Research of the methodology of the development of the demo exam in Russia and its aspects in the competence Digital metrology

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Abstract. Nowadays, the demo exam is becoming a frequently used way to additionally test the knowledge of students in technical schools and colleges. However, due to the difficult epidemiological situation, this process is carried out remotely. Let's consider the features of the demo exam in this format. The demo exam changes the perception of learning, because the traditional final qualifying work becomes only a small part of the main exam. On the frontier of successful completion of education, there is the ability to work with measuring equipment, the skills of perceiving production tasks and the possibility of solving them in the shortest possible time. It is important to note in this case the complexity of the transition to this type of exam for many students who are accustomed to perceiving the defense of their graduation work as a formal process associated with retelling a pre-written text. The demo exam is a bridge between theory and practice, which must be introduced gradually into the education system in order to eliminate a negative effect.

1. Introduction
Initially, we will designate the key dates that became the basis for the launch of the demo exam in the Russian segment of education. The beginning of this process is considered to be the message to the Federal Assembly on December 4, 2014, in which the President of the Russian Federation gave an instruction aimed at developing the system of training workers. In pursuance of this instruction, the Union "Agency for the Development of Professional Communities and Workers Young Professionals (WorldSkills Russia)" "has begun a pilot testing of a demonstration exam according to WorldSkills Russia standards as part of the state final certification [1]. Why do students need a demo exam if a student, after graduating from college, writes a theoretical qualification paper or passes a theoretical exam to a qualification commission? The demo exam is designed to complement the theoretical course with real tasks related to the production needs of specialized companies. The demo exam was based on the European and Finnish experience in assessing the qualifications of company employees. The Finnish College Riveria [2] can be cited as a college following an identical path. According to the director of the college, Esa Karvinen, “only a close connection between production and education provides the college with immense popularity in Finland and Russia” [3-4]. In Russia, the standardization and openness of the demo examination processes is assigned to the international World Skills standards, which in a demo format oblige experts to work in three platforms: IVA (video conferencing) and World Skills electronic platforms for entering the assessment results (figure 1).
Figure 1. Experts at the Advanced Training Center prepare computers for remote access before the start of the demo exam, the MCOSMOS program is tested.

Since 2018, the Center for Advanced Professional Training of the Moscow Region has become a certified demo exam site for the Digital Metrology competency thanks to a well-equipped computer network that allows you to connect to the CPP resource remotely from anywhere in Russia. The TsOPPE, certified for conducting a demo exam, has an impressive base of measuring equipment. At the same time, Mitutoyo is positioned in this competence as an employer assessing the quality of graduate training. This company is a supplier of equipment for the demo exam. During the demo exam, students who pass the exam on the basis of the CSPC are trained to work in specialized software products MeasureLink and MCosmos Mitutoyo (figure 1).

The application is designed to work in workshops, production facilities, remote objects and measurement positions. The MICAT software (MCOSMOS-3) uses the actual CMM configuration, including all magazines and sensors installed on the machine, to select the most suitable configuration based on user measurement rights.

2. Materials and methods

Let's consider in detail the software products used in the demo exam. Measurement control software products are of great benefit in the production process: they allow to eliminate operator errors, increase the data transfer rate, and generate an electronic bill automatically. The articles previously considered software products "Best: Metrological Service" and software "Asomi", which are used for the automation of verification and calibration, the creation of a database of measuring instruments. In addition to them, I would like to consider software products from Mitutoyo. The modern trend in the development of digital technologies in metrology (figure 2) allows the use of radio channel systems within laboratories as innovations, which provide the ability to download data about the measured object online. Examples of such systems used in laboratories are micrometers and calipers with a Miitytoyo measuring channel [7].

Figure 2. Hand measuring instrument with radio channel.
In real time, characteristics can be automatically identified during data collection based on input data and emission ranges (figure 3).

Failed test email notifications will be deferred until other failures have been processed. This allows an assignable cause and corrective action to be included in the email, and avoids sending inaccurate emails when data is rejected because it is not possible to flag the assigned reason [2–3]. MeasurLink allows you to always be aware of the measuring process, during data collection you can view the new CUSUM statistical diagram. Mitutoyo’s next product, MCosmos, is designed to work in workshops, production rooms, remote sites and measurement positions to customize the measurement program of a coordinate measuring machine.

![Figure 3. a. Setting up the Mitutoyo coordinate measuring machine Crysta-Apex in the MICAT software package (MCOSMOS-3); b - Installation and measurement of the part.](image)

3. Experimental part

The use of MiCAT allows to reduce the amount of effort required for effective programming, and the intelligent automatic generator of measurement programs allows you to save time and reduce money costs for measurements. Table 1 compares the Mitutoyo packages for measurement systems

| №  | Type of MICAT (MCOSMOS-3) | Functions                                                                 |
|----|--------------------------|--------------------------------------------------------------------------|
| 1  | PartManager              | Party manager managing MCOSMOS software package fixed                    |
| 2  | GEOPAK                   | Generates measurement programs for geometric elements                    |
| 3  | CAT1000P                 | Uses CAD models for software measurement tasks                            |
| 4  | CAT1000S                 | Compares the tolerances of the curved surfaces of a 3D model              |
| 5  | SCANPAK                  | Evaluates and scans 2D contours                                           |

In the process of using automatic software, the operator is able to reduce the likelihood of errors and so-called metrological failure due to a well-thought-out data transmission system. In addition, such software products have the function of calculating the standard deviation of a sample of
measurements, which is important for finding the methodological measurement error. Obligatory documents to be filled out by experts in this case are the labor protection protocol, the protocol of the distribution of jobs (drawing of lots), the protocol of familiarization with the task. During the exam, you will have to work with several World Skills platforms to record the assessment results and enter the final protocols. In the remote format of the demo exam, it is necessary to ensure the uninterrupted work of students through the AnyDesk remote access system, distribute ID-addresses, conduct training exams, and consultations. In the process of conducting a demo exam, it is necessary to repeatedly consult students on the importance of this event, to involve them in solving tasks, developing a measurement program. The qualification of the future employee (student) in the exam for this competence is based on the fact that the employer (Mitutoyo company) confirms his skills (and, accordingly, knowledge and experience) that were formed in the process of training and subsequent work in the specialty. The main method of such assessment in this process is a demo exam.

4. Result and discussion

In the process of researching the methodology of the demo exam, there are some similarities with the training system in the USSR. Created in the USSR, the main direction of development set “polytechnicism” - the main task, which in the USSR was clearly focused on the possibility of unification of specialists. It was possible at one university to train specialists in the field - from a tank designer to a mining engineer. Universities were created specifically for the industry developed in the territorial location of the university. This was often done directly at factories and for factories. An example of such a segment is the creation of practice-oriented universities-factories-high-tech institutions. This is an extremely interesting phenomenon with changing forms of education in the educational process - from full-time to evening and part-time, but at the same time, the period of practice at the exit reached at least 1.5 years in the profile of the profession. The educational model of the USSR was based on the principle of flexibility to meet the needs of the party's five-year plan. Most of the specialties had a military connotation that could be used in the introduction of martial law. Much attention was paid to the final work - the diploma and intermediate control methods-sessions. The educational process proceeds according to the polytechnic principle (a huge profile of specialties is being taught at the university), while conducting research there is an orientation towards the needs of the People's Commissariats and enterprises, at which the university exists. After graduation from the university, there is a clear distribution of graduates to the enterprise. In case of refusal to work on distribution, penalties follow, incl. before administrative responsibility. In the post-war USSR, decisions on the development of higher education were associated with the fulfillment of five-year plans tied to educational programs (there are tasks in the five-year plan - there is a specialty for it, and if there is no task in the five-year plan, then the specialty must be changed). The decisions to transfer universities to departments (people's commissariats), on the one hand, deprived them of the opportunity to compete in the battle for applicants, as was the case in tsarist times, but, on the other hand, allowed them to specialize in a purely practical model of understanding technological processes. However, at the same time, as noted by Professor M. Meerovich, a problem arose due to the lack of clear training programs (in a modern university-RPD), in which subjects and competencies are prescribed for which a specialist needs to be trained.

Thus, in the process of studying the origins of the demoexamination, one can find out how this process is closely related to the enlargement of the number of working professions based on the best methods of the USSR. It is important to note that this approach has a number of both positive and negative assessments. First, it is necessary to introduce the demo-exam into the work programs of the disciplines and to increase the theoretical course, increasing the course of tactical training for good results in the demo-exam. Secondly, it is necessary to purchase expensive equipment for permanent training on the demo exam. However, along with this, there are many positive aspects - in particular, the opportunity to receive a grant support from the state for the development of professional competencies, the possibility of closer contact with enterprises-workers due to their invitation as
experts at the enterprise, the ability to process orders from the industry for the measurement of complex parts.

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