BULLETIN OF NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
ISSN 1991-3494
Volume 6, Number 388 (2020), 181 – 187 **https://doi.org/10.32014/2020.2518-1467.198**

UDC 378.046.2

O. M. Chorosova[1], G. Yu. Protodyakonova[1], R. E. Gerasimova[1], R. R. Aetdinova[2], Sh. Niyazbekova[3], N. T. Zakharov[1]

[1]Northeast Federal University named after M. K. Ammosova, Russia;
[2]Kazan Federal University, Russia;
[3]Moscow Witte University, Russia.
E-mail: chorosovaom@mail.ru, protogalina@mail.ru, roza_gerasimova@mail.ru, shakizada.niyazbekova@gmail.com, rasulya_a@mail.ru, zakharov.nt@mail.ru

QUALIMETRIC APPROACH TO EVALUATING DIGITAL COMPETENCIES OF TEACHERS

Abstract. The article is devoted to the study of the problems of the formation and evaluation of digital competencies in the context of digitalization of general education. Currently, the problem of determining the level of formation of competencies among specialists in any field is an urgent task in the preparation and competitive selection of specialists. In the Russian education system, the training of future teachers and advanced training, additional professional education of experienced teachers should go to a new level of development in connection with the implementation of competency-based educational programs. And in these conditions, it becomes necessary to search for new approaches to assessing professional and digital competencies in general education teachers.

Various models and algorithms for the formation of professional and digital competencies in general education teachers are studied. The approaches to the development of a cognitive model of competency formation are identified. A qualimetric approach to assessing digital competencies is revealed, as one of the most effective.

Descriptors of key competencies of the digital economy, digital competencies are developed. The criteria for assessing digital and professional competencies formed by general education teachers were identified, the main indicators for evaluating the results were determined. A mechanism and means for assessing the level of formation of digital competencies, a scale for translating assessments of the level of competencies into a verbal assessment system have been developed. Based on the main indicators for assessing results, competency matrices have been developed for all stages of competency formation. An appraisal fund has been developed, consisting of various competency-level appraisals that have both formative and appraisal functions.

This study allows us to develop a cognitive model of the formation of the digital competence of a teacher in the context of digitalization of general education. The results of the study can become the basis for the modernization of the system of training and retraining of teachers in the context of digitalization of general education.

Key words: teacher, competence, digitalization, digital competence, education.

Introduction. The current realities of the information society require the development of a competence-based approach to educational programs of various types, which leads to changes and transformations of the main components of the education system as a whole in Russia. The Russian education system is developing and modernizing its organizational, technological and qualimetric components. As a result of all this, the training of personnel is also changing. [1].

The global goals of digital economy development in Russia imply the emergence of new digital technologies, their implementation in all industries, and as a result there is a need for personnel with formed digital competences. In all spheres, including in the education system, those personnel who have formed key and digital competencies inherent in the digital economy become in demand. There are new requirements for the professional competencies of teachers, including digital ones. Digital competencies are becoming a significant, creative factor in the competitiveness of subjects of the educational system

At this stage of development of digitalization of general education emphasis is placed on formation of digital competences in schoolchildren, various championships of WorldSkills Russia Juniors on digital

competences are held, etc. The implementation of the competency-oriented basic educational program for the training of teachers for general education, the program of additional vocational education require the modernization of the main teaching and evaluation means, which are intended to serve simultaneously as a forming and evaluating factor. Formation and evaluation of digital competences and should go continuously at all stages of competency formation. There is a need to define approaches to the formation and evaluation of digital and professional competences of students - future, as well as experienced teachers.

Analysis of publications. Today, there are interesting approaches to the implementation of the competency model of basic educational programs. Various authors V. A. Bogoslovsky, E. V. Karavaev, E. N. Koftun and others consider the competency-based approach to the design of valuation tools [2]. In his writings, V. I. Baidenko identified the components of competencies of university graduates [3]. Adult education, including vocational training of pedagogical personnel, is devoted to the works of A.A. Verbitsky, Yu.N. Kulyutkina, A.K. Markova, G.R. Sukhobskoy, G.S. Vershlovsky and others. The theoretical foundations of teacher training are investigated by N.I. Mickiewicz, E.M. Nikitin, V.T. Onushkin and others.

In modern conditions of development of digitalization of General education, the main attention is paid to the formation of digital competencies in students, first of all, in teachers themselves as integral personality qualities [4]. The formation of digital competencies of teachers occurs in the process of implementing competence-oriented programs of additional professional education [5]. Increasing the responsibility of the teacher in developing the digital skills of the trainees can cause some problems, accompanied by certain risks, which are related to the mandatory need to develop their own digital competencies and personal needs [6]. A modern teacher must possess not only general user, but also general pedagogical, subject-pedagogical digital competencies. Thus, the teacher becomes a key figure in the formation of a new digital educational environment, including the network [7].

The competency-based format implies multidimensionality in the structure of the formed competencies. On this basis, a cognitive model of the formation of the digital competence of the teacher in the digitalization of general education is developed. Each teacher should have formed the key competencies of the digital economy: communication and cooperation; self-development; creative thinking; information and data management; critical thinking in a digital environment. Along with this, digital competencies of choice should also be formed, in accordance with the educational areas of professional activity of each teacher.

The results of the research. Based on the goals of the study, a mechanism and methods for assessing key and digital competencies of the digital economy were developed, the main indicators for assessing results, a rating scale and transfer from the level of competencies to verbal assessment were determined.

In this article, we present the application of the basic scheme of qualimetry in order to control the formation of digital competence.

In order to assess the initial level of digital competencies formation among teachers, a survey and testing of teachers of the Republic of Sakha (Yakutia) was conducted. The survey involved 220 school teachers from different regions of the Republic (17.3% of men and 82.7% of women, teaching experience of teachers: 9.5% - up to 3 years old, 41.8% - 4-16 years old, 25.7% - 17-30 years, 23% - over 30 years).

The main tool for determining the initial level of formation of the key and digital competencies of teachers was the developed questionnaire. Next, a contingent of experts was determined, who were to evaluate competencies. The study was carried out in two stages. At the first stage, experts were selected. For this, the qualimetric method of assessing the level of their digital competence was used.

In order to assess digital competencies, a qualimetric method was applied based on a general quality assessment algorithm [8]. Nowadays, qualimetry is the most important scientific and practical direction in pedagogy [9].

To use qualimetry as a means of assessment, it is necessary to decompose digital competence into components [10]:

Components of Digital Competency

Components of Digital Competency	
Key competencies	Digital competencies
-Communication and cooperation -Self-development -Creative thinking -Manage information -Critical thinking	-Internet of things; - Cybersecurity and data protection -Programming IT product creation -Lightweight design and 3D modeling -Development of computer games and multimedia applications -Mobile application development -Sensorics and components of robotics -System administration -Digital fashion designer -Digital marketing and media -Electronics and radio engineering

Each competency component was numerically evaluated as p_i, where lies on [1, N]. The final integrative value of digital competence P is calculated by the formula (1):

$$\sum_{i=1}^{N} k_i \, p_i, \tag{1}$$

k_1, k_2, … k_N — weighting factors that bring the values of the components of competence to a single metric scale [8].

The reference indicator P_{max} - is the final level of digital competency and P_{min} - is the minimum level (threshold). Then the learning objective will be presented as:

$$P\ (p_1\ ,\ p_2\ ,\ \dots\ ,\ p_N\ ) \rightarrow \max, \tag{2}$$

$$P_{min} \leq P \leq P_{max}, \tag{3}$$

Competency descriptors may differ in the performance of components, therefore, to convert heterogeneous indicators to a single scale, you can use the normalizing transformation of the form.

$$d_i = \frac{p_i - p_{min}}{p_{max} - p_i} \tag{4}$$

At this stage, the initial assessment of digital competencies of teachers was carried out before professional development. This took into account the key and digital competencies, which are shown in the properties tree of digital competence components (figure 1).

The assessment of the works was carried out by an expert group - teachers and experts on these competences. A rating scale was used. The benchmark for each competence is an average value of 6.25%. As can be seen from figure 1, the highest value shows the percentage of the result (5.82%) of the competence "Communication and cooperation." This is due to the mandatory use of digital technologies by teachers in schools in Russia, as school document circulation has been digitized, and a system of digital school journals and diaries has been introduced. 4.82% of respondents have the skill "Self-development in conditions of uncertainty," teachers do not want to apply digital innovations, citing different reasons. 5.34% of respondents have creative thinking. The relatively low output on the competence of Information and Data Management (4.33%) is due to the weak digital infrastructure of the school. As a result of the survey, 5.63% of respondents have a high level of ability to evaluate information, its reliability, build logical conclusions on the basis of incoming information and data, including in various digital environments. (figure 1).

When evaluating digital competencies, it turned out that teachers have some idea of the methods for identifying and constructing information flow paths in an organization (Cybersecurity - 3.21%), about algorithms and algorithmic programming languages (Programming and creating IT products - 3.95%), they have only a general idea of the element base, components and principles of operation of typical electronic and digital devices and devices (Electronics and circuitry - 1.38%). The competencies “Internet of Things”, “Industrial Design and 3D Modeling”, “Development of Computer Games and Multimedia Applications”, “Development of Mobile Applications”, “Sensors and Robotics Components” are poorly developed and the values of the results correlate from 1.85-2.68 % Half of the teachers can understand the

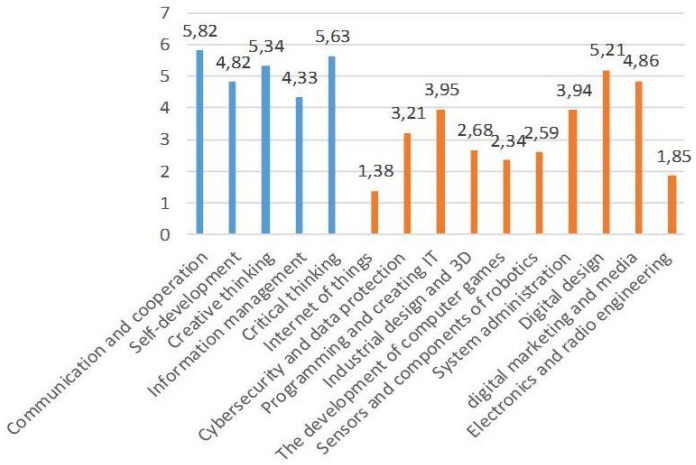

Figure 1 – Teacher Competency Survey Results

process of choosing the appropriate drivers for different types of hardware and are guided by the basic hardware functions (System Administration - 3.94%). In the competencies “Digital Design” and “Digital Marketing and Media”, high results (5.21% and 4.86%) indicate the use by respondents of basic graphic editors to create digital design and awareness of the main types of marketing communications, the development trend of commercial marketing.

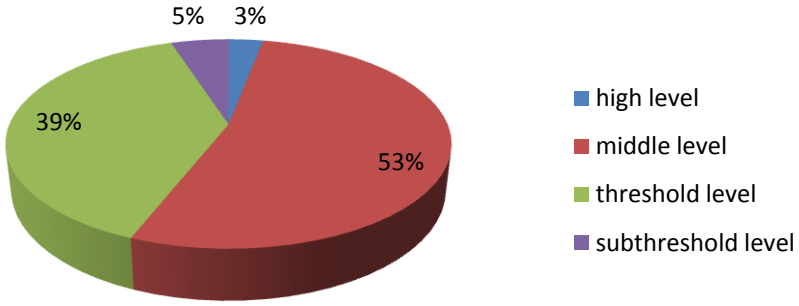

Figure 2 – Digital competency test results.

When evaluating digital competencies, a scale for evaluating competencies and translating the level of competencies to verbal counterparts was developed.

High level-85-100%; (excellent)

Middle level 70-85%; (good)

Threshold level-55-70%; (satisfactory)

Sub-threshold level is 40-55%. (unsatisfactorily)

Based on the research, we can conclude that 3% have a high level of digital competence, 53% have a middle level, 39% have a threshold level, and 5% have an sub- threshold level. This allowed us to make a plan for the development of DPO courses on the same competencies, course programs. All teachers should form a basic module: the key competencies of the digital economy, and as a variable part– digital competencies (figure 2). Based on this, we state that the qualimetric approach to the assessment of key and digital competencies is of great practical significance.

Conclusion. Digital education contributes to the transition to another level of development of the education system, which will become a necessary condition for the emergence of better and more effective approaches to the educational process (digital didactics) and methods of teaching and upbringing.

The studied and identified problems will allow us to determine the main directions and approaches to the development of the cognitive model of competence formation when applying qualimetric methods to the assessment of digital competencies. The results of the research can become the basis for modernizing

the system of training and retraining of teachers in the conditions of digitalization of General education, which will lead to an overall improvement in the quality of education in schools.

Acknowledgements. This article was prepared with the support of the Russian Foundation for Basic Research, project 19-29-14030 "Cognitive models and algorithms for the formation of a digital competence of a teacher in the context of digitalization of general education."

О. М. Чоросова[1], Г. Ю. Протодьяконова[1], Р. Е. Герасимова[1], Р. Р. Аетдинова[2], Ш. Ниязбекова[3], Н. Т. Захаров[1]

[1]М. К. Аммосов атындағы Солтүстік-Шығыс федералды университеті;
[2]Қазан федералды университеті, Ресей;
[3]Мәскеу Витте университеті, Ресей

ОҚЫТУШЫЛАРДЫҢ САНДЫҚ ҚҰЗІРЕТТІЛІГІН БАҒАЛАУДАҒЫ КВАЛИМЕТРИЯЛЫҚ ТӘСІЛ

Аннотация. Мақала жалпы білім беруді цифрландыру жағдайында сандық құзыреттілікті қалыптастыру және бағалау мәселелерін зерттеуге арналған.

Экономиканы цифрландыру білім беру жүйесін одан әрі дамыту факторына, тұлғаны жоғары технологиялық әлеуметтік сандық экожүйеге интеграциялайтын жаңа кәсіби функциялардың пайда болуының катализаторы болып саналады, сандық құзыреттілікті үздіксіз дамыту негізінде педагогтарда тиісті құзыреттілікті талап етеді. Педагог жаһандық сандық білім беру ортасында негізгі тұлға ретінде білім беру сапасын қамтамасыз ету үшін сандық технологияларды қарқынды және жүйелі түрде пайдалануы тиіс

Осыған байланысты педагог жоғары, неғұрлым озық деңгейде практикалық міндеттерді шешуге, онлайн-ақпаратты іздеу, табу және талдауға ғана емес, сандық экономиканың қажетті сандық және түйінді құзыреттіліктерін меңгеруі тиіс; виртуалды білім беру ортасын, оның ішінде желілік ортаны өздерінің құруы, алдағы уақытта білім алушылардың құзыреттілігін дамыту үшін халықаралық стандарттардың әртүрлі сандық құзыреттіліктерін меңгеруі тиіс; оқыту мен тәрбиелеу үдерісінде заманауи сандық технологиялар мен құралдарды пайдалану және т.б.

Қазіргі уақытта кез-келген салада маман құзыреттіліктерінің қалыптасу деңгейін анықтау мәселесі мамандарды дайындау және байқауда іріктеуде өзекті міндет болып саналады. Ресейдің білім беру жүйесінде болашақ педагогтарды даярлау және біліктілігін арттыру, тәжірибелі педагогтардың қосымша кәсіби білім беру құзыреттілін дамытатын білім беру бағдарламаларын іске асыруға байланысты дамудың жаңа сапалы деңгейіне көшуі тиіс. Бұл жағдайда жалпы білім беру педагогтарының кәсіби және сандық құзыреттілігін бағалаудың жаңа тәсілдерін іздеу қажет.

Құзырет дегеніміз – еңбек нарығы мен қоғамның тапсырысы әрі әлеуметтік-экономикалық саланың дамуына байланысты.

Бүгінде білім беруді цифрландыру жағдайында педагогтың кәсіби қызметін бағалаудың жаңа тетіктерін әзірлеу қажеттілігі туындайды.

Квалиметрия – педагогикалық зерттеудің негізгі бағыттарының бірі, оның негізгі мәні, өзіміздің жағдайда қарастырғанда, педагогикалық нәтижелерді бағалау болып саналады.

Жалпы білім беру педагогтарының кәсіби және сандық құзыреттілігін қалыптастырудың түрлі модельдері мен алгоритмдері зерттелді. Сандық және кәсіби құзыреттілікті бағалау критерийлері анықталды, нәтижелерді бағалаудың негізгі көрсеткіштері, құзыреттілік деңгейін бағалаудың вербалды жүйесіне ауыстыру шкаласы анықталды. Құзыреттілік қалыптастырудың когнитивті моделін әзірлеу тәсілдері, сандық құзыреттілікті бағалаудың тиімді тәсілдерінің бірі ретінде квалиметриялық тәсілдер анықталды.

Сандық экономиканың негізгі құзыреттілігінің дескрипторлары, сандық құзыреттер әзірленді. Жалпы білім беру педагогтарында қалыптасатын сандық және кәсіби құзыреттілікті бағалау критерийлері анықталды, нәтижелерді бағалаудың негізгі көрсеткіштері айқындалды. Цифрлық құзыреттіліктің қалыптасу деңгейін бағалаудың тетігі мен құралдары, құзыреттілік деңгейін бағалаудың вербалды жүйесіне ауыстыру шкаласы әзірленді. Нәтижелерді бағалаудың негізгі көрсеткіші жаңа сандық білім беру ортасын қалыптастыру, оның ішінде әртүрлі қолжетімді контентпен желілік, педагогтардың үнемі өзін-өзі дамытуға бағыттай отырып, когнитивті дағдыларды дамытуға ықпал етеді. Бұл зерттеу жалпы білім беруді цифрландыру жағдайында педагогтың сандық құзыреттілігін қалыптастырудың когнитивті моделін жасауға мүмкіндік береді.

Зерттеу нәтижелері жалпы білім беруді цифрландыру жағдайында педагогтарды даярлау және қайта даярлау жүйесін жаңғыртуға негіз бола алады.

Түйін сөздер: мұғалім, құзіреттілік, цифрландыру, сандық құзіреттілік, білім

О. М. Чоросова[1], Г. Ю. Протодьяконова[1], Р. Е. Герасимова[1], Р. Р. Аетдинова[2], Ш. Ниязбекова[3], Н. Т.Захаров[1]

[1]Северо-Восточный федеральный университет им. М. К. Аммосова, Россия;
[2]Казанский федеральный университет, Россия;
[3]Московский университет Витте, Россия

КВАЛИМЕТРИЧЕСКИЙ ПОДХОД К ОЦЕНКЕ ЦИФРОВЫХ КОМПЕТЕНЦИЙ УЧИТЕЛЕЙ

Аннотация. Статья посвящена исследованию проблем формирования и оценивания цифровых компетенций в условиях цифровизации общего образования.

Цифровизация экономики становится фактором дальнейшего развития системы образования, катализатором появления новых профессиональных функций, интегрирующие личность в высокотехнологичную социальную цифровую экосистему, требуют соответствующих компетенций у педагогов на основе непрерывного развития цифровой компетентности. Педагог становится ключевой фигурой в глобальной цифровой образовательной среде, интенсивно и системно должен использовать цифровые технологии для обеспечения качества образования.

В связи с этим педагог должен овладевать необходимыми цифровыми и ключевыми компетенциями цифровой экономики, позволяющими решать практические задачи на высоком, более продвинутом уровне, не просто искать, находить и анализировать онлайн-информацию; а самим создавать виртуальную образовательную среду, в том числе сетевую, овладевать различными цифровыми компетенциями международных стандартов, чтобы развивать компетенции продвинутых, шагающих во времени и впереди времени обучающихся; использовать суперсовременные цифровые технологии и средства в процессе обучения и воспитания и др.

В настоящее время проблема определения уровня сформированности компетенций у специалистов в любой сфере является актуальной задачей при подготовке и конкурсном отборе специалистов. В Российской системе образования подготовка будущих педагогов и повышение квалификации, дополнительное профессиональное образование опытных педагогов должна перейти на качественно новый виток развития в связи с реализацией компетентностных образовательных программ. И в этих условиях становится необходимым поиск новых подходов к оцениванию профессиональных и цифровых компетенций у педагогов общего образования.

Следует отметить, что компетенции – это заказ рынка труда, общества и они будут зависеть от развития социально-экономической сферы

Сегодня появляется необходимость в разработке новых механизмов оценивания профессиональной деятельности педагога в условиях цифровизации образования.

Квалиметрия является одним из основных направлений педагогического исследования, основная суть, которой заключается, в нашем случае, в оценке педагогических результатов.

Исследованы различные модели и алгоритмы формирования профессиональных и цифровых компетенций у педагогов общего образования. Были выявлены критерии оценивания цифровых и профессиональных компетенций, определены основные показатели оценки результатов, шкала перевода оценки уровня компетенций в вербальную систему оценивания. Определены подходы к разработке когнитивной модели формирования компетенций, квалиметрический подход к оцениванию цифровых компетенций как один из наиболее эффективных.

Разработаны дескрипторы ключевых компетенций цифровой экономики, цифровых компетенций. Были выявлены критерии оценивания цифровых и профессиональных компетенций, формируемых у педагогов общего образования, определены основные показатели оценки результатов. Разработаны механизм и средства оценивания уровня сформированности цифровых компетенций, шкала перевода оценки уровня компетенций в вербальную систему оценивания. На основе основных показателей оценки результатов разработаны матрицы компетенций для всех этапов формирования компетенций. Разработан фонд оце-ночных средств, состоящий из различных компетентностных, уровневых оценочных средств, имеющих и формирующие, и оценочные функции.

Формирование новой цифровой образовательной среды, в том числе сетевой, с разнообразным доступным контентом, способствует развитию когнитивных навыков, нацеливая педагогов на постоянное саморазвитие. Данное исследование позволяет разработать когнитивную модель формирования цифровой компетентности педагога в условиях цифровизации общего образования.

Результаты исследования могут стать основой для модернизации системы подготовки и переподготовки педагогов в условиях цифровизации общего образования

Ключевые слова: учитель, компетентность, цифровизация, цифровая компетенция, знания

Information about authors:

Chorosova Olga, Professor, of the Northeast Federal University named after M.K. Ammosova, Russia; chorosovaom@mail.ru; protogalina@mail.ru

Protodyakonova Galina, Ph.D. of the Northeast Federal University named after M.K. Ammosova, Russia; protogalina@mail.ru

Gerasimova Rozalia, PhD., associate Professor, of the Northeast Federal University named after M.K. Ammosova, Russia; roza_gerasimova@mail.ru; http://orcid.org/0000-0002-5066-3174

Niyazbekova Shakizada, PhD., associate Professor, Moscow Witte University, Russia; shakizada.niyazbekova@gmail.com; https://orcid.org/0000-0002-3433-9841

Aetdinova Rasulya, PhD., Professor of the Kazan Federal University, Russia; rasulya_a@mail.ru; http://orcid.org//0000-0002-3047-5918

Zakharov Nikolay, Teacher of the Northeast Federal University named after M.K. Ammosova, Russia; zakharov.nt@mail.ru

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