Procedural Simulators as an Element of the Digital Educational Environment in the Aviation Specialist Training

Nina Romancheva [a], Olesya Manolova [a], Vadim Michkasov [a]

[a] The Moscow State Technical University of Civil Aviation, Kronshtadtsky blvd 20, Moscow, 125993, Russia

Abstract

The features of the procedural simulators integration into the educational resource of an aviation technical university are considered. The analysis of the conditions for using the process-oriented environment of the university is presented. This analysis is based on the modern digital technologies that allow mobile and effective improve educational programs in accordance with the changes of the conditions of the university working. The procedural simulator is considered as an educational environment element, also the main tasks and requirements of on-line simulator training are highlighted. The factors of the procedural simulators using of the MFTD type are presented. This factors characterize the effectiveness of their use in the modern educational environment.

Keywords [1]

Procedural Simulators, digital educational environment, generalized labor function, distance learning, practical competencies, Maintenance Flight Training Device.

1. Introduction

A digital environment creation in education is a priority project, which attention is paid at the state level. Its purpose is "high-quality and available online education for citizens of the country through digital technologies". It is supposed, that using this resources, Universities "will introduce into practice new forms and methods of work, both with students and other segments of the population (schoolchildren, employees of organizations)". It is necessary to embody the "education - throughout life" idea. Changes in the scope of education in connection with the massive transition to distance learning technologies in connection with COVID-19 dictate the need for revision to the formation and adjustment of the educational environment, especially in technical universities. The current situation requires solutions that can maintain the "elasticity" of the elements of the information educational environment (IEE). Today the typification of solutions for universities is extremely ineffective, since this approach requires adaptation and revisions even before the introduction into the educational process and university infrastructure. Therefore, a reasonable way out is to use a process-oriented environment, based on technology, which allows you to quickly update and create new applications in accordance with changes in the operating conditions of the university. Moreover, these changes are reflected both in the model of the university's activities and in its implementation. This flexibility is ensured by the use of a model architecture, in which a model is first created that includes a student, a teacher, developers of procedural simulators, employers, and the model is based on a digital learning platform in a modern university [1].

The offered approach focuses on a process-oriented architecture, which allows, in a heterogeneous and unstable information environment of an educational institution, to combine and integrate various elements of the educational process, to create a single effective digital educational space. The

selection of such an architecture significantly reduces the "washing out" possibility elements of educational technologies that have stood the test of time. The created digital environment saves the infrastructure created earlier by the university, and, at the same time, allows you to reach a quality new level of support for learning processes by means of information technology. In this way, the qualitative changes that are taking place in education in general, and especially in the condition of the transition to forced distance learning, must meet the requirements and criteria of the labor market, since the latter is most interested in a competitive specialist with a high level of qualifications and having the appropriate competencies.

In accordance with the Federal Law of July 3, 2016 N 238-ФЗ "On independent assessment of qualifications" (Collected Legislation of the Russian Federation, 2016, N 27, Art. 4171), the procedure of independent assessment of qualifications has come into force in Russia. The qualification assessment procedure is directly related to the introduction of professional standards and the transition of educational institutions to FGOS 3++. In addition, the quality of training for aviation specialists is a requirement of international standards [2] and is defined as "compliance with user requirements". The main indicator of competence in work [3] is the level of formation of a given set of specialist competencies in accordance with certain professional standards. And it is this level of competence formation that affects the indicators of the final result of the graduate's professional activity. It is almost impossible to ensure the quality of training of an aviation specialist in the absence of real laboratory installations, various modules that allow performing technological procedures for the aircraft maintenance and aircraft repair in the training process. In this way, the inclusion of procedural simulators and specialized technologies in the digital educational environment to provide the quality of an aviation specialist training is an urgent task.

2. Formulation of the task

The purpose of this work is to identify new forms and methods to improve the quality of training for aviation specialists in the conditions of abrupt changes in training conditions. The quality of training of specialists is the degree of preparedness of a graduate to perform a generalized labor function (GLF), considered as a certain sum of the functional and technical characteristics of a specialist's activity, shown in the labor function of the corresponding professional standard and ICAO documents.

The research task consists of the following subtasks: classification of elements and technologies of the educational environment; selection of elements of a new format; modeling the inclusion (integration) of a procedural simulator into the digital educational environment of an aviation university; criteria and provision determination of an independent assessment of the student formed competence.

The high quality of the results of the educational process directly affects the professional skills of the graduate.

The changes that are taking place in education in general and, especially, in the context of the transition to forced distance learning, must meet the requirements and criteria of the labor market, which is interested in competitive specialists with a high level of qualifications and having the appropriate professional competencies.

2.1.1. Aviation Professionals Training Methods

The educational environment effectiveness of an aviation technical university is directly related to the use of modern information technologies in the learning process. There are various possibilities of using information technologies in the training of future aviation specialists: the creation and development of information space, information educational technologies proper, the use of interactive multimedia tools, which allows you to create, store, reproduce and process information, as well as provide material to the student in various ways. In other words, modern information technologies are an effective tool to speed up the process and improve the quality of education in relation to the formation of students' knowledge. Distance learning, as well as the procedural, complex or specialized

simulators application, is inextricably linked with the actualization of skills, the formation and improvement of practical competencies, therefore, requires the development of practice-oriented tasks.

A necessary component of practice-oriented programs is the joint project activity of students - the ability to work in a team for a specific result. Today imitation of work activities, the creation of a work environment in the exam (test) is a rather ambiguous task and is due to a number of reasons: it is necessary to clearly understand which work function is being tested; creating a case - how to check compliance, and, most importantly, the relevance of actions in a particular situation. Also, simulators are the most effective way of professional training of students in higher educational institutions. Simulators and, moreover, training complexes are the most complex high-tech software and hardware objects that are characterized by many different indicators that form a structural system. They provide artificial reproduction of conditions and factors that take place in the course of the operator's work to control real dynamic objects of civil aviation.

The working experience with simulators in an aviation technical university has shown that the introduction of modern procedural simulators in the educational process of technical specialties improves both the learning process and the assimilation of the passed material by students. The main tasks of integrating simulator training in university education is, on the one hand, the objectification of certain knowledge, abilities and skills, on the other, at the end of training, - automated or automatic checking and assessment of students' actions.

Regardless of the types of simulators, the main requirements for simulator training are to form the skills of students to make a competent, competent decision in a complex information environment, develop the skills and abilities of qualified operator work with equipment, as well as the ability to work both in regular and emergency situations.

Let us consider the training of aviation specialists on the example of using a modern procedural simulator of the MFTD (Maintenance Flight Training Device) type. These simulators are essential for training students in aircraft maintenance. The simulators themselves are designed as computer classes. A virtual copy of a real Boeing 737 aircraft allows you to perform aircraft maintenance procedures in the cockpit, in the aircraft cabin, technical and cargo compartments. The simulator allows you to bring the aircraft to various flight modes and to set a failure or deviation of the system operation parameters in any system. Thanks to this functionality, you can observe the behavior of systems under various circumstances. Students of an aviation university are invited to independently choose a troubleshooting procedure (TBS - Trouble Shooting) on the topic of a system failure. The simulator base provides for the possibility of mastering the technology of using technical documentation in English.

In fact, I would like to study the material part of the aircraft on the operating aircraft. But such an approach will actually only complicate educational activities, since in the process of studying the material part, it becomes necessary to comply with various norms and rules (labor protection, rules for working at height, safety precautions), and these factors only disorganize activities, distract the attention of aviation specialists and do not give concentrated study in such conditions.

Not every higher educational institution or aviation training center can own at least a small fleet of foreign aircraft to fully provide the educational process to students in the form of practical exercises, and even more so, theoretical studies to study aircraft systems. Aviation enterprises offer services for the use of their aviation fleet as training, but only at strictly defined times during which the aircraft is in the process of maintenance. However, this raises the problem of the cost of parking at the airport, the issue of labor costs and the use of aviation fuel, as well as the need for time to organize a large number of technical procedures.

Not all procedures can be practiced on a real aircraft. For example, the stage of starting a gas turbine engine involves not only the sequence of pressing buttons and switches, but the implementation of all preparatory work points, practicing actions in the event of an engine fire, in case of a bird hit, or actions in case of unacceptable vibration. All these and other procedures can be simulated on a procedural simulator, and with the help of technical documentation, the procedure for troubleshooting technical actions can be carried out, which are prescribed in the simulator software.

Expansion of the areas of aviation procedural simulators application in the training of aviation specialists makes it possible to provide more than 80% of training practical sessions. The commissioning of simulators and their use in the educational process leads not only to a decrease in

the cost of aircraft maintenance or the use of consumables and components on the aircraft, but also to a qualitative increase in the level of training of aviation specialists.

The use of procedural simulators in the educational process is determined by several factors: a large amount of visual information; high degree of clarity; compliance with the conditions for organizing collective performance of work; a differentiated approach to the study of material by students; organization of an automated assessment of the actions performed by the simulator operator.

The highlighted factors of the use of MFTD procedural simulators characterize the effectiveness of its application in the modern educational environment. This means that this simulator is a rationally compiled digital educational resource that takes into account both the specifics of content information and the psychological and pedagogical patterns of assimilation of this information by students. It is also necessary to highlight the basic didactic principles of using the procedural simulator in training aviation specialists:

- compensatory - the learning process is perceived at an adequate level of students, less time, effort and resources are spent on understanding the material studied;
- integrability - the aircraft material part study can be carried out element by element and as a whole;
- reliability - the ability to provide high-level and quality material for an unlimited number of listeners;
- visibility - the integration of a software and technological resource into educational programs allows modeling the most complex real processes, providing future aviation engineers with the necessary training material;
- virtuality - the ability to demonstrate simulated processes that cannot be imagined in reality (in projection, in dynamics, on a changed scale);
- interactivity - the conditions for the educational process organization in accordance with the level of students training; - the choice of methods, techniques, temp of learning is determined by the individual characteristics of the student;
- manufacturability - the ability to obtain statistical processing of learning and control results.

The qualified application of procedural aviation simulators influences all aspects of training in terms of their didactic capabilities, namely: it allows to determine the purpose of training, develop the content of a practical lesson, justify the selection of training methods, contributes to an increase in the effectiveness of training, forms the content and nature of the activities of both the teacher and student. In addition, the training process includes equipment manufacturers, employers, programmers. Important pedagogical tasks are being solved - the development of a production culture, the formation of the intellectual and creative potential of students, the skills of a team are formed, a responsible attitude to project activities, including when studying complex material.

To include a procedural simulator as a digital educational resource into the model, and then into the digital educational environment, it is necessary to gradually integrate the procedural simulator into the educational process. At the first stage of integration, there is a need to determine the organizational and technical capabilities of the training equipment of an educational institution, the potential of the teaching staff, as well as the level of information culture of both teachers and students.

At the second stage, a curriculum is created, which shows the topics of the training sessions. The analysis of the content of the material, its structure, capabilities, features and limitations is carried out. More complex sections are singled out separately, the format of the classes is determined, in which the procedural simulator will be rationally used, and the analysis of students' knowledge on the relevant topics and sections is carried out.

At the third stage, the procedural simulator is analyzed, and characteristics are identified and determined. The teaching staff of the university develops a scenario and technology for application the simulator in training future aviation specialists.

At the next stage, a psychological and pedagogical analysis of the predicted changes in the effectiveness of training is carried out when using a procedural simulator , their influence on the main factors of intensification of the educational process and personal development of students is assessed, the problems and difficulties that may arise for both teachers and students when using simulator.

At the fifth stage, the aviation procedural simulator is integrated into the educational process for small groups of students, statistical information is collected on its use and the improvement of the quality of training for aviation specialists.

If the quality of training students with the rational use of a digital educational resource, in the form of a simulator, has been achieved, then an educational program using a simulator complex can be proposed for implementation in the educational process at a university.

2.1.2. Results

The suggested model for integrating a procedural simulator with a digital educational environment was approved in the transition condition to distance learning at the Moscow State Technical University of Civil Aviation (MSTU GA). To provide the quality of aviation specialists training and the impossibility of transferring simulator training sessions to the next academic year, MFTD procedural simulators were included in the existing educational environment. Students' access was carried out through various types of mobile devices, allowing them to perform all procedures that correspond to the flow charts for aircraft maintenance. The advantage of the proposed integration model is that both teachers and employers were involved in the process of training and control, which not only did not reduce, but also significantly increased the quality of training of specialists with the possibility of direct employment at an airline of the corresponding profile.

To determine a qualitative assessment of the effectiveness of the inclusion of a procedural simulator as an element of the digital environment, 3 groups of students of the training direction 25.03.02, 25 people in each group, took part. Upon completion of the course, control was carried out for all aircraft systems to assess the formed competencies. The analysis showed that the time for mastering the GPC-3 (General Professional Competencies) competence was reduced by 25% in comparison with training before integration. The average grade of academic performance increased from 3.2 to 4.3, 60 out of 75 students received a score of "good" and "excellent". Involvement of employers in checking the final knowledge upon completion of the simulator training course provided versatility and objectivity in assessing the knowledge of future aviation specialists. The number of students with direct employment in employer-proposed organizations increased by 30% compared to training prior to the integration of procedural simulators. The results of the admission campaign showed that the rating of the educational program for training aviation specialists has almost doubled.

Figure **1** shows a comparative assessment of the quality of simulator training in a digital educational environment.
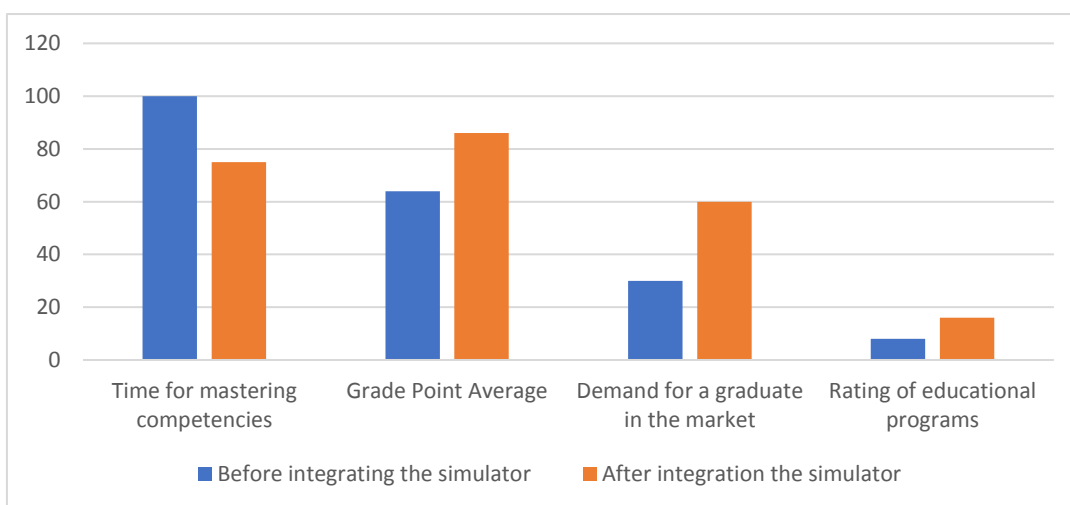

Figure 1: Comparative assessment of the quality of simulator training in a digital educational environment

2.1.3. Conclusion

Thus, the MFTD procedural simulator is a modern element of the digital educational environment. The rational use of a digital educational resource in the form of simulators (software-technological complexes) is an effective means and method for the implementation of professional training of students, the formation of professional and special competencies of future aviation specialists, aimed at creating conditions for making a competent decision and performing labor functions in simulated conditions. The rational use of a digital educational resource in the form of simulators (software-technological complexes) is an effective means and method for the implementation of professional training of students, the formation of professional and special competencies of future aviation specialists, aimed at creating conditions for making a competent decision and performing labor functions in simulated conditions. The application of simulators increases the quality of the educational process at all levels of the educational system, providing the interaction of students, university teachers, developers of procedural simulators and employers. It should be noted that the introduction of any new educational technology and teaching aids is a difficult task. The process of introducing a new training tool has its advantages and disadvantages, therefore the combination of traditional and innovative training tools is an important stage in the development of digital education for future aviation professionals.

3. Acknowledgements

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