (K3.1), K9 (K9.3) – one sub-criterion CQEP. The largest number of the least important sub-criteria (scores below the average level – 7.23) belongs to CQEP K2 (K2.2, K2.6-K2.9 – 5), K8 (K8.2, K8.4, K8.6, K8.7 – 4th), K3 (K3.2 – K3.4) and K7 (K7.3, K7.5, K7.6) – 3<sup>rd</sup> each.

## 7. Conclusions

The list of branches of knowledge and specialties in which higher education students are trained in Ukraine and needed to harmonize with the International Standard Classification of Education is defined. It is necessary to take into account both national characteristics and the experience of countries belonging to the European Higher Education Area. It is also advisable to fully harmonize the national terminological and conceptual apparatus with the relevant international in the field of higher education.

Assessing the quality of the educational program by experts and the National Agency according to established criteria and sub-criteria helps to improve the its quality. More attention should be paid to programs identified by experts as the most important or/and significantly affected ones. Such criteria include, first, training through research (K10, only for the programs of the third level of higher education), human resources (K6), teaching and learning for educational program (K4).

## 8. Gratitude

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## 9. Conflict of interest

The authors state that there are no mutual financial conflicts regarding this work.

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