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Building foundational digital competencies of teachers in general and inclusive education

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Abstract

The article discusses some approaches to developing conceptually new cognitive models and algorithms of forming and evaluating key and digital competencies of teachers in inclusive education, aimed at constructing management decisions when organizing additional professional education in conditions of the digitalization of general education. The significance of the research is in the need to identify the level of and to improve the foundational digital competencies of teachers in conditions of digital transformation of education.

Nowadays, due to a mass shift towards online education internet users, especially children with disabilities or with special needs, find themselves in the risk zone, and urgently need to be immersed into the field of digital technologies. The results of research on identifying digital competencies in this situation show that the problem is in the contradiction between the indicators of use of electronic teaching and distant education technologies in general education organizations and the level of development of digital competencies among teachers who work with such children.

The authors identified approaches to building and evaluating key and digital competencies among teachers and analysed the issues of organizing and implementing advanced training programmes for teachers, including those who work with children with disabilities or with special needs.

The results of the research will contribute to updating the content of additional professional education system; creating a modern digital educational environment, where the development of key and digital competencies among teachers will promote a systemic introduction of a wide range of modern methods and foundational technologies of digital education.

Keywords: inclusive education, additional professional programmes, foundational digital competencies, adapted educational programmes, digital educational environment.

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Introduction

Today, when digital technologies are being actively introduced into the lifelong education system, the mastery of foundational digital competencies by teachers becomes extremely important, contributing to improvements in the quality of both general education and inclusive education.

Educational process should provide accessible environment for teaching students with disabilities and special needs on an individual basis or with other students, based on principles of protecting their life and health, and creating optimally comfortable conditions that allow them to study successfully.

Individual approach to education is the principal approach when realizing distant learning using digital technologies and tools, ensuring constant monitoring and actualization of the education process, taking into account problems and development trajectories of persons with disabilities and special needs. Distant learning using digital technologies and tools should provide various means for communicating with teachers and other students; promote cooperation during the process of collective or group educational activity; ensure development of cognitive interests and raise motivation of children with disabilities and special needs.

It should be noted that nowadays tutor support for children with disabilities and special needs is becoming increasingly popular. Tutors are the link between the participants (children with disabilities and special needs, other students, parents, teachers, school technical staff) of the educational space (Pedagogy of inclusive education: a reader, 2014).

Tutors should have digital competencies that promote quick adaptation and socialization of the educational process participants in a new digital environment, build their digital learning skills and abilities.

Due to the mass transition to full or partial online education internet users, especially students with disabilities and special needs who are in the risk zone, urgently need comfortable immersion into the digital educational environment, where the principal role is played by teachers.

Teachers who work with children with disabilities and special needs should:

- know the nature and related risks of working with children with disabilities and special needs and their parents;

- update in a timely manner the digital educational resources (educational content), including methodology resources;

- master foundational digital competencies with the aim of developing cognitive interests of children and motivating them;

- assist the participants of the educational process in overcoming difficulties of technological and psychological nature.

The educational environment should have digital educational resources that are adapted to the special needs of children and take into account their specific needs and barriers to health and information perception.

When using the distant means of educating children with disabilities and special needs teachers should choose and develop information and learning resources that conform to legal requirements of web content accessibility, allowing for work in 'virtual groups' using information and communication networks.

Considering the above, teachers should master those foundational digital competencies. Teachers should have skills for designing adapted educational programmes, should learn how to select and develop digital study materials and create content.

The adapted principal educational programme of general education for children with disabilities and special needs should provide for the correction of their developmental disorders and promote their social adaptation. It should be noted that for the implementation of these programmes teachers should have certain foundational digital and psychological-pedagogical competencies. As such, there is a need for modernizing the system of additional professional education in the field of general education digitalization, including inclusive education.

Purposes and objectives of the study

The principal aim of the study is to improve the quality and effectiveness of teachers' activities in conditions of digital transformation of general education, including inclusive education, by perfecting and developing the digital competencies of teachers when making management decisions on designing or updating programmes of advanced training.

The following objectives needed to be met in order to reach the goal of the study:

1. Studying the issues and prospects of professional and personal growth of teachers, including those working with children with disabilities and special needs, taking into account identification of digital competencies of teachers.

2. Developing criteria and assessment scale of key and digital competencies of teachers, including those working with children with disabilities and special needs.

3. Developing structural and cognitive model of organizing additional professional education of teachers in conditions of digital transformation of general education based on the imprecise values of significance of digital competencies.

4. Developing the cognitive model of building and assessing key and digital competencies of teachers working with children with disabilities and special needs.

5. Developing parameters for accessing the conformity of existing programmes of advanced training to set requirements for building key and digital competences for digital economy.

Literature review

Nowadays, despite the great interest of researchers and practitioners to issues of building digital competencies of teachers working with children with disabilities and special needs, there are not enough studies on the issue, evidenced by the lack of applied and fundamental research, as well as absence of practical application in modern educational systems.

In 1994 an international conference was held in Salamanca (Spain) where a Salamanca Statement was adopted on Principles, Policy and Practice in Special Needs Education. The Statement stressed that children, no matter their individual differences, should study in similar conditions and that there should be no discrimination towards children who need inclusive education (United Nations Educational, Scientific and Cultural Organization, 1994).

Of great interest are works by Dr David Mitchell, honorary professor of the University of Waikato and research advisor on the issues of inclusive education, especially his monograph on *Effective pedagogical technologies of special and inclusive education* (Mitchell, 2011) about the creation of comfortable inclusive educational space.

The work, consisting of 22 strategies, explores the issues of implementing inclusive education in a regular school, describes psychotherapeutic methods and mechanisms, as well as techniques for organizing the educational process, taking into account different needs and abilities of students.

Today, there are research works on the current state and comparative analysis of prospects and issues of developing inclusive education not only abroad, but also in Russia.

The issues of inclusive education in Russian scientific literature have been explored in the works of Bakharev (2018).

Alekhina and Silantyeva (2014) justifiably think that inclusion starts with teachers. They also note that the quality of implementing inclusive education in general education depends on the support and assistance of not only school management, but also special education teachers.

Many works are dedicated to issues of training teachers for inclusive education. In her doctoral thesis Muller (2019) writes that the issues of training future teachers are explored by Aysina, Nesterova, Suslova, & Khitryuk (2020) and Cherkasova (2012), and the issues of training practicing teachers in the system of additional professional education are studied by Karynbaeva, Shapovalova, Shklyar, Emelyanova, & Borisova (2019). We agree with the point of view of Voronina (2018) that building and evaluating digital competencies of teachers should be done constantly on all stages of building these competencies, taking into account educational needs of learners and, primarily, the professional and personal characteristics of each teacher.

The analysis of existing literature shows that the issues connected with building foundational digital competencies of teachers working with children with disabilities and special needs, as well as constructing management decisions when organizing additional professional education in conditions of digitalization of general education have not been fully explored.

Therefore, it becomes necessary to study the approaches and methods of building foundational digital competencies of teachers in general and inclusive education.

Methodology

The methodology of research is based on research works in the field of using digital technologies for organizing and realizing educational processes, and changes that affect the competencies of modern teachers.

The principal method, in addition to theoretical review of research literature (on psychology and pedagogics, philosophy, methods) in assessing the components of digital competencies of teachers working with students with disabilities and special needs is qualimetric method based on the general algorithm of assessing the quality of education (Chorosova et al., 2020).

A testing has been conducted among the teachers of the Sakha Republic (Yakutia) who work with students with disabilities and special needs in order to initially assess their level of digital competencies. 146 teachers took part in the testing (24.2% men and 75.8% women). Teachers' participation was voluntary and they had a right to withdraw.

As a result of study in 2019-2020 approaches have been identified to building and assessing digital and professional competencies of teachers. Descriptors of key and digital competencies of digital economy were identified, parameters for assessing competencies and a universal method of assessing were developed.

Evaluation sheets for competencies were developed, in which levels of key and digital competencies are recorded.

The main aim at this stage of designing a cognitive model and algorithms for assessing digital competencies of teachers was development of approaches and methods of assessing key and digital competencies. The authors developed parameters and conditions for conformity of teachers' advanced training programmes (ATP) to established digital competencies of teachers in various subjects.

Results

At the current stage of development of information society there is a need for changes and transformation of main components of the system of education in Russia in general. The Russian system of education develops and modernizes organizational, technological and qualimetric components. As a result of this specialist training is also undergoing changes. There is a new need for specialists with formed digital competencies (Protodyakonova, 2018). In all spheres, including the education system, there is demand for specialists with mastered key and digital competencies, typical for a digital economy (Chorosova, Protodyakonova, Aetdinova, & Solomonova, 2020). There are new requirements for professional competencies of teachers, including digital ones. Digital competencies become a significant, creative factor of competitiveness of education system subjects, including students with disabilities and special needs.

The implementation of competence-based principal educational programme for training general education teachers, advanced training programmes, and programmes of additional professional education requires modernization of basic didactic and assessment tools, which are meant to simultaneously play the role of building and assessing factors (Chorosova, Gerasimova, & Solomonova, 2017).

In order to evaluate digital competencies qualimetric method was used, based on the general algorithm of assessing quality. It was ascertained that the principal schemes of qualimetry are an optimal method for assessing foundational digital competencies of teachers in general and inclusive education.

For this, digital competence was divided into components: key competencies: communication and cooperation; self-development; creative thinking; information management; critical thinking.

Digital competencies: internet of things; cybersecurity and data protection; programming and creation of IT products; industrial design and 3D modelling; development of computer games and multimedia applications; mobile app development; sensorics and components of robotics; system administration; digital designer; digital marketing and media; electronics and radio technology.

Each individual component of competencies was numerically assessed through pi, where i belongs to interval [1,N]. The final value of competence P is calculated using formula (1):

$$\sum_{i=1}^{N} k_i \, p_i, \text{ (1)}$$

where k1, k2, … kN are coefficients.

We defined the levels of competencies as: high, improved, threshold. Note that the benchmark indicator Pmax is high level of digital competence, and Pmin is threshold level. In this case, the aim of training will be defined as follows:

$$P\,(p1,\,p2,\,\ldots,\,pN\,) \to \max, \text{ (2)}$$

$$\text{Pmin} \le \text{P} \le \text{Pmax, (3)}$$

The main indicators for assessing the results are defined using the transformation:

$$d_i = \frac{p_i - p_{min}}{p_{max} - p_i} \qquad \text{(4)}$$

Digital competence of teachers who work with students with disabilities and special needs were assessed by individual components: key and digital competencies. The experts assessed the level of competencies at this stage using the assessment scale that was developed in accordance with main indicators of result evaluation. An average value of 6.25% was accepted as a benchmark indicator for a competence. Based on the test results the maximum value was 8.63% for competence "Communication and cooperation". This key competence is mastered by most teachers who work with different nosological groups of students with disabilities and special needs. "Self-development" competence is formed among 7.65% and "Creative thinking" among 6.71% of respondents. The key competence "Information and data management" shows the lowest level of mastery among teachers (4.21%). This is due to the fact that foundational digital technologies are implemented in schools very slowly. Even though each school has computers, special equipment needed by various nosological groups of students, such as braille keyboards, special mouse pointing devices and others, is practically non-existent. As a result, we identified that only 5.42% of respondents have high level skills for working with different forms of perceiving educational information in various digital environments, adapted to specific needs of students with special needs for perceiving and processing signals and data as integral components of information.

The low level of key digital competencies among teachers working with students with special needs underscores the need for urgently finding the solution to this problem. The principal means of perceiving educational information: auditory, visual, or kinesthetic is the critical factor when choosing and developing digital educational resources and building educational environments for a specific student with disability or special needs. Each teacher, as well as tutors, should provide educational content to students: with vision disorders in the form of audio files; with hearing disorders in the form of digital information and video files, utilizing captions and sign language interpretation using robots and emulators; with muscle-skeleton disorders in the form of files with audio and video; with neuropsychic disorders in the form of didactic general content with lively illustrations and multimedia software. All of this requires high levels of mastery in not only key, but also specific digital competencies in accordance with international standards.

In the next stage of the study we assessed foundational digital competencies of teachers and tutors. The test showed that the teachers know methods of promoting information in organizations in only 4.2% of cases, this being the "Cybersecurity" competence; 3.91% know algorithmic languages and programming languages ("Programming and creation of IT products" competence); 1.2% are aware of the working principles of electronic and digital devices ("Electronics and circuit engineering" competence).

Low correlation of results (1.21 – 2.52%) was shown by tests in competencies "Internet of things", "Industrial design and 3D modelling", "Development of computer games and multimedia applications", "Mobile app development", "Sensorics and components of robotics". Only some teachers (4.3%) know how to set up and maintain computer hardware ("System administration" competence). Relatively high results were received in competencies "Digital design" and "Digital marketing and media", being 5.27% and 5.78% respectively. This shows that the teachers are aware of and use in their work graphics editors to create simple multimedia resources, and also know about various types and methods of marketing communications and commercial marketing.

At this stage of the study, when evaluating digital competencies, we used the scale for assessing digital competencies, developed for assessing competencies of teachers of general education institutions:

High level of competence – 85-100%;

Improved level of competence – 70-85%;

Threshold level of competence – 55-70%;

Below threshold level – 40-55%.

The results of two stages of study show that high level of digital competencies has been identified in only 2% of teachers working with children with disabilities and special needs, which is lower than the indicators of teachers on average by 1%, improved level in 23%, which is lower than the indicators of teachers on average by 30%, threshold level in 65%, which is higher than the indicators of teachers on average due to lower numbers of teachers with improved level, and below threshold level in 10%.

In accordance with the results of the study additional professional education programmes will be developed for building key and foundational digital competencies of teachers working with children with disabilities and special needs. Based on our study we came to the conclusion that the qualimetric approach for assessing key and digital competencies of teachers working with children with disabilities and special needs has high practical value for making management decisions in additional education of teachers.

For the purposes of the study an "Examiner" software was developed using Delphi, aimed at assessing the levels of key and foundational digital competencies in teachers.

Points are recorded and data is saved in forms labelled key competencies and digital competencies.

The administration section has functions for editing expert and student lists, as well as the list of key and digital competencies. This software product is universal and can be used in educational institutions of any type for assessing the levels of competence mastery.

Due to all of the above, there is a need for improving and developing foundational digital competencies of teachers working with children with disabilities and special needs within the frames of additional professional education programmes.

Discussion

The significance of this study is due to the need for identifying the levels of and creating conceptually new approaches for developing foundational digital competencies of teachers in conditions of digital transformation of education.

It should be noted that the digital transformation of education has some risks:

- insufficient professional training of general education teachers;

- teachers not being ready to provide qualified assistance to children with disabilities and special needs and their parents in conditions of education digitalization.

Building and developing digital competencies of teachers is becoming an integral part of the educational process in the additional professional education system, the main stages of which are:

1. Identifying the levels of mastery of foundational digital competencies of attendees of advanced training or professional retraining courses;

2. Structuring of existing knowledge and skills in the field of modern foundational digital technologies and inclusive education with the goal of their continued development during the process of performing professional tasks;

3. Building foundational digital competencies of teachers for distant and electronic education of children with disabilities and special needs.

There is also a need to resolve the following issues (challenges):

- Mass mobile development of foundational digital competencies of teachers working with children with disabilities and special needs when modernizing and implementing additional professional education in quickly changing conditions of digital transformation of the education system;

- Inclusion in each advanced training and professional retraining course programme topics or modules that promote the development of key digital, psychological and pedagogical competencies of teachers for working with children with disabilities and special needs.

Conclusion

The study showed that at the current stage of digital economy development and informational development of society there is no fully cohesive digital informational educational space in the education process that takes into account inclusive education. The assessment of the current state of general education led to the following conclusions that the low speed of internet access due to technical and geographical reasons affects:

- use of foundational digital technologies by teachers in inclusive education;

- mastery of key and foundational digital competencies of general and inclusive education teachers, which become a barrier for the digital transformation of the education system as a whole, affecting the quality of education.

Due to the above it is necessary to modernize the system of additional professional education in the field of advanced training of general and inclusive education teachers in order to build their foundational digital competencies. However, it is necessary to consider that:

- teachers working with children with disabilities and special needs need to show professional and personal readiness for work that requires mastery of a whole range of digital competencies;

- teachers should learn to create required special conditions for students with disabilities and special needs in accordance with nosological groups (for example, alternative forms to auditory and visual educational content for students with sensory impairment; to create digital content in an accessible and understandable manner; to create individual education trajectories; to ensure strict and consistent navigation of presenting didactic materials);

- there needs to be access to information and communication networks and systems adapted for use by students with disabilities and special needs.

Thus, it can be concluded that building deep foundational digital competencies of teachers will promote and motivate students with disabilities and special needs to acquire and develop specific skills and abilities in digital competencies in conditions of digital transformation of economic development in Russia, which will contribute in the future to their further studies and acquisition of a profession, ensuring social adaptation and employment or self-employment not only in the spheres of information and communication technologies, but also high-tech manufacturing, etc.

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