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ANALYSIS OF TRAINING PROGRAMS FOR THE TRAINING OF AIR TRAFFIC CONTROLLERS FOR DETERMINING THE FIELD OF DIGITIZATION

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Abstract. *The article emphasizes the high demands that are put forward to the professional knowledge and skills of air traffic controllers. Attention is drawn to ICAO's civil aviation training policy, which supports the human resource development strategies developed by Member States and the aviation community and provides access to a sufficient number of qualified and competent professionals. Based on this, the feasibility of research and improvement of the educational process of training air traffic controllers is substantiated. As a research method, the collection, processing and analysis of statistical data is used. As the subject of the study, educational programs for the training of aviation specialists of higher educational institutions of the USA, the Russian Federation, the Czech Republic, the Republic of Belarus and the Republic of Uzbekistan were adopted. The article presents the results of the analysis of curricula, arguing the choice of the most relevant areas of the educational process, in which it is advisable to digitalize educational and methodological support. The analysis concerns the content of curricula, the composition of academic disciplines and the motivations established for them. Based on the analysis, the dominant requirements are identified that determine the specifics of education for the training of specialists for air traffic management and services. It has been established that in the structures of curricula of specialized disciplines the greatest attention is given to knowledge of regulatory legal documents. This became the evidential basis to make a conclusion about the relevance of digitalization of educational and methodical manuals related to regulatory legal documents and the use of electronic educational technologies in the training process of air traffic controllers.*

Key words: *civil aviation, air traffic control, air traffic controller, educational process, analysis, regulatory documents, improvement, educational and methodological support, digitalization.*

The training of aviation specialists is subject to very high and strict requirements, since the safety of aircraft flights largely depends on the level of their professional knowledge and skills. From this perspective, ICAO has developed and is developing the necessary guidance and recommendation documents for international air traffic, designed to solve problems and tasks of training aviation specialists, including air traffic controllers. Among such documents is the document [1], which reflects ICAO's policy in the field of civil aviation (CA) training. This policy is based on four fundamental factors - "TRAINAIR PLUS Program", "Recognition by ICAO of civil aviation training activities", "Civil Aviation training programs developed by ICAO" and "Cooperation and Partnership Agreements". The policy imposes certain obligations on educational institutions. One of the duties is to provide a qualitative level of the educational process with the necessary educational, methodical and technical tools. In terms of this, another important document of ICAO is the document [2], which is devoted to the qualification system of training and assessment of air traffic control managers. The implementation of ICAO's recommendations in terms of its personnel policy contributes to the unification of training programs for aviation specialists, the growth of flight safety, as well as ensures the expansion of

the region of employment of graduates of educational institutions and increase in the human resources potential of the Civil Aviation Authority.

The relevance of research in the field of aviation education as an example can be confirmed by the state of the Eurasian Economic Union (EEU), which includes the Russian Federation, the Republic of Belarus, the Republic of Armenia, the Republic of Kazakhstan and the Kyrgyz Republic. The EEU Analytical Report [3] presents the accumulated problems in the system of personnel training for CA. It puts forward proposals for the unification of training programs for aviation specialists in the light of the recommendations of ICAO and legislative and regulatory documents of EEU member states, which have semantic, terminological, conceptual and other types of discrepancies. In the concluding position of the Analytical report, concerning the analysis of the system of training and professional development of aviation personnel, differences between training bases and programs, lack of training system development, lack of simulators, low level of infrastructure of educational institutions, which reduces their competitiveness in the global market of educational services, etc., are mentioned.

Based on the above-mentioned, it can be concluded that the aviation training system should be kept under constant consideration. All the necessary investigations should be carried out in order to modernize and improve it in the conditions of development and growth of requirements to aircraft flight operation, development of technical, organizational and economic systems of air traffic servicing.

The purpose of this research is to create an electronic educational complex (EEEC) for practical training on the legislative and regulatory documents of the CA.

Within the framework of the target problem, the development of models and software and algorithmic tools is foreseen. The EEEC concept envisages the development of a database (DB), which will contain legislative and regulatory documents related to the training of air traffic controllers. The Air Code of the Republic of Uzbekistan, documents of ICAO, aviation rules and various documents of the air traffic management services of the Civil Aviation of the Republic of Uzbekistan will be included in the database. EEEC software and algorithmic software provides for synthesis and generation of variants of individual training tasks, search for necessary information to perform the task, analysis and evaluation of the performed task. The adopted interactive mode will allow the student to search and select the necessary information in a wide range of opportunities and use it in the performance of the given educational task. The system will be open, which will make it possible to improve it, expand its functions and capabilities, and fill up the database.

The relevance of the goal set and the choice of the sphere of digitalization of the training process of air traffic controllers are justified below by the evidence considered below.

The modern educational system at the global level is being transformed towards the widespread use of digital technologies. The expediency of wide introduction of EEECs into the educational process is discussed at forums, and quite a lot of scientific works are devoted to it. Let's focus on the coverage of some of them.

At the Gaidar Forum "Russia and the World: Values and Virtues" [4], an open dialogue "Trends in Education: Challenges, Expectations, Reality" was held, the main trend of education is the digital revolution. The participants of the forum, including heads of higher education institutions, noted that the digital revolution creates new challenges; it affects education from the perspective of the labor market and the need for internal restructuring. At the same time, it is emphasized that society needs new digital competencies, creative elements, decision making training, communication and cooperation. The next conclusion is "Education market by 2030 - this is more of an online, private and global marketplace" and that "the new digital system has already started to provide online courses and models".

The paper [5] highlights the question of the expediency of a confident transition of the education system in the digital age, aimed at increasing productivity and new types of labor,

which is seen through the inclusion of all segments of the population in the educational process. Within this framework, it is proposed to build individual routes of learning and management of one's own learning outcomes. It is mentioned that the main directions of application of information technologies in education should be:

- a) The development of pedagogical tools for various purposes;
- b) Development of educational websites;
- c) Development of teaching and learning materials;
- d) Real object management;
- e) Organizing and conducting computer experiments with virtual models.

The article [6] provides information on the work of the conference EdCrunch-2019, dedicated to the modern digital educational environment in the Russian Federation and training for the digital economy, and the creation of conditions for improving the quality and accessibility of education. It states that transition to digital economy requires transformation of usual approaches to education. Attention is drawn to the National Platforms of Open Education established by leading universities, where online courses are hosted and on the portal online.edu.ru. At the same time, there is an urgent need for digital transformation, which allows not only to widely use the potential of educational platforms, communication and multimedia tools in education, but also to provide an opportunity to automate many processes that take up considerable time from teachers and administrators, to provide employees and students with a range of services to improve the quality and convenience of learning.

The research [7] addresses the issues related to the joint training of air traffic controllers and pilots. Improvement of such simulators by adding new functional programs to the software package will bring the simulator training much closer to the real conditions of flight service. The value of this approach is also reflected in the fact that the learning process on such a platform consolidates solid knowledge and enhances the ability of air traffic controllers to make adequate decisions when various conflict situations arise. In principle, the joint training of air traffic controller and pilot is optimizing the educational process, which is very important for today. In these conditions, a joint training program can act as an optimization tool in the context of this publication, it should be noted that simulator training is also a digital learning technology that allows for the development of solid skills that allow for the automatic development of solutions. However, simulator training does not have the functions of a wide and in-depth study of legislative and regulatory documents for the formation of basic knowledge for training.

Regarding the digitalization of the educational process of training air traffic controllers was studied [8]. This paper provides a thorough justification for the expediency of developing and widely using electronic educational technologies. The materials of the publication [9] also confirm the completeness of the policy of digitalization of educational processes.

In the context of the issues discussed above, there are publications that are directly related to the digitalization of student education in legislative and regulatory instruments. The publication [10] discusses specific procedures for compiling study assignments for practical training on legislative and regulatory instruments. The paper [11] provides a conceptual solution to the problem of automating the learning process mentioned in [10]. But it should be noted that these works do not provide a solid evidence base that confirms the relevance of research in the field of digitalization of the educational process of training air traffic controllers. Bridging this gap is provided by this publication, which, based on a sufficiently large volume of statistical data on the requirements set forth in the training programs for air traffic controllers, justifies the approach of choosing the areas of digitalization, which allows to obtain the greatest educational effect.

Targeted training of air traffic controllers in Uzbekistan is carried out at the Aeronautical faculty of the Tashkent State Technical University (TSTU) [12]. Bachelors and masters are trained in accordance with the State Educational Standards. Bachelors are trained in the direction of education 5620200 - Air Traffic Control, and masters - in the specialty 5A620200 - Air Traffic Control and Air Navigation. In addition, the civil aviation structure of Uzbekistan has a training unit of Aviation Training Center LLC [13], where, if those wishing to do so have the necessary basic education, initial training of pilots, flight attendants and flight support staff for work in the management centers and flight support services is conducted.

The effectiveness of the learning process depends entirely on the professional level and skills of teachers. However, the lack or insufficiency of educational, methodological and material-technical infrastructure clearly leads to a decrease in the quality of the educational process, as well as has a negative impact on the activities of the teacher. As a result, this leads to a decrease in the level of knowledge of the student.

One of the effective measures to improve the educational process is the digitalization of the most important and complex components of it, which involves the study of a large volume of materials. Such components of the training of air traffic controllers include the study and implementation of a large number of different legislative and regulatory instruments with domestic or international application. For example, regional laws and aviation rules concerning various types of flight support, as well as ICAO standards and documents, which are devoted to the regulation of international aviation.

In order to justify the relevance of improving the educational process on the basis of the digitalization of the educational and methodological base of normative legal documents, an analysis of the training programs of a number of countries was carried out in order to establish the weight of the selected aspect of digitalization and the formulation of its objectives.

The analysis of training processes for air traffic controllers was carried out within the framework of education systems of the Republic of Uzbekistan, the USA, the Russian Federation, the Republic of Belarus and the Czech Republic, the information about which was the most accessible and extensive in terms of the research conducted in the Internet. However, the statistics within these States were considered sufficient to justify the relevance of the topic of the study. However, it should be noted that the number of aviation education institutions and centers that are currently given preference is quite large.

The study focused on curriculum analysis in order to identify the dominant knowledge requirements of the student, the implementation of which determines the level of readiness of the student. Based on the purpose and objectives of the study, the comparative analysis is carried out according to the scheme shown in Fig. 1.

United States of America. The United States has a number of aviation training institutions [14]. The analysis of the potential of educational institutions was carried out according to the scheme shown in Fig. 1. It has been revealed that educational institutions train air traffic controllers within the framework of education profiles, whose names are similar or close to the name of the direction of education 5620200 - Air Traffic Control, adopted in Uzbekistan. As for the study of normative legal documents, it is provided for in the bachelor's degree programs and is conducted within the framework of a separate discipline according to FAA rules [15]. The material and technical basis of the training processes deserves special attention, as in the process of training of air traffic controllers the use of various simulators is provided. At the same time, which is especially important, the training and production practice provides for the participation of students in aircraft flights. This contributes to the formation of good professional qualities and skills of future air traffic controllers. Obviously, this is a good example for using this experience in Uzbekistan.

Russian Federation. Russia has the following main educational institutions for training of Aeronavigation specialists:

- 1) Moscow State Technical University of Civil Aviation (MSTU CA);
- 2) Ulyanovsk Higher Aviation School of Civil Aviation;
- 3) Saint-Petersburg State University of Civil Aviation and its Krasnoyarsk branch;
- 4) Academy of Civil Protection of the Ministry of the Russian Federation for Civil Defence, Emergencies and Elimination of Consequences of Natural Disasters.

The educational process in all the above mentioned educational institutions is based on the unified government educational standard (GES) of higher professional education (HPE), so it was not reasonable to analyze the curriculum of each of them separately. MSTU CA was used as an example [16].

Training of air traffic controllers in the Russian Federation in the field of air traffic control is carried out within the framework of specialty 161000 "Aeronavigation" in accordance with the State Standards of Higher Professional Education of the Russian Federation, which set the requirements for the level of training of graduates. Specialist training is assessed within two categories of competencies: the types of general cultural competencies (QC) QC_i ($i=1..61$) and professional competencies (PC) PC_j ($j=1..72$). Meaningful content of each of the types of competencies is given in the State Standard of Higher Professional Education of the Russian Federation and curricula of disciplines [17].

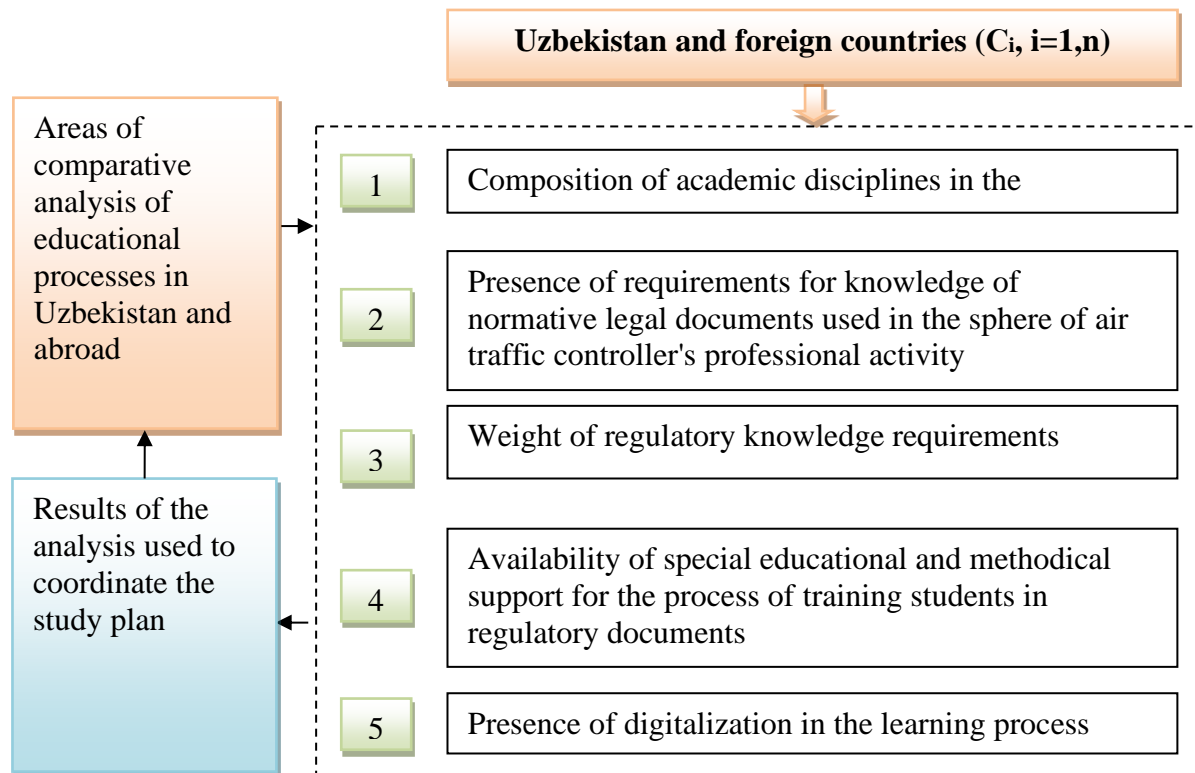


Fig. 1. Scheme of comparative analysis of training processes in Uzbekistan and abroad for air traffic controllers

The analysis of the programs in 41 academic disciplines allowed revealing a picture of the requirements to the level of readiness of the student within the categories and types of competences. A sample of the most frequently mentioned competencies of the QC_i and PC_j was selected and presented in a table.

On the basis of the most frequently mentioned competences the diagrams of QC (Fig. 2) and PC (Fig. 3) are plotted. In order to increase the visualization of analytical data, the coefficient of weight has been introduced $K_{v i}$:

$$K_v = \frac{Nk}{Nud},$$

where: Nk - number of references to competence in the curriculum; Nud - number of disciplines in the curriculum.

The diagrams of QC (Fig. 2) and PC (Fig. 3) are based on K_v values. It can be seen from the diagram of QC that the highest weight coefficients are QC -3, QC -4, and QC -10, and from the diagram of PC - PC-1 and PC-3.

Types of competencies of QC and PCs most often mentioned in the program of 41 training disciplines for air traffic controllers at MGTU CA

Table

Code	Content of competence	N_k
<i>Category of general cultural competences</i>		
QC -1	Have a culture of thinking, to know its general laws	7
QC -2	Have the ability to formulate concepts and judgments, inductive and deductive inferences, and to identify meanings, meanings, and content in what has been heard, seen, or read.	8
QC -3	The ability to perceive, summarize, analyze and synthesize information from different sources, set goals and choose how to achieve them.	17
QC -4	To be able to logically correct, argumentatively and clearly structure oral and written speech, to master the skills of rhetoric, argumentation, discussion and polemics.	14
QC -5	Have readiness to cooperate with colleagues, work in a team, be able to organize the work of a small team of performers.	10
QC -6	Have the ability to find solutions in non-standard situations and the willingness to take responsibility for them.	9
QC -7	Possess creative thinking, ability to analyze the situation independently, formalize the problem, plan, make and implement decisions in conditions of uncertainty and lack of time.	10
QC -8	Strive for self-development, advanced training and skill	12
QC -10	Awareness of the social significance of their future profession and high motivation to perform professional activities.	15
<i>Category of professional competencies</i>		
PC -1	To be able to use normative legal documents in their professional activity.	28
PC -3	Have readiness for independent, individual work, making responsible decisions within their professional competence.	18
PC -29	Be ready to provide and maintain aircraft flights.	11
PC -30	Be ready to provide air traffic services.	12
PC -37	Possess methods and procedures to ensure the safety of aircraft flights and the use of airspace.	11

It has been revealed that the type of professional competence of PC-1 (ability to use normative legal documents in their professional activity) is mentioned 28 times, i.e. this type of competence is set as a requirement for the level of education in 28 out of 41 academic disciplines, it covers 68.3% of academic disciplines. Thus, on the basis of these data, a picture has been identified that clearly justifies the choice of the learning area to be improved.

In the context of analytical results, it should be noted that the dominant place of the above mentioned QC and PCs absolutely does not diminish the role of other competences, but they are the basis on which other competences are formed.

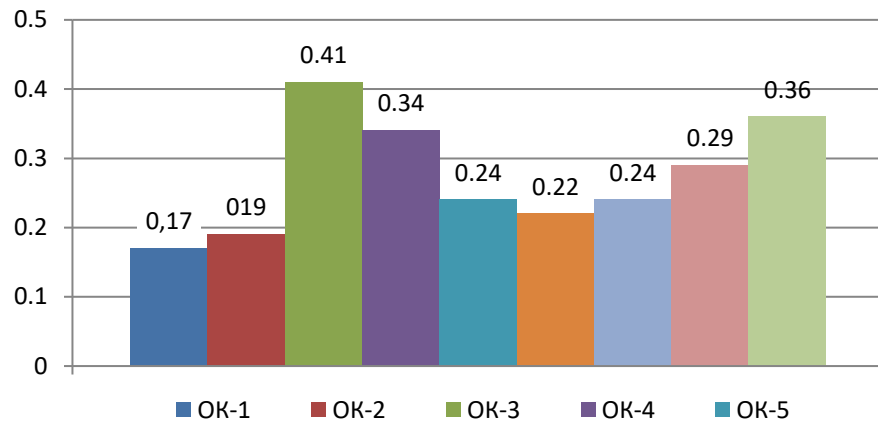


Fig. 2. Weighting diagram of the types of QC most frequently mentioned in the curriculum

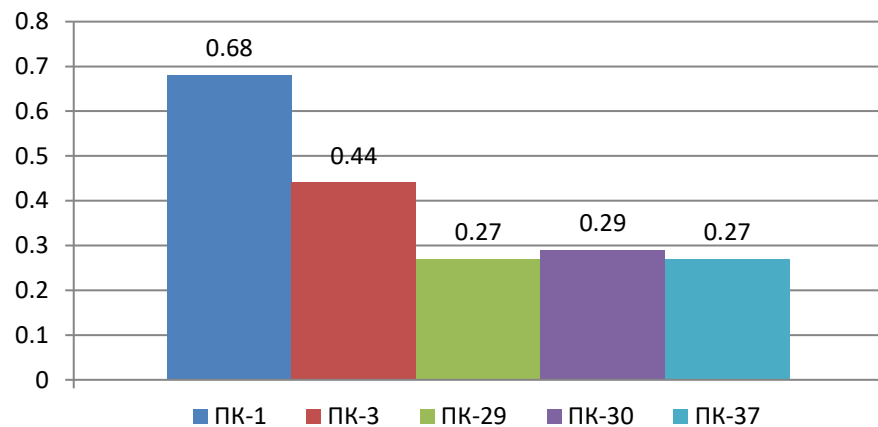


Fig. 3. Weighting diagram of PC types most frequently mentioned in the curriculum

Thus, one of the bottlenecks of the educational process is the correct and effective teaching of normative legal documents to the student, as they determine the level of his professional activity in the future.

Republic of Belarus. In the Republic of Belarus aviation specialists (engineers), including aviation dispatchers, are trained in the Belarusian State Academy of Aviation (BSAA) [17] in specialization 1-44 01 05-01 "Organization and support of flights on air transport (organization of air traffic)".

The curriculum for training air traffic controllers in terms of the composition of disciplines does not differ much from the curriculum of education direction 5620200 - Air Traffic Management, adopted in Uzbekistan. Based on an analysis of the content of 16 academic disciplines, it has been established that 10 of them provide for the study of legal and regulatory documents. Two of these 10 disciplines are "Air law" and "Air law of the Republic of Belarus". The first of these two disciplines provides students with knowledge of the basic principles of formation of laws of the legal system, law-making, rules of preparation of regulatory legal acts by legislative authorities and their registration. The second discipline gives system knowledge on the use of airspace and the implementation of activities in the field of aviation in the Republic of Belarus and the world, as well as the ability to work competently and efficiently with international standards and recommended practices of ICAO and IAC, legislative and regulatory acts. Thus, the analysis of BSAA's training programs for air traffic controllers showed that the weight coefficient of knowledge in the field of regulatory documents is 10/16, i.e. 0.63. This

once again confirms the importance of knowledge of regulatory legal documents that determine the specifics of the professional activities of air traffic controllers.

The Czech Republic. The analysis of the composition of the mandatory disciplines for the training program of aviation specialists of the Transport Faculty of the Czech Technical University [18] has shown that there is a mandatory discipline "Legislation and operational regulations", which provides for "Introduction to aviation rules. Scope of activities of international and national organizations in civil aviation. Analysis and interpretation of ICAO Annexes 1-19, ICAO Documents. 4444, 7030, 8168. Introduction to the Regulation of the European Parliament and Council (EC), Regulation of the Commission (EC) and Decisions of the Executive Director of EASA".

Based on the results of the analysis of foreign universities' training programs for aviation specialists, the following conclusions can be made:

1. TSTU's training programs for air traffic controllers in terms of composition and subject names do not differ in principle from foreign training programs.
2. All training programs have disciplines related to the study of legislative and regulatory documents, which are the basis for ensuring the safety of aircraft flights.
3. The dominant nature of the training discipline for the study of legislative and regulatory documents gives grounds for the expediency of digitalization of their educational and methodical support.

In conclusion, it should be noted that the data of the analysis of the subject area of the study were the evidence base for the development of the concept of automated EOC, which is a computer version of the educational and methodical complex based on the mathematical formalization of the learning process and the necessary software and algorithmic means to fully use the complex in the educational process. This approach provides not only the audit form of education, but also training in the "e-learning" mode.

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