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## Spring 2020: Toward a Digital Transformation of Education

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### Abstract

“We will remember this spring as a time of digital transformation in education,” these words of Valery Falkov at the opening of 2020 International Moscow Salon of Education convey an atmosphere of change that has filled the entire educational sphere. Today’s disputes on need for measuring teachers’ professional deficits grow fast. Deficiency approach focused on revealing certain mismatch of teacher and his professional activity prevails in most studies that identify and assess the level of professional competences. Of course, this one of important tools for determining qualification gaps will be presented in research works, but in combination with activity-based approach which has proved its effectiveness. Action research is one that identifies and professional difficulties and need of teacher and logically determines routes of his professional development through the system of continuing professional education. It should be noticed that pandemic and transition to distant and online learning revealed lack of very simple skills in teachers such as proper organization of learning process in remote or online mode. Many teachers, students and their parents were not psychologically prepared for complete transition to digital education. In this regard, it is quite reasonable to highlight such challenge in education in digitalization process and need for overcoming it. The paper includes analysis of current situation in school education in terms of digitalization and transition to online learning. The study brings together various views on methodology and mechanisms of digitalizing school education, and criteria of valid identification of teachers’ digital competencies. The present study attempts to compile a passport of teacher’s digital competencies and approve a pilot program called “Cognitive models and algorithms for formation of teacher’s digital competence in context of digital transformation of general education”. The reported study was funded by RFBR, project number 19-29-14030.

*Keywords:* competency mapping, cognitive modeling, e-learning, digital transformation of education, continuing professional education, digitalization.

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## **Introduction**

At the current situation in Russian education and in foreign countries clearly show the need for intelligible mechanisms and tools that can quickly bring the professional level of educators in line with the requirements of global digital transformation. It suggests an adequate consistent mechanism for assessing the dynamics of competency development. Design of competency passport, task pool according to regional and other features, as well as measurement of future competencies, are also required.

In regions of Russia institutions are divided into those that ensure professional development of teachers (public institutions etc.) and alternative resources compensating the growing deficit in teacher education. Some regions suggest that federal project “Teacher of the future” is to be revised as it considers the measurement of teachers` professional deficits that certainly causes some protests.

When automation of all processes is forecasted or already has begun - both educational activities, and organizational and methodological support, teacher can no longer work to the fullest without possessing the relevant competencies that go beyond the boundaries of IT competencies and defined as digital.

At the present stage, there are acute problems of high-quality electronic content, digital didactics, which is fundamentally different from traditional ones, the revision of standards in education, an integration platform that will allow integration with state educational organizations, private and public and non-profit organizations functioning in sphere of education. The system of general education particularly forecasts creation of systems of educational artificial intelligence and outlines the need for solving the problem connected with lack of forming digital ethics and morality, development of digital didactics as in higher education system. There is a high professional anxiety of teachers associated with uncertain situation in education after the crisis in connection with the pandemic.

“The shock of the future has come today”. As every other sphere, education changes in front of our eyes, and we are undergoing a transformational transition to a completely different stage of development (Kaganer, 2020). We should move away from outdated standards in order to teach people to be creative. We should form people`s ability to learn continuously, as they must have the right to choose their own development path. The educational process and educational environment should be integrated into the innovative information environment, because students should have digital literacy and digital competencies.

The Republic of Sakha (Yakutia), being a part of the Far Eastern Federal District, has its own specific features, such as extreme climatic and geographical conditions, remoteness of settlements from centers,

poorly developed transport scheme and significant sparseness of the population, causing socio-economic features, etc. At the same time, the economics of the northernmost region of Russia can be characterized as dynamically developing. As a result, the formation of the Republic of Sakha (Yakutia) is faced with the task of transforming the education system, introducing a new standard for all levels of education, focusing on the “smart economics”. Great importance is attached to the modern equipment of the educational process and integration into the digital environment. Therefore, in the educational system, digital competencies become the creative factor that, transforming into an intellectual resource, generates an effective development of the system.

The work on the article coincided with the time of global, widespread changes in education, when all levels of education switched to online format in a few days. It can be argued that we are currently experiencing a period of the most radical and deepest transformations of education in connection with the pandemic caused by coronavirus infection. This is evidenced by the direct experience of authors of the article, and the observed practice, and many analytical publications.

### **Purpose and objectives of the study**

The purpose of the study is to increase the effectiveness of teacher in digital transformation of general education through the development of teachers` digital competence through implementing cognitive models and algorithms for assessing digital competencies of teachers and making decisions on design or adjustment of continuing education programs.

### **Literature review**

Pedagogical science has a sufficient amount of researches on various aspects of adult education, continuous pedagogical and professional education of teachers. It is not possible to dwell on the review of all works of respected and recognized Russian and foreign researchers of past years, but it is worth noticing that a large number of scientific works in recent years have been devoted to Russian and foreign experience in implementing national frame of qualifications and related transformations in professional education. This process is based on theory and practice of professional education, ensuring interrelation between spheres of education and labor and related urgent problems of binding education systems and independent assessment of qualifications, digital transformation of education, development of e-learning including continuing professional education.

The analysis of existing works on the research topic shows that currently the tasks related to the assessment and formation of the digital competencies of the teacher are not sufficiently studied. Assessment of teacher's digital competencies from the point of system analysis, development of cross-functional algorithms for assessing teachers' digital competencies and its compliance with the digitalization requirements of educational process, also require solutions.

The formation of teachers' digital competencies occurs in the process of implementing the competency-based programs of continuing professional education. The implementation of competency model of teacher development programs requires a fundamental change in the content and structure of didactic and assessment tools, as well as the methods and technologies for their use in educational process. The competency-based approach is based on assessing a level of competency formation, which includes, along with the knowledge component, cognitive, personal, value, intercultural and other components. These components are taken into account when assessing any competencies, including digital ones.

The analysis of scientific papers published in Web of Science and Scopus within 2018 – 2020 period was carried out. Search and selection of materials were carried out according to the keywords “digital competencies of educators”, “digitalization of education”, “e-learning”, “and assessment of competencies”. It should be noted here that, both in the UNESCO Recommendations and in materials studied, foreign authors often use the concept of “IT competencies” as identical or equivalent to the concept of “digital competencies”. The terminological aspect of research problem requires a separate consideration, which is not the subject of analysis in the framework of this article. Having studied works on teachers' digital competency McGarr and McDonagh outlined three main approaches: 1) determination of quantitative and qualitative characteristics of digital technologies' use in school; 2) identification level of teachers' skills in IT according to requirements of national standards and programs; 3) assessment of students' skills in completing assignments in the field of IT (Matukhin & Nizkodubov, 2013). According to McGarr and McDonagh (2019), a significant gap between the theory of IT competencies reflected in science and national standards and requirements, and the practice of their application in teaching and assessing knowledge poses the problem of both accurately determining the IT competencies of teachers (terminological aspect), and developing appropriate tools for their assessment.

Ketil-Engen (2019), in contrast to the traditional understanding of IT competencies as universal knowledge and skills suitable for solving any tasks without reference to a specific area or situation, speaks of a complex of interconnected IT competencies. So, Ketil-Engen considers teacher's competence in the field of IT as a broader skill in the use of electronic tools and technologies in relation to various tasks and situations.

Manzuoli, García and Cifuentes (2016) highlight some methodological approaches to measuring IT competencies of teachers in four areas of information technology use: 1) for academic purposes, 2) in teaching, 3) for students and 4) educational innovations related to IT.

Kiss (2017) draws attention to three areas: basic competencies, applied competencies, and ethical competencies. Kiss's (2017) toolkit was developed on the basis of Lakert scale of four gradations; in the analysis of the data Mann-Whitney U-test was used, which allowed to obtain reliably accurate results (Luksha, 2018).

Tondeur (2017) distinguishes two main interdependent types of IT competencies of teachers: a) competencies in providing support to students in the use of IT in classroom and b) competencies in the use of IT for the development of educational programs.

Langset (2018) in the process of international comparative research identified factors that contribute to or, conversely, hinder the formation and development of IT competencies of teachers and information literacy of students. The study tends to discuss the two main objectives: 1) IT equipment in schools, professional competencies and qualifications of teachers, goals of school education and level of professional self-esteem of teachers and its influence on learning in various education systems; 2) relationship between accepted level of teachers' reasonable use of computers in school with digital competence of students in different systems.

For analysis, the authors used data from four countries: Australia, Norway, the Czech Republic and Germany, obtained during the ICILS 2013 International Computer and Information Literacy Study, organized by the International Association for the Assessment of Learning Achievements (IEA). The data was divided into four information components: 1) personal data of students of the 8th year of study (gender, immigration status, educational level of parents); 2) results of testing the computer skills of students; 3) data on the school (technical equipment of IT facilities, educational goals and the quality of professional personnel); 4) indicators of professional self-esteem of teachers.

Ally (2019) considers factors that influence formation of future education parameters and development of teacher competencies. During the study, the selected 105 competencies of teachers are grouped in nine areas: General; Use of digital technology, use of various digital educational resources (Re-mix digital learning resources), communication, promotion of learning (Facilitate Learning), pedagogical strategies, assessment of learning, and personal characteristics.

According to Ally (2019), in the near future, a teacher will conduct educational activities in partnership with robot teachers, in a virtual environment. The author considers facilitate learning as one of the prior competencies. A teacher should know how to: personalize instruction for individual students, promptly answer student questions, change mobile learning strategies to meet student needs, be an example of a professional in digital age, motivation that encourages students to learn, encourage social interaction between students, demonstrate proper virtual behavior, be accessible, and be an example of citizenship and responsibility in a digital environment.

According to Tomczyk (2020), a modern school is a social institution that not only actively implements digital technologies in educational practice, but also prepares students for protection against a growing number of Internet threats. A competent, purposefully acting teacher is a key element of this process. Tomczyk focuses on two areas: 1) personal information and self-esteem (gender, age, work experience, frequency of use of digital technologies in education, self-esteem of digital skills, etc.), 2) measurement of competencies related to digital security, in six areas: technical safety when using media; assessment of reliability of information; secure communication; maintaining anonymity; creating secure usernames and passwords; copyright and intellectual property in digital environment.

## **Results and Discussions**

Experience of a rapid transition to online format which is being experienced by Russian education requires serious study and reflection. Teachers in urban and rural settlements, central part of Yakutia and north arctic areas are in unequal conditions in terms of organizing distant learning. There are a lot of issues in technical equipment in educational institutions, low internet connection and a lot of teachers who have professional deficits caused by reasons mentioned above. These conclusions were followed by the projects conducted in 2015-2017:

1. In the process of implementing state contract No. 15-01 / 01 on 06/10/2015 on distance interactive teaching of English to teachers of educational organizations of the Republic of Sakha (Yakutia) in English by native speakers;
2. Research work “Continuous professional education in conditions of modern transformations and their impact on the quality of teachers` life (on the example of the Republic of Sakha (Yakutia) and the Republic of Kazakhstan, with the support of the NEFU Endowment Fund);

3. Participation in Comprehensive scientific research in the Republic of Sakha (Yakutia) aimed at developing productive forces in the direction “Current State and Trends in the Development of Further Continuing Education of the Republic of Sakha (Yakutia)” in 2016 - 2017.



Figure.1. Amount of teachers and teaching staff graduated from North Eastern Federal University in 2016-2019.

In January 2020, North Eastern Federal University launched a study aimed at increasing teachers' effectiveness in digital transformation of general education through the development of teachers' digital competence by implementing cognitive models and algorithms for assessing teachers' digital competencies as well as making decisions on design or adjustment of continuing education programs. The study was initiated as a part of supported project on “Cognitive models and algorithms for formation of teacher's digital competence in digital transformation of general education” in 2019 (grant RFBR No. 19-29-14030).

Postgraduates of Institute of continuous professional education of North-Eastern Federal University conducted research among teachers and executives of education organizations of the Republic of Sakha (Yakutia) (Figures 2.1, 2.2).

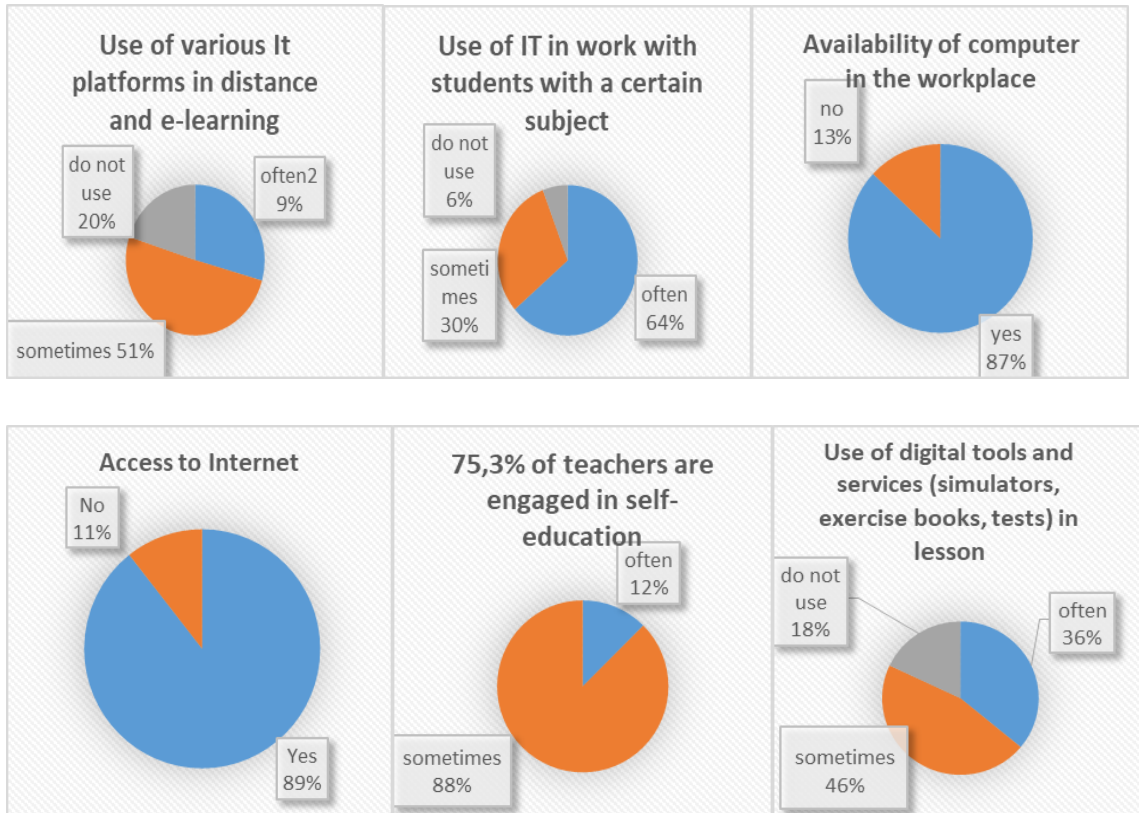


Figure. 2.1. Results of research on digital and IT competencies among teachers conducted by postgraduates of Institute of continuous professional education of North-Eastern Federal University

Among 101 people holding leadership positions in schools of the republic, 5% do not use e-learning platforms to improve their skills; only 8% of managers have a personal website. However, 82% use mobile applications, but they prefer distant and full-time forms of continuing education (34% and 38% respectively); 15 - 21% of all recipients systematically practice online briefings in everyday work, and 53% of all executives of educational organizations do not use these forms.

The obtained results confirmed the need for a special study of current situation of digital transformation in school education. There is a contradiction between features of mass transition of schools to distant and online learning and results of survey used for identifying IT and digital competencies of teachers and leaders of Yakutia.



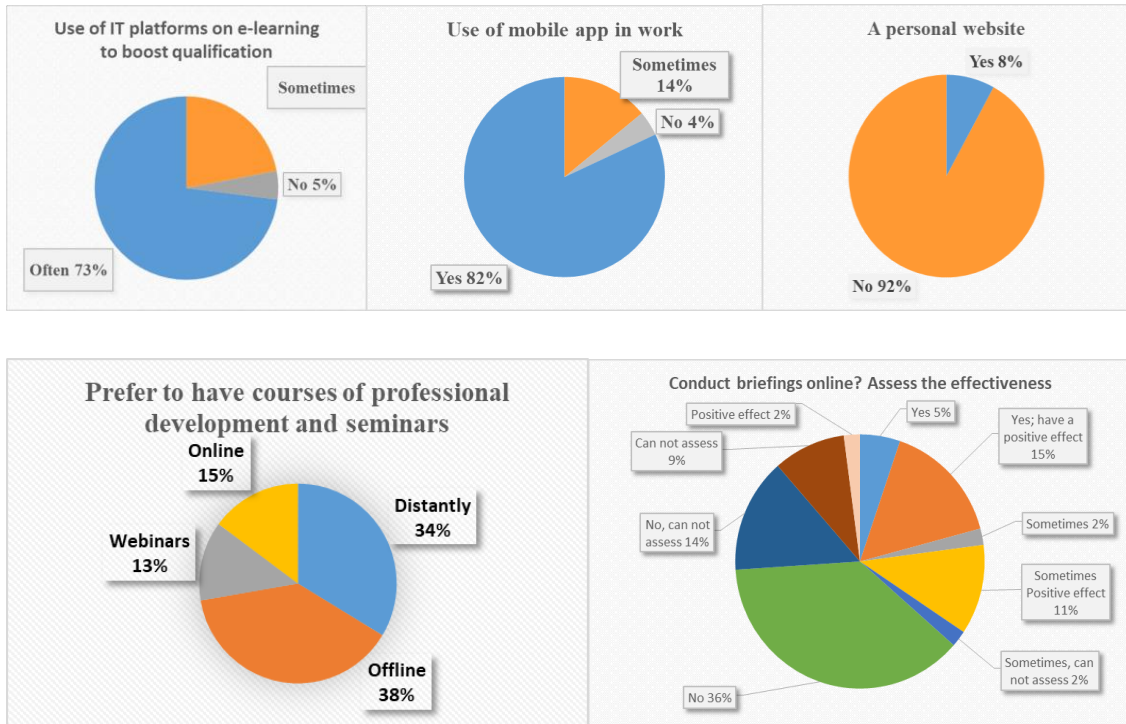


Figure.2.2. Results of research on digital competencies among executive of educational organizations

At the first stage, the current state of the problem of professional and personal development of educators in context of digitalization of education, their digital competence, approaches to identifying digital competencies and their assessment were investigated; conceptual approaches to identification of digital competencies of educators were identified, the main indicators for assessing digital competence were developed. Moreover, approaches to classification of digital competencies were studied; descriptors of key competencies on digital economy and digital competencies have been developed; criteria for assessing competencies have been developed. The criteria are subdivided into the main indicators for assessing results, and a scale for assessing level of competency formation. Competency matrices for all stages of competency formation were designed according to the main indicators for assessing results. It allowed creating a bank of competency-based and level assessing tools that has both formative and assessing functions.

A toolbox for identifying and evaluating level of formation of key competencies on digital economy among teachers was developed to determine teachers` needs within the sphere of digital economy and digital transformation of general education. Development of toolbox was based on such factors as conceptual approaches in current scientific and pedagogical research that allow identifying and assessing

level of digital competencies of a teacher; methodological substantiation of cognitive modeling of studied competencies; assumption of most optimal combinations of key and digital competencies for teachers in different subject areas and levels of education; interrelation and interdependence of some professional deficits associated with a deficit of key and digital competencies.

Questions were divided into groups according to the analysis of European Framework for the Digital Competence of Educators (European framework, a list of key competencies of digital economy), and UNESCO recommendations on structure of teachers` IT competency (Teachers and schoolchildren). The last one has the following levels: 1) Work with data; information and data management; 2) Communication and cooperation; communication and cooperation in a digital multicultural environment; 3) Creation of digital content; creative thinking; 4) Security and problem solving; 5) Information and digital literacy; critical thinking in a technical environment; 6) Questions on 11 digital competencies.

Competency mapping of teachers` digital competencies was produced to solve the fundamental problem of designing new conceptual models and algorithms for complex evaluation of digital competencies, which were set to improve the quality of management in terms of digital transformation in education system. During the process of its development list of key competencies of digital economy (Ketil-Engen, 2019), UNESCO recommendations (News Ykt, 2020), proceeding of the European foundation for education on digital and online learning (Soldatova, Nestik, Rasskazova, & Zotova, 2013) European Framework for the Digital Competence of Educators (European framework, 2017), were used.

This will certainly help to develop:

- main indicators for assessing teachers` digital competency;
- sample for organizing professional development of teachers in terms of digital transformation of education;
- cognitive model of teachers` cognitive competency that allows linking digital competencies with other ones, and stages of their formation;
- cognitive model of a continuing education program that considers relation between education blocks and competencies;
- criteria for evaluating continuing education programs according to the requirements of digitalization of education process.

The current state of investigated problem let designing a digital simulator, which is aimed at identifying levels (theoretical unit) and development (practical unit) of digital competencies in teachers. The practical block included tasks on such competencies as cybersecurity and data protection, programming and design of IT products, digital marketing and media, digital design.

It is worth highlighting the work that has begun on testing the questionnaire on digital competencies and simulator program. Initial measurement of the level of formation of digital and key competencies of digital economy among teachers of the Republic of Sakha (Yakutia) was carried out.

At this stage of the study, a universal unified methodology has been developed for assessing the level of formation among teachers of key and digital competencies. In February - March 2020, as part of the study, a survey of about 200 teachers and executives of general education of the Republic of Sakha (Yakutia) was conducted.

## **Conclusion**

Review of publications in the context of research problem, an assessment of current situation in school education in the Republic of Sakha (Yakutia), results of a survey of teachers and executives of educational organizations confirmed the relevance of the study, especially in the current situation. The outcomes of the study will help taking determined steps to design and adjust the programs on professional development for boosting teachers` activity I n terms of digital transformation of education.

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