Framework for Assessing the ICT Competency in Teachers up to the Requirements of "Teacher" Occupational Standard

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ABSTRACT

The paper deals with problems of working out a test framework for the assessment of teachers' ICT competency in line with the requirements of "Teacher" occupational standard. The authors have analyzed the known approaches to assessing teachers' ICT competency – ISTE Standards and UNESCO ICT CFT and have suggested their own approach to analyzing the pedagogical activity based on the requirements of "Teacher" occupational standard for assessing the ICT competency in teachers. The crosscutting principles of using the ICT are determined and observance of them underlies the assessment of teachers' ICT competency, in particular: the priority of health and safety of educational process participants; observance of ethic and moral interaction standards, including the IEE; cooperation and constructive interaction of all educational process participants, among them teachers, learners, parents, representatives of the administration. The authors have attempted to single out three qualification categories according to the requirements reflected in "Teacher" standard: teacher, senior teacher, and leading teacher, and to describe the complication of teachers' professional tasks using the ICT. The constituents of teachers' ICT competence have been identified and described: selection, processing, creation, placement of information and organization of communication in the information educational

Introduction

Assessment of teachers' ICT competency is an important milestone on the way of implementation of "Teacher" occupational standard.

The currently effective Unified skills guide for positions of managers, specialists and non-manual workers, section "Qualification characteristics for

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positions of educators", was approved by the order of the Ministry of health and social development of the Russian Federation (dated August 26, 2010 No. 761n) and is used mainly for solving the questions related to regulation of labor relations and for ensuring an efficient system of managing the personnel of educational institutions and organizations. However, documents of a new type are being approved – occupational standards that are a part of a new system, NCQS (National Competences and Qualifications System) (Leibovich, 2011; Leibovich, 2014a; Leibovich, 2014b) and are to be a reference for independent assessment of professionals' competences.

An occupational standard is a characteristics of qualification essential for a worker to perform a certain vocational activity (Article 195 of the RF Labor code).

The occupational standard "Teacher (pedagogical activity in the sphere of preschool, primary general, basic general, secondary general education) (educator, teacher)" was approved by the order of the Ministry of labor of Russia No. 544n dated October 18, 2013.

The standard contains a detailed description of generalized labor functions - the occupational standard "Teacher (pedagogical activity in the sphere of preschool, primary general, basic general, secondary general education) (educator, teacher)":

— Pedagogical activity in designing and fulfilling the educational process at educational organizations of preschool, primary general, basic general, secondary general education;

— Pedagogical activity in designing and fulfilling the main general educational programs.

The standard lists labor functions and labor actions corresponding to them as well as knowledge and skills required for performance thereof.

In the nearest future, it will be applied by employers when forming the personnel policy and in managing the personnel, for organizing the training and appraisal of employees, making labor contracts, developing job descriptions and introducing the remuneration system. So it is already today that work has to be commenced on a toolkit for certifying the teachers' qualification level (The levels of qualification for the development of occupational standards` projects, 2013) as required by the occupational standard.

Such a toolkit will be in demand with various groups of specialists (Public discussion of the draft concept and content of the occupational standard for teachers, 2016):

— teachers of all levels of the general, vocational and further education;

— administrative and managerial personnel of educational institutions;

— workers of regional and municipal education administration agencies.

The independent certification will allow finding out or confirming a teacher's real level of qualification (Factorovich, 2014) which can become an index in the rating, a ground for material reward or for a decision about referral to skills upgrading.

Research Methodology

A teacher's qualification is evidently an integral characteristic of many competences of the teacher: subject-related, pedagogical, etc. One of the principal places in the rank belongs to teachers' ICT competency.

Justification of conceptual approaches to elaborating the toolkit for assessing teachers' ICT competency up to the requirements of "Teacher" occupational standard became the objective of the research conducted by specialists of the Center for educational information technologies, resources and networks of the Federal Education Development Institute.

Tasks of the research:

1. Analysis of the existing toolkits for assessing the ICT competence and methods of the development of test assignments based on the Russian and foreign experience.

2. Development of the concept for assessing teachers' ICT competence based on the requirements of "Teacher" occupational standard.

3. Development of the test framework, toolkit and matrix of competences corresponding to the said test framework.

4. Experts' discussion of the worked out test framework, toolkit and matrix of competences.

5. Elaboration of the test framework, toolkit and matrix of competences according to the results of the experts' discussion.

6. Selection, justification and description of the method for developing the test assignments of the toolkit for assessing teachers' ICT competence based on the requirements of the occupational standard, specification of the test assignments included.

7. Development of examples of test assignment scenarios for the toolkit for assessing teachers' ICT competence.

When developing the concept of assessment of teachers' ICT competence, test framework toolkit, and matrix of competences, the methods of criterion score, critical analysis, competence-based and systemic approaches were used.

As the authors proceeded from the context of labor sphere and relied on the occupational standard for teachers when analyzing the teachers' ICT competence, the latter is determined in this research in terms of the occupational standard.

The ICT competency of a teacher is the teacher's ability and readiness to use ICT when fulfilling their labor functions.

Determining the following principles of teachers' work proved to be extremely important, especially within the context of teachers' ICT competence:

— the priority of health and safety of the participants of educational process;

— adherence to ethic and moral standards of interaction, including in the IEE;

— cooperation and constructive interaction of all participants of educational process, including the teachers, learners, parents, and representatives of the administration.

Analysis of Approaches

The list of works dealing with description and forming of ICT competence counts thousands of titles. One of the recent reviews was compiled by H.S. Kim H.J. Kil & A. Shin et al. (2014). It should only be mentioned that approaches to measuring the ICT competence were also described by the representatives of the Russian education system (Avdeeva & Khudenko, 2014; Avdeeva, 2012; Avdeeva et al., 2009). After many years of research, an accepted and rather stable idea about what the teachers' ICT competence should be based on has formed by the present time. First of all, the idea is based on two international standards: "ICT Competency Framework for Teachers" developed under the guidance of UNESCO (hereinafter – ICT CFT) (ICT Competency Framework for Teachers: UNESCO guidelines, 2011) and "Standards of ICT Competency for Teachers" developed by the International society for technology in education, ISTE (hereinafter – ISTE Standards*T) (National Educational Technology Standards for Teachers, 2008). The two standards are an authority among the developers of standards for pedagogical ICT competency of teachers in all countries of the world.

It has been found out that both standards of pedagogical ICT competency for teachers (UNESCO ICT-CFT and ISTE Standards*T) include two groups of competences each. There are ones associated with mastering the knowledge, abilities and skills in the ICT area and the ones that are necessary for teachers to prepare the learners for living in an information society, in conditions of the knowledge-based economy (Uvarov, 2012).

The structure of the standards differs considerably, which is easy to notice when comparing them (see Table 1 and Table 2).

Table 1. The structure of ISTE Standards*T

1. Encouragement and support for the studies and creativity of learners.
2. Study program and assessment.
3. Pedagogical foundations.
4. Organization and management of the educational process.
5. Development of one's professional abilities and leadership qualities.

Table 2. The structure of UNESCO ICT CFT

	Application of ICT	Acquisition of knowledge	Production of knowledge
1. Understanding of the role of ICT in education	Familiarization with the educational policy	Understanding of the educational policy	Initiation of innovations
2. Study program and assessment	Basic knowledge	Application of knowledge	Skills of a member of the society of knowledge
3. Pedagogical practices	Use of ICT	Solving the integrated tasks	Capacity for self-education
4. Technical and software ICT means	Basic tools	Complicated tools	Proliferating technologies
5. Organization and management of the educational process	Traditional forms of the study work	Groups of cooperation	Learning organization
6. Professional development of teachers	Computer literacy	Help and supervision	Teacher as a master of learning

The framework of ISTE standard is single-dimensional and sets broad directions for assessing the teachers' professional activity.

The framework of UNESCO standard is designed as a two-dimensional matrix. It already sets some levels of ICT competency not only for teachers but also for educational organizations as a whole.

Results and Discussion

In Russia, conditions of work and labor functions of teachers coincide in much with those abroad, however, there are essential distinctions to be borne in mind when developing the concept for assessing teachers' ICT competency.

During the research, the expert group analyzed one of the crucial documents determining the approaches to analysis and assessment of teachers' professional activity, "Teacher" occupational standard. The expert group decided to set the logics of describing the pedagogical activity proceeding from its structure and stages. Table 3 represents the correspondence of labor functions and actions to directions of pedagogical activity. Detailed labor actions served as the basis for describing the ICT competences essential for a teacher.

Table 3. Structural basis of teachers' ICT competency matrix

Labor functions	Labor actions	Labor actions – detailed
1. Participation in management of the general educational organization	1.1. Participation in elaboration and implementation of the educational organization (EO) development program	Participation in analysis and identification of the existing problems of the educational organization, participants of the educational process. Participation in analysis and identification of interests, needs, prospects of development of the educational organization, participants of the educational process. Participation in implementation of the educational organization (EO) development program. Participation in assessment of the results of development of the educational organization. Making suggestions for the development program of the educational organization.
	1.2. Participation in creation and maintaining of a developing environment, including the information and educational one, in the educational organization	Participation in creation and maintaining a secure developing and psychologically comfortable educational environment of the educational organization, including the IEE.
2. Organization and performance of study and upbringing process	2.1. Planning of study and upbringing process	Setting of objectives that promote the development of learners, regardless their abilities and character. Development of programs for academic disciplines within the main general education program.

Labor functions	Labor actions	Labor actions – detailed
		Development of individual educational paths, individual development programs, and individually oriented educational programs taking into account the personality and age particularities of learners.
	2.2. Performance of study and upbringing process	Performance of professional activity as required by the federal state educational standards of preschool, primary general, basic general, and secondary general education. Holding of academic classes. Forming of skills related to the information and communication technologies. Organization of learners achieving the results (personal, meta-subject, subject ones) stipulated by FSES. Organization of various activities: play, study and research, artistic and productive, cultural and leisure ones taking into account the opportunities of the educational organization, place of residence, and historical and cultural originality of the region. Performance of the modern work forms and methods, including the interactive ones, using them both at classes and in extracurricular activity. Fulfillment of individual educational paths, individual development programs, and individually oriented educational programs taking into account the personality and age particularities of learners. Adjustment of academic activity proceeding from the data of educational results monitoring with the children's non-homogeneous individual mental development taken into account. Controlling the learners' behavior for ensuring a safe educational environment Cooperation with other pedagogical workers and parents in solving the study and upbringing tasks.
	2.3. Diagnosing of learners and control of the study and upbringing process results	Organization and performance of control and assessment of study progress, current and final results of learners' acquisition of the main educational program. Objective assessment of the learners'

Labor functions	Labor actions	Labor actions – detailed
		knowledge based on testing and other control methods according to the children's actual academic opportunities. The use of toolkit and methods for diagnostics and assessment of the level and dynamics of children's development. The consistent analysis of efficiency of academic classes and approaches to teaching.
3. Teachers' continuous professional development	3.1. One's own professional development	Institutional skills upgrading and retraining. Self-education: • reading, analysis of literature; • visiting the open classes and analyzing them, visiting the conferences; • studying the colleagues' experience. On-the-job training. Research activity.
	3.2. Interaction with colleagues for professional sharing of one's experience	Writing and publishing the articles / study aids / study books. Speaking at methodological meetings, conferences. Participation in pedagogical excellence contests. Participation in professional communities; supervision etc.

The analysis of teachers' pedagogical activity and requirements for their ICT competency (Weindorf-Sysoeva & Hapaeva, 2014) allowed singling out such operational constituents of the ICT competency as selection, processing, creation and placement of information and organization of communication in IEE.

1. Selection of information.

As of today, one of the main requirements for any specialist is the ability to find one's bearings in the boundless ocean of information (Ionova, 2007) represented in various forms, on various carriers – first of all, on digital carriers and in the global network. The following algorithm can be suggested as an efficient information selection algorithm.

First, the problem for solution of which the information is necessary has to be worded in an appropriate way. It is no mere chance that good wording of a question is said to be half the answer to it. A clear wording allows outlining the information search area more exactly.

Next, sources of information have to be selected from the standpoint of their validity, reliability and relevance. The teacher's knowledge of classification principles for the information sources is also essential for organizing the work in an efficient manner, i.e. teachers have to understand what kind of information

can be obtained from an encyclopedia, an electronic study book, a professional forum, a blog and so on.

After that, a query for the search system has to be built, whether for the global network or for a database. A good wording of the query allows reducing the quantity of information sources to the necessary minimum, thus saving the time on browsing them.

Finally, the selected information has to be stored. This is a very important step when selecting the information which allows further efficient processing it. Here the teacher's ability to save the selected information in a required format on the appropriate carrier is critical while also remembering to specify the source of information. At the same step, it is especially important to be guided by a knowledge of the copyright licensing and protection law.

2. Processing of information.

Processing of information in order to use it for solving the pedagogical tasks is one of the key constituents of teachers' ICT competences. The priority task of this stage of working with information is knowing how to analyze and assess it from the standpoint of its relevance. For this, a teacher has to know criteria for the proper and efficient performance of this operation. The ability to structure the information collected from various sources proceeding from the study and upbringing tasks has to be referred here too. So, for instance, what is suitable for organizing the academic classes can not always be used for organizing extracurricular activity. What can be used for one age group is completely unacceptable for another one, and so on. The same holds true for selection of the information presentation form: graphic, text, animation, sound etc. It has to be borne in mind that one and the same information can be used for different pedagogical tasks depending on its presentation form (Bosova, 2012). For instance, the same tests are used during academic classes if given as questions in a computer presentation slide and for organizing the learners' independent work if placed as text in the distance learning shell with a self-check option. The use of animation and sound effects when demonstrating the slides at a face-to-face class can distract the learners' attention while that during organizing the independent work can enhance the interest for further viewing.

3. Creation of information.

There is no doubt that a teacher's work in information educational environment encompasses more than selecting and processing someone else's information. Any teacher creates new information: writes his or her own texts, draws pictures in a graphic editor (Elizarov, 2004). If teachers create their own presentation, supportive notes of a class, test etc. – they create their own product. When discussing teachers' ICT competency, it makes sense to speak not only about the basic computer literacy (typing and simplest text formatting, creating simple presentation slides, file saving, working with the Internet browsers etc.) but also to put up the questions associated with understanding of the efficient use of various information presentation forms (Panyukova, 2010; Panyukova, Gostin & Avilkina, 2014). In particular, while every teacher already needs the skills of creating a hypertext, the skills of creating animation are not compulsory. However, knowledge of this presentation form and an ability to provide for creating one expand the range of opportunities for teachers' organizing the academic activity. In its turn, this means that teachers have to know how to structure and present the results of their work in various forms.

They have to possess skills of numerical processing of the results, to appropriately select visualization means for the numerical information, to be able to use the means of monitoring and registering the progress and results of academic activity and educational process as a whole using the hardware and software means provided by the IEE of the educational institution.

4. Placement of information.

Currently, almost each educational institution has not only its own local network but also its own website hosting the information required for organizing the educational process. Hence an essential condition of teachers' efficient work is not only knowing about the information placement technologies but also knowing how to use them.

The modern information and communication technologies grant broad opportunities for teachers to go beyond the walls of not only their grades / groups but also of their educational institution (Zakharova & Zakharov, 2012). The development of distance learning forms, organization of distance forms of experience exchange and skills upgrading introduce in the agenda the teachers' ability to place the information created by them in the global network. It is already now that many of us obtain useful information from teachers' personal blogs, keenly work with their students using wiki-technologies, share information in cloud services, and use social networks. Such practice shall become commonplace. However, it should always be borne in mind that having the skills of information placement in the Internet environment is no more than a tool, i.e. only a small part of solving the pedagogical task. The crucial component is the content oriented to a certain target audience, skillfully arranged in the didactic aspect and clothed in a form matching its objective.

5. Organization of communication in IEE.

First of all, the questions of communication organization shall include ensuring the safe work for learners. While earlier the problems were solved by a correct organization of class work from the standpoint of occupational health and ergonomic PC operation, today it is the questions of ensuring the security of working with the Internet sources – especially within the learners' independent work – that become relevant.

The modern communication in the IEE implies teachers' knowing the new forms of educational activity organization (Koryakina, 2007) – both within the traditional classroom studies and in the form of the Internet conferences, webinars, Internet-based telephone communication, social networking etc. (Nikulicheva, 2009). The knowledge of network etiquette and teaching it to one's pupils when working in the new forms are an important requirement specified for the modern teachers. Attention should also be paid to the fact that in many communication cases a modern teacher acts both as an organizer and as a participant of communication, so the requirements for the teacher can differ in the cases (Polat & Bukharkina, 2010). An ability to efficiently organize work in the webinar mode so as to keep the interest of all participants, to engage all pupils at the class into work with the Internet sources, to motivate their colleagues to voice their opinions on the relevant education questions at the forum, to correctly build the communication with parents – be it e-mail or social network, etc. – is a distinctive feature of a modern teacher.

Thus, as a result of the research, the expert group has identified the measured construct "Teachers' ICT competency" and detailed its constituents. Then the expert group suggested to use three generalized qualification categories of teachers. Each of them is distinguished by its generalized labor function (GTF). This is a suggestion which is still under discussion and has a working character. It allows subdividing the teachers into three qualification levels:

— Category 1 (Teacher. GTF: fulfillment of educational programs),

— Category 2 (Senior teacher. GTF: design and fulfillment of educational programs),

— Category 3 (Leading teacher. GTF: management of design and fulfillment of educational programs).

The classification suggested allowed not only registering the three qualification categories of teachers each of which has its own set of ICT competences but also working out the requirements for each qualification categories. In particular, not only were the requirements elaborated in the general "Teachers' ICT competency" construct but also the levels of each constituent of the general construct were determined.

The requirements for the ICT competency constituent "Selection of information" for each qualification category are brought down in Table 4.

Table 4. Description of acquisition indices for the "Selection of information" competence

Teacher	Senior teacher	Leading teacher
At this level, the tested one performs the following actions: words questions up to the information need, the questions being: — aimed at the information objective; — relevant; — limiting the essence of information need; — reasonably specific (e.g. event, problem, aspect, personality, time span); selects the information resource from the suggested ones according to the criteria of: — thoroughness, — reliability, — relevance, — validity; words a query that allows getting the information for solving the problem at an acceptable level using:	At this level, the tested one performs the following actions: words questions up to the information need, the questions being: — aimed at the information objective; — relevant; — limiting the essence of information need; — reasonably specific (e.g. event, problem, aspect, personality, time span); performs an independent search for information resources according to the criteria of: — thoroughness, — reliability, — relevance, — validity; words a query that allows getting the information for solving the problem at an acceptable level using: — keywords, — logical operators, — functional syntax,	At this level, the tested one performs the following actions: generates and explains questions associated with the information need; makes an unclear research question more precise bringing it down to the appropriate particular area; replaces completely the appropriate information need from the existing problem; selects previous questions completely associated with previous information; selects an information resource that satisfies all the following criteria of the set information need: — appropriate; — efficient in terms of expenses; — usable. looks for information in many sources in a directed

Teacher	Senior teacher	Leading teacher
— keywords, — logical operators, — functional syntax; selects the appropriate results (if there are excessive ones) with the set educational task borne in mind; selects different results in the following search operations; uses the obtained information fully or partially for obtaining the answer to the set question; stores the obtained information in a format that is convenient for further use; pays respect to authorship, copyright, trademark and confidential information, if this is expressed clearly enough.	— limiters and filters, — certain, unique search conditions (notions); — organizes the search in such a way that search results in the sources are characterized by: — preciseness (the results are ordered by numbers); — carefulness (the results are complete in line with the information need); — optimum orientation to the information need; stores the information about the source and metadata that allow referring the information to a source and restoring its source; selects the appropriate results (if there are excessive ones) with the set educational task borne in mind; organizes further search by "narrowing down" the results; stores the obtained information in a format that is convenient for further use; uses the obtained information completely for obtaining the answer to the set question; recognizes and pays respect to authorship, copyright, trademark and confidential information.	and conscious manner in line with previous results; uses search strategies for the set information need, in particular: — sets / uses the appropriate limiting conditions, — eliminates the unnecessary, — uses the correct syntax, — is efficient, — adapts to the previous results both by "tailoring" (narrowing down) the results and by replacement (producing various results); selects the appropriate results (if there are excessive ones) with the set educational task borne in mind; organizes the search in such a way that search results in the sources are characterized by: — preciseness (the results are ordered by numbers); — carefulness (the results are complete in line with the information need); — optimum orientation to the information need; stores the information about the source and metadata that allow referring the information to a source and restoring its source; stores the obtained information in a format that is convenient for further use; uses the obtained information completely for obtaining the answer to the set question; recognizes and pays respect to authorship, copyright, trademark and confidential information.

Furthermore, as the work on the theoretical framework for assessing the ICT competency through analyzing the teachers' professional activity according to the main labor functions singled out (Table 3) continued, a set of actions was formed that could give evidence about certain qualification categories for each of the five individual competences (constituents) of teachers' ICT competency in line with definitions thereof. For instance, the following pieces of evidence according to which it can be assessed were identified for the "Selection of information" constituent:

O1. The relevance of the resource selected during identification of the problem (Are the selected resources relevant? How likely are they to contain the information essential for fulfilling the pedagogical process?)

O2. Quality of search results (Was enough relevant information obtained as a result of the search? The teacher will have to choose one or several information sources from the suggested ones).

O3. Completeness of the data retrieved (Has the information selection yielded enough data in a convenient form?).

O4. Quality of information selection results for a number of tasks (Was enough relevant information obtained as a result?).

O5. Quality of the notions used for compiling the initial search query or when working with search results (Do the words in the search query touch on all aspects of the topic?) and so on.

It should be noted that wordings of the evidence do not appeal to knowledge or certain actions but, according to the competence-based approach, they do so to abilities and demonstration of the abilities.

The expert group suggested using a regular approach to the development of assessment means in working on them, or the so-called evidence centered design (the term is not translated literally but its essence is rendered; the approach is detailed in works of R. Mislevy & R. Levy (2007) who systemized and conceptualized the practices of educational tests development).

This approach allows answering two questions. First, what data can we retrieve from teachers' behavior during performing their professional activity that would be indicative of them having the discussed ICT competency or not? Second, how can we create a pedagogical situation which would help obtain the data? (Mislevy & Levy, 2007).

The main advantage of this approach is its consistency, clarity and reversible logics, as it is always clear how a certain evidence is related to the construct measured, which is the source of a high construct validity of the assessment means. Moreover, such an approach is in line with the logics of psychometric measurement i.e. the association of latent variables (ICT competency and 5 constituents thereof) with their observed indicators (evidence).

Conclusion

Thus, as a result of the research a framework for assessing teachers' ICT competency has been developed and requirements for each constituent of it have been described. A matrix of requirements for ICT competence has been formed and requirements for each constituent have been detailed with qualification categories borne in mind.

Preparation of a documents package describing ICT competency, requirements for forming and measuring it is just the first step on the way of working out the tool for assessing teachers' ICT competency. The next step involves developing the scales and assessment means for all qualification categories. Yet this is still the beginning, too. The crucial point is now to ensure understanding and support among teachers, methodologists, workers of education administration agencies, professionals in teachers' training and skills upgrading for the materials elaborated during the research. This can only be achieved via a broad discussion of the progress and results of the development by teachers and by the entire pedagogical community.

The specialists of the Center for educational information technologies, resources and networks of the Federal Education Development Institute invite everybody to join this discussion which is organized on the website: [ictlit.com/teacher].

After the extensive discussion, the completed theoretical framework of assessing the ICT competency will form the basis for working out the tool; a joint team of experts, psychometrists, assessment means development specialists and programmers are expected to cooperate in elaborating the tool. It will allow objectively assessing teachers' ICT competency and performing certification of specialists on the basis of the universal requirements of "Teacher" occupational standard.

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