Chapter 3
Professional Training: Challenges in the Digital Economy Context

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3.1 Introduction

Computer systems and technologies significantly change our society. These changes are interrelated both with social and production spheres. The concept of "digital economy," introduced by Nicholas Negroponte in 1995 (Negroponte 1999), defined the name of the State Program of the Russian Federation, drawing out the prospective until 2024 in such areas as legislation, human resources and education, research competences and technical facilities, information infrastructure, and information security (On the Strategy for the Development of the Information Society in the Russian Federation for 2017–2030, 2017).

Innovative digital technologies have a huge impact on the labor market and professional activities, contributing to their transfer into an electronic environment.

When using digital technologies, modern people set new goals and meet the challenges, with the increasing speed of problem-solving, benefitting from the possibilities of joint distributed actions within networks. In this regard, new competencies of specialists are in a demand.

There are several main questions to be answered: What are the manifestations of professional activity specificity in digital environment? What are the new professional training requirements for a digital economy?

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3.2 Changes of Professional Activity in a Digital Environment

The digital environment transforms life and activities of a modern person. To assess the degree of digital technologies penetration to person's life, the project "Ivanov Digital Index" was launched last year in Russia. Ivanov is an average Russian aged 14–64 who lives in a city with a population of more than 100,000 people. The first value of the "Ivanov Digital Index" is 51%. Sberbank Investment Research believes that this indicator reflects a turning point in the penetration of digital technologies into the lives of Russians: on the one hand, many Russians have the technical capabilities to use certain digital products; on the other hand, there is a great potential for further growth and expansion of technology. This index is quantitative but inconsistently reflects qualitative changes in the daily and professional activity of citizens. According to analysts, one of the catalysts for the growth of this index will be the increasing intensity of mobile Internet and mobile services use, as well as the gradual transition of various daily activities to online and more active life online with increasing confidence in digital environment (TASS 2017).

The other important indicator of country digitalization is e-government implementation degree, periodically measured by United Nations experts with special rating – E-government Readiness Index (Ecquaria 2018). An E-government promotes the delivery of essential services with the use of information technologies at different levels: digital interactions between a citizen and a government (C2G), between a government and other agencies (G2G), between government and citizen (G2C), between a government and an employee (G2E), and between a government and business/commerce (G2B) (Jeong 2007).

The data of these ratings allow us to approve that informatization is a new sociohistorical stage of human activity in technical and social aspects. On the technical side, considering informatization as the use of ICT tools for collecting, storing, transforming, and transmitting information, professional activities in digital environment can be interpreted as a change of intellectual tools (Noskova 2015). The transition from "manual work" to digital technologies changes professional activity radically.

According to the psychological theory of activity, the following elements are distinguished: means (conditions), goals, and motives (Leontiev 1975). Sociohistorical change of tools transforms all these interrelated elements. To achieve a new quality of professional activity, first, objectives must be reconsidered. Without stating new goals and tasks, it is impossible to reach a new level of achievements.

Informatization opens the wide information access for every person. However, such remote access becomes relevant only with appropriate personal needs and motivations to extract knowledge from extensive digital resources. Therefore, the principles of new goals and tasks implementation and shaping special personal competencies are gaining importance in conditions of digital professional environment.

New professional goals require new knowledge and skills. ICT competence is extremely demanded in almost all spheres of human activity, but can't guarantee the transition to a new level of achieved results. Specialists should be motivated to explore fundamentally new ways of solving professional problems to reveal the potential of digital technologies.

A modern person acquires an opportunity to solve professional problems, previously unavailable, with the support of information systems, modeling tools, and automated translation systems. From the standpoint of the cultural and historical concept (Vygotsky 1982), this symbolizes the transition to a new stage in human development. Tikhomirov, O.K. specified the expansion of computer devices in human activities as a switch "from the use of signs to the use of sign systems" (Tikhomirov 1984).

3.3 Digital Labor Market: New Demands for Specialists

Because of digital tools and technologies improvement, the labor market is dynamically changing. New industries are being formed and new types of professional activity are emerging; new specialties appear that could not have existed in the last century.

The demand for specialists who are competent in the field of big data processing and analysis, computer modeling, neural network, artificial intelligence, virtual reality, digital platforms, and cybersecurity is expected to grow. Significant changes are expected in industry, medicine, social services, urban environment, and agrarian sector in the near future. The relevance of such concepts as "smart city" and "Internet of things" (IoT) increases rapidly. In the agrarian sector, the digital economy assumes the development of sustainable agriculture and precision livestock farming (PLF) based on GPS (Global Positioning System), GIS (geographic information systems), yield monitor technologies, Variable Rate Technology, etc.; new materials; augmented reality; additive technologies; self-driving transportation devices with elements of artificial intelligence; advanced robotics; cloud computing and data storage technologies; big data and machine learning; and many others – all these phenomena have one common essence: the pervasive ICT scope (Digital Economy of the Russian Federation 2017).

In turn, this causes the growth of high-productivity jobs, the redistribution of human resources, and new demands for professional training and indicates the necessity of significant education quality improvements. Consequently, in professional training, digital environment must be considered as a new comprehensive environment for learning activities, professional activities, and continuous professional development.

3.4 Actual Changes in Professional Training for Expanding Digital Economy

In context of digital economy, new classes of tasks, related to digital technologies, appear for a prevailing number of traditional jobs. Required competencies should be shaped at different stages of training: vocational secondary and high school and advanced training and retraining.

The important trend for all training levels is upgrading of digital educational environment and increasing of e-learning. A process of shaping competencies should be organized in a digital environment.

Annually, the ratings of the most popular ICT tools for education are compiled (e.g., Top 200 Tools for Learning 2017 (Top 200 Tools for Learning 2017)). Learning Management Systems (LMS), Learning Content Management Systems (LCMS), e-learning platforms, electronic libraries, and repositories constitute the technological basis for distance learning technologies and e-learning. In certain cases computer simulators, virtual laboratories, virtual reality systems, etc. are applicable for skills development in e-environments. Learning practices in social networks are explored, and web 3.0 opportunities for education are comprehended (Noskov and Laptev 2016).

Remote access to digital resources provides possibilities to expand the information field of learning by taking advantages of digital portals, databases of publishing houses, scientific databases, and digital knowledge bases. The competition of knowledge is intensifying, because universities and scientific organizations contribute to the global information environment. Universities are evaluated by open resources representation in the Internet (publications, citation, impact factor, etc. (Drlik et al. 2016; Labrosse 2013).

Leading universities by offering their MOOCs provide learning for thousands of people simultaneously. In Russia, a national Open Education Platform was created (https://openedu.ru/) for offering online courses studied at Russian universities.

Thus, professional training in digital environment is carried through the use of new resources, tools, and technologies and therefore requires new methods and pedagogical practices for shaping new competences.

Not only technological innovations are of great importance but also profound psychological changes in training process. In conditions of technological upgrading, formation of digital economy, and uncertainty and dynamics of the labor market, teachers have to direct students to responsibility for active self-improvement. The support of initiative, creativity, and self-realization in learning together with a consideration of personal learning demands and strategies are especially important.

The leading part of students should be oriented to a breakthrough, advanced exploring of new approaches to learning and solving professional problems.

A high potential of an enriched and expanded digital environment is opening an access to unlimited resources in native and foreign languages and achievements of science and culture. Advanced technologies require new personal characteristics in

educational and professional activities. Goals of new computer-based cognition methods acquisition become the priorities. Student's ability to select necessary information, learning techniques, and methods contributes to new personal semantic reality and opens new ways for extracting knowledge and training new skills. The free choice of learning activities acquires special significance.

A teacher should understand the diversity of expanded learning opportunities provided for a student. Personal learning environments and training plans become the subject for a joint analysis of a teacher and a student. The implementation of nonlinear educational practices and learning strategies in digital space allows to realize the personal potential in the context of professional interests and life plans (Noskova and Laptev 2016). The center of professional training should be a student as an active learner, as a person of potential professional activity in digital environment.

In recent years, the situation and attitude to ICT in education have changed significantly. A considerable contribution to the changes was provided not only by the growth of the ICT equipment status for educational institutions and students but also by the new target orientations of education. When analyzing pedagogical activity in terms of a degree of digital technologies penetration, it is important to reveal not only quantitative characteristics but also their influence on learning conditions and results, on changing the learning content and teaching methods that ensure the professional competence shaping.

Nonlinear educational practices require changes in the pedagogical design of an electronic environment. A new way to understand these changes is the psychodidactic approach to educational interaction in a digital space. This approach involves an allocation of three general scientific concepts, based on pedagogy, psychology, and informatics: information (digital educational resources), communication (network educational communication), and management of educational interactions (Noskova 2007). To achieve a new quality of the educational process, it is required to coordinate transformations of these basic components of an e-environment. At the same time, a psychological plan of activity in a digital environment acquires of special significance from a pedagogical support point of view. A teacher should explore what are learners' personal goals, internal motives, attitudes, and action methods in the new information conditions. A problem of the correspondence between the educational opportunities provided by a teacher to a student and the potential of the digital educational environment is expanding.

A promising trend is the digital educational environment impact on students' self-development, initiative, leadership, and self-realization in learning and research activities.

The means of the digital environment make it possible setting learning tasks in a new way and to create innovative conditions for shaping students' readiness:

- To act within the framework of corporate information systems, cloud offices, which are the attributes of professional activity in any sphere
- To carry out self-study and professional self-development in open information environment

- To interact effectively with partners within teamwork in the remote mode
- To strive for innovation and assimilation of new means and situations in professional activity

3.5 Experimental Data on the Use of Digital Environment Potential in Pedagogical Activity

According to "Ivanov Digital Index" an average Russian has already crossed the threshold of 50% entry into the digital environment. But can we confirm that situation is the same in pedagogical activities? To draw such conclusion, it is important to find an evidence of an efficient digital technologies application that empowers professional training.

In order to form the relevant set of learning conditions in digital space, it is necessary to correlate an expanded range of educational goals, students' needs and preferences, an appropriate training methodology and teaching methods, and an IT infrastructure of the educational institution. This is the essence of the new pedagogical competencies and attitudes.

For this purpose, a survey was conducted among the academic teachers in order to determine how they use the potential of digital educational environment. Teachers were invited to mark what opportunities they provide to students in e-environment and what ICT tools they use.

The survey involved 120 people with sufficient experience in teaching with ICT (5 years or more). This respondents' selection criterion responds to the fact that the study was supposed to rely on proven experience and methods of ICT application in the educational process.

In accordance with student-centered approach, questions for academic teachers were formulated in context of providing extended learning opportunities in an e-environment. The questions were divided into three categories:

- Acquisition of learning content
- Network communication with learning goals
- Self-organization, self-management, self-realization in learning activity

Survey participants were asked to relate to a 5-point scale their professional activity concerning the diversity of ICT tools and special learning conditions provided for students in an e-environment.

According to the received data, the normalized ICT tools variety index was calculated. It integrates the contribution of different types of ICT tools in pedagogical activity. The obtained value of this index is only 3.24.

Detailed data analysis approved that in their practice, academic teachers predominantly use ICT tools, which are now perceived as traditional and ensure the convenience of interaction between a teacher and students in the remote mode (presentation technologies, 4.68; educational sites, 3.88; computer testing programs, 3.45).

The degree of information systems (LMS, LCMS) application is only 3.14, mobile devices and applications – 2.7.

Experimental data characterizing educational opportunities that educators perceive and provide students in e-environment is much more informative. It directly correlates with shaping of important professional competencies.

The values of indices reflecting conditions for learning content assimilation are presented in Table 3.1:

The value of normalized learning content assimilation conditions index is 3.4. It allows detecting that academic teachers apply interactive and multimedia capabilities of digital learning environment fragmentary, but the environmental potential is much richer.

Data obtained on the second group of questions related to network interaction are presented in Table 3.2.

The value of normalized communication conditions index is 3.79. Data in the table show that to some extent the indicated possibilities of network communication are involved in learning process. Nevertheless, among teachers with considerable experience of professional activity in e-environment, the values of the indices do not reach 4. Thus, the potential of the digital communication environment is not adequately disclosed in pedagogical activity.

Specificity of pedagogical activity in the remote mode is determined by minimized role of direct communication. Learning activities management is based on remote support of students' self-organization and self-management.

Data obtained on the issues referred to the mediated management of learning interaction are presented in the Table 3.3.

The value of normalized self-organization and self-management conditions index is only 3.3. It is the lowest index in three groups of learning conditions that teachers provide in e-environment. Many teachers still prefer to use traditional pedagogical management methods.

Table 3.1 Data reflecting conditions facilitating digital learning content assimilation

Index name	Index value
Individualized content selection (content redundancy, navigation on educational content, foreign language resources, opens online courses, etc.)	3.77
Selection of the preferred learning content formats (text, audio, video)	3.75
Contextual help and tips	3.35
Automated self-monitoring and control of content assimilation	3.32
Learning motivation support (motivating resources, video sequences, examples, real situations, etc.)	3.55
Practical assimilation of learning with the use of digital tools (cognitive map, annotation, abstracting, presentation of the results of mastering the content in a given format)	3.29
Interactive actions with digital learning objects (training programs, virtual tours, virtual laboratories, virtual educational environments, including game environments)	2.75

Table 3.2 Data reflecting conditions referred to network interaction, contributing to shaping social professionally significant competencies

Index name	Index value
Personal communication support (counseling, correction)	3.94
Practical training (discussion, expression of opinions, joint activities with learning partners)	3.86
Learning motivation and reflective learning position support	3.85
Shaping soft skills (responsibility, discipline, teamwork, leadership, etc.)	3.66
Self-realization support (network initiatives, events, competitions, external professional communities, etc.)	3.64

Table 3.3 Data reflecting conditions for self-organization and self-management in learning interaction

Index name	Index value
Personal learning activity planning (digital calendars, organizers, road maps, etc.)	3.37
Identifying personal needs and preferences (online questionnaires, surveys, discussions, etc.)	3.16
Automated control and self-control	3.77
Feedback in learning activities (discussion, online questionnaires, voting, etc.)	3.14
Self-evaluation in learning activities (evaluation criteria)	3.83
Reflective position support (ratings, reflexive questionnaires, self-evaluation, peer evaluation, e-portfolio, etc.)	3.25
Learning activities monitoring (e-grading journals, progress scales, task completion markers, etc.)	3.91

Taking into account that data was obtained only for teachers who have experience in e-environment, we assume that the indicators for an ordinary teacher will be lower.

Still by the analogy with the "Ivanov digital index," which exceeded the middle barrier, the values of indices obtained by described diagnostic tool also indicate a turning point in the penetration of digital technologies in professional training.

There is a real prospect for professional experience and knowledge dissemination, and these indicators will have a positive trend in the near future.

3.6 Conclusions

From a psychological standpoint, informatization transforms all main components of professional activity: goals, conditions, and motives. Activity, including professional, is the active interaction of a person with the environment when he achieves a consciously set goal that arises as a result of the appearance of a certain need for him and the emergence of a motive. Operational and motivational aspects are closely intertwined in human activity.

A new quality of professional results can be achieved only with setting new goals and solving new tasks, which meets the challenges of a changing digital labor market, the emergence of new areas of activity, and the transformation of existing ones.

Therefore, in professional training, along with the use of information systems and digital technologies to solve traditional learning tasks, it is necessary to set new goals and create conditions to support motives reflecting the trends of the digital economy. To ensure prospective specialists training, internal psychological changes must occur in educational interaction.

Academic teachers who participated in the study did not give the high evaluation to the level of educational opportunities that they provide to students in e-environment.

A rich and diverse innovation potential of e-environment should be more fully used in professional training to shape new professional thinking, an open vision of problems and a readiness to new trends apperception. Therefore, not only external changes in the technological plan are important in educational interaction but also deep psychological interpersonal processes within a student's conscious – an adoption of new goals, motivations, and aspirations should be considered in pedagogical support.

In the process of professional training, it is necessary to form a special set of digital learning conditions in e-environment that promotes the active study of new knowledge areas, self-realization, and self-development in a rapidly changing professional environment.

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