Continious Development of Information-Communication Competence of the Biology Teacher as a Factor of Advancing the Level of General Professional Qualifications

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Abstract: The study considers the notion of information-communication competence of the Biology teacher which concerns adoption of the methods and means of ICT into the system of education. It has been examined the conditions which are necessary for ensuring the improvement of quality of continuous professional pedagogical education with adoption of ICT. It has been differentiated competences that the teacher of Biology of modern educational system must have. Since, an effective and efficient form of developing ICT-competence of future teachers of Biology is the study of special discipline, the study deals with the consideration of the program of the discipline "Application of information-communicative technologies in teaching Biology which is meant to use for training future teachers of Biology" and raising of qualification of already practicing educators.

Key words: Professional standard of an educator, ICT-competence of the Biology teacher, discipline, notion, information-communication technologies of education

INTRODUCTION

In conception of professional standard of an educator approved by Order of the Ministry of Labor of Russia from September 18, 2013 No. 544n "On approval of professional standard "Teacher (educational activity in the field of preschool, primary general, basic general, secondary education) (tutor, teacher)" the following is noted: "Teacher is a key figure in reforming education". "In training and education, in general schooling nothing can be improved without a teacher" (K.D. Ushinsky). In the rushing open world, the main professional quality an educator should constantly demonstrate to his pupils becomes an ability to study. Readiness for change, mobility, ability to non-standard working activities, responsibility and independency in decision making all these characteristics are in full measure referred to the educator as well. Acquisition of these important qualities is impossible without extension of the space for pedagogical creative work".

Major but fragmentary elements of ICT-competence of the teacher are included into qualifying requirements adopted at the end of the 2000s. Over the past time, Russian school develops on the whole in the direction to informatization of all processes becomes digital.

Most educators use computers for text processing, cellular phones for sending short messages. In their presentations, the teachers use the multimedia projector give tasks to the pupils on searching for information in the internet, deliver information to the parents using E-mail and so on.

In many regions of Russia, it is permissible or introduced directively the electronic journals and diaries providing partial immersion of the educational process into Information Environment (IE). More total immersion (implying allocating the main information of the educational process into IE) provides additional educational abilities, the grasp of these abilities basic element of educational ICT-competence, equally with the ability to skillfully input the text from a keyboard and to formulate a request for search in the internet.

Federal state educational standards for all levels of the Russian education comprise a professional ICT-competence of the teacher as a requirement for educational process in particular work in IE. The experience of training the Biology teachers for working under conditions of implementation of federal state educational standards of general education shows the reality of forming professional ICT-competence of absolute majority of the teachers. The professional ICT-competence of an educator in this case implies the skilled use of widespread in this professional field in the developed countries means of ICT in solving professional tasks where it is necessary and when it is needed (Yamburg, 2014). Professional educational ICT-competence comprises:

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Table 1: Components of ICT-competence of the Biology teacher

General user-defined component	General educational component	Subject-educational component
The use of techniques and observance of the rules of start, interruption, continuation and completion of the work with ICT, debugging, providing with expendables, ergonomics, safety engineering and the other issues, resulting in mastering ICT in school	Educational activity in Information Environment (IE) and its constant reflection in IE according to the tasks of planning and objective analysis of the educational process, transparency and comprehensibility of educational process to the surrounding world	Definition and conduction of the experiment in virtual laboratories at the lessons of Biology
Observation of ethical and legal norms of using ICT (including impermissibility of non-authorized using and information imposing)	Organization of educational process: task description for the pupils, task checkup before the next lesson, reviewing and fixation of intermediate and final results, in particular, and annotation of the pupils' and own portfolio, distance consulting of the pupils when doing a task, support of interaction between the pupil and the tutor	Acquisition of numerical data array by automatic reading from digital measuring devices (sensing devices) marking of video images, measured and accumulated experimental data
Video audio record of the processes in the outside world and educational process	Preparation and conduction of presentations, discussions, computer support consultations, including telecommunication environment	Processing of numerical data by means of tools of computer statistics and visualization
Key-entry	Organization and conduction of group (including interschool) activity in telecommunication environment	Object recognition in maps and pictures of space, matching the maps and pictures
Audio video text communication (two-way communications, conference, flash and postponed messages, automated correction of the text and translations)	Use of the tools of planning activities (including collective), visualization of the roles and events	Use of digital detectors, their supplement
The internet and database search skills	Visual communication use of visual aids in the process of communication, including conceptual, organizational and others (diagrams, video editing)	Knowledge of qualitative information sources on the subject "Biology"
Systematic use of the skills in everyday and professional context	Prediction, projection and relative estimation of individual progress of the pupil, on the basis of the current state, personal characteristics, previous story, early accumulated information about different pupils	Teacher's support of realization of all elements of subject-educational component of the subject "Biology" in the pupils' working
	Estimation of efficiency of digital educational resources (sources, tools) in relation to the given educational tasks of their using Responsiveness to public information space in particular youth. Support of forming and using of general user component in the pupils' work Organization of health status monitoring by the pupils Definition and conduction of the experiment in virtual laboratories at the lessons of Biology Acquisition of numerical data array by automatic reading from digital measuring devices (sensing devices) marking of video images, measured and accumulated experimental data Processing of numerical data by means of tools of computer statistics and visualization Object recognition in maps and pictures of space, matching the maps and pictures Use of digital detectors, their supplement Knowledge of qualitative information sources on the subject "Biology" Teacher's support of realization of all elements of subject-educational component of the subject "Biology" in the pupils' working	

C   General user-defined ICT-competence
C   General educational ICT-competence
C   Subject-educational ICT-competence (reflecting professional ICT-competence in corresponding sphere of human activity)

Each of the components includes ICT-competence, consisting of an appropriate skill to use the resources of ICT (Table 1).

As the graduates from pedagogical higher schools should meet the requirements of professional pedagogical standard, the system of higher pedagogical education should meet the requirements at all its levels from fundamental (primarily, technological) training through special professional preparation for continuous professional pedagogical education during all time. Taking into account the above-stated, the purpose of the study is the analysis of the component of

ICT-competence of the graduates of pedagogical speciality and working teachers of Biology and also grounds for choice of technologies for continuous development of ICT-competence of the Biology teacher.

MATERIALS AND METHODS

In writing the study, it has been used the theoretical and empirical methods: the study and analysis of psycho-pedagogical and methodological literature, theoretical sources on the problem of introduction of ICT into the process of education, the study of normative-methodological documentation, the study of educational experience, educational process observation, testing, questioning.

Investigation organization: The analysis of the recent research papers and publications has shown that the highly qualified Biology teachers' training requires the change of methodological system of education such as: to bring innovative information-communication technologies to the means of organization and support of training. Development and introduction of ICT into education has been studied by scientific workers of the international organization: UNESCO, UNO, European Union, Council of Europe and others (Anonymous, 2008). The works of S. Peipert, M. Reznik (the USA); Ye. Patarakin, Ye. Polat, A. Khutorsky, B. Yarmakhov, O. Yastrebtsev (Russia); V. Bykov, M. Zhaldak, M. Zgurovsky, V. Kukharenko, V. Lapinsky, N. Morze, A. Pilipchuk, S. Rakovaya, S. Semerikov, Ye. Slovak, A. Stryuk, M. Shishkina (Ukraine) and of the researchers from other countries are devoted to this question. The problem of introduction of ICT into the process of studying of the fundamental discipline is highlighted in the works of K. Vlasenko, V. Klochko, T. Krylov, T. Maksimova, I. Reutova, N. Rashevskaya, Yu. Trius and other native research people. At the same time, the question of continuous development of information-communication competence of the Biology teacher has not been sufficiently investigated.

RESULTS AND DISCUSSION

The experience of the best systems of schooling indicates that the three factors play a crucial role:

C   It is necessary the teachers to be the right people for that work
C   They should have the training allowing to raise effectiveness of teacher's work
C   Conditions should be provided such as by which each pupil without exception to gain qualitative education

The results of investigation made by Barber and Murshed (2008) demonstrate that in the most developed countries, in this relation, there exist the systems that are organized in such a way that all these factors work without reference to culture context which one has to deal with. One of the key components of the system of conditions providing qualitative education is ICT-competence of the educator.

In judgment of leading home and Foreign researchers (Kuznetsov A.A., Krayevsky V.V., Lebedev O.Ye., Raven J., Semenov A.L., etc.) the importance of ICT-competence for the educator' professional activity in widespread adoption of tools of information and communication of technologies in educational space of school increases. The future of all world society depends to the utmost on how qualitatively the pedagogical staff will have been trained, how proficiently, they will employ the facilities of information and communication technologies (Peksheva, 2008).

In scientific literature, one can find a lot of definitions of the term "information competence". Depending on the field of scientific knowledge the researchers emphasized one or another aspect of this kind of competence in each of the definitions. Among their number Zaitseva (2002) in his investigation treats information competence as a comprehensive individual and psychological education on the basis of integration of theoretical knowledge, practical skills in the field innovation technologies and certain set of personal qualities Semenov (2000) defines information competence as a new literacy which comprises the skills of active independent information processing by a man, taking landmark decisions in unforeseen situations using technological aids (Robert, 2004) . Peksheva (2008) defines information competence as "a set of abilities and skills of obtaining and processing information". Trishina (2005) considers information competence as "an integrative quality of a personality being the result of reflecting the process of selection, learning, processing, transforming and generating information into special form of subject-specific knowledge enabling to work out, receive, predict, realize optimal solutions in different spheres of activity" Gritskov *et al*. (2008) believe that information competence is "mastery of new information technologies, realizing the scope of application of them in educational process and also critical attitude to widespread information".

Many international organizations have already determined the goals of adoption of ICT into the process of education and also developed for the educators the norms and standards on using appropriate tools. At the

present time, the interaction between several factors is taking place and therefore, it is arising greater want for the educators to master practical skills of using ICT being defined in UNESCO and International Society on International Technologies in Education (ISTE). These factors include growing need for acquiring new skills relating to information, technological and visual literacy, understanding of the pupils to have been changed and there is no educational practice and also understanding of need existing already worldwide for the pupils who are able with time to become proficient specialists and to successfully integrate into economic system.

Existence of the norms and standards of the teachers' ICT-competence of itself is insufficient to make necessary changes. The important element needed for reformation of school and effective application of ICT is training and continuous raising of teachers' qualification.

The results of many investigations in this field evidently point to the fact that among the other factors the key role here is played by teachers' professional development of high-quality which is unfortunately treated somewhat meagerly in the context of efforts on the reformation of the system of education. In the meantime, the very absence of effective professional development of the pedagogical workers is often thought to be the principal reason of the gap between the goal the pupils can potentially reach and the reality they face in fact in their classes all over the world.

Ensuring further training of the teachers to adoption of ICT into schools is the most important element in systematic approach. The teachers who are not assured of their ability of effective using the computers in work with their pupils will try to avoid to use them. There exist many examples when mobile classrooms gather dust in school cupboards. The task of up-to-date educational systems does not consist in changing mentality of the teachers but in giving them confidence in their work in school equipped with modern facilities. Modern society is based on using information and knowledge. Today, it is impossible to ignore extensive spread of media, different forms of information and communication technologies or their influence on our private, economic, political and social life. Therefore, new competences (of knowledge, skills and aims) are necessary to take an active and successful part in the life of information society.

It is impossible to overestimate the significance of the skills to count, read and write but inclusion of information competence into the set of key professional competences of the educator means that today, it is necessary for both the teacher and the pupil to understand the functions of media and other providers of information (for example, libraries where the media-resources are books) to be able to search, estimate, use and create information for achieving personal, social, professional and educational goals. Investigations in the area of information competence of modern pupils have shown that the schoolchildren meet with difficulties in estimation of reliability of data, though, it is considered that the technological skills and consequently, the skills of media and information literacy of the young people are developed better than those of older generation.

Acquisition of information competence opens before teachers and students a wide spectrum of opportunities enriching the educational environment and enabling to do the process of teaching-learning more dynamic.

Information competence, according to the researchers from the Institute of UNESO on information technologies in education is a set of competences necessary for acquisition, understanding, evaluation, adaptation, generation, storage and presentation of the information used for problem analyzing and decision making. Information-competent people master the basic skills such as: critical thinking, ability to analyze information and use it for self-expression, ability to self-education, creation of information, readiness to be informed citizen and professional to participate in state activity and democratic processes occurring in society.

One of the main tendencies determining the requirements to the level of ICT-competence of a modern teacher is change of emphasis from technological tasks (referring to mastering the concrete tools, concrete programming products) to pedagogical level. The Federal State Educational Standard of general education (FSES) defines except its main values and main notions, the systems of the key tasks providing formation of universal forms of learning activity being adequate to the standard requirements for the results of education. The requirements for the level of qualification of the teachers, fixed in the FSES refer also to them. Schools are delegated the responsibility for fulfillment of all the requirements of FSES on formation of information educational environment in school and organization of training teachers to actively use the resources of such environment. Information educational environment must include electronic educational resources, electronic school record book and journal, school site, environment for electronic portfolio of the pupils and teachers and so on.

The system of ICT-competences of the Biology teacher to be is based on the requirements

Table 2: The student's competences to be formed as a result of mastering the discipline

As a result of mastering the discipline "Application of information-communication technologies in teaching Biology"

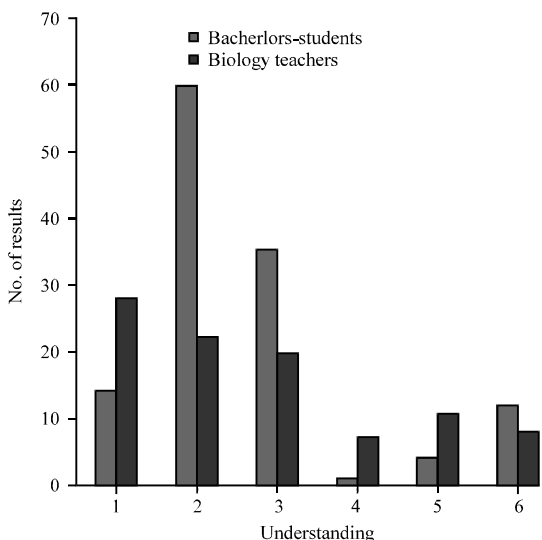| The student must know how to	The student must master
Use ICT for improving teaching and educational work at school	The techniques of using board at the lesson of Biology
Organize professional diagnosis of the learners using computer process	Computer technologies of education and to use them in learning
Organize design and investigation work of the learners by means of ICT	Techniques of preparing didactic materials and working documents that will enable to plan and organize multipurpose use of the wares of ICT at the lessons of Biology and integrated courses
Plan lesson in information educational environment	Up-to-date techniques and methods of fitting out the educational process
Organize educational computer modeling of the learners	The skills of using mobile computers of different size at the lesson of Biology
Select the training aids for realization of new forms of learning activity (electronic educational resources, educational Internet-resources, computer facilities: computer, video projector, printer, scanner, interactive board, interactive pads, telecommunication ware)	
Use interactive models, virtual laboratories, integrated environments for front, individual and group work with the class	
Use the distance resources in doing home tasks	
Compile tasks and tests in electronic form or with the tools of IE	

Fig. 1: The results of analyzed understandings about organization of educational process on the basis of ICT

of the discipline program "Application of Information-Communicative Technologies in Biology Teaching" for Bachelors in the directions "Education" in specialization "Biology and Chemistry" (Table 2). This program determines the content, scope and level of professional training. The object of the discipline: forming of competence of modern Biology teacher in the field of support of information basis of activities. The features of mastering this discipline, concretization and detailed elaboration must be guided by specificity of professional activity of the future graduate. Therefore, revelation of the level of training needed in the field of ICT-competence of the Biology teacher is more reasonable to do through the prism of his professional activity. To this purpose, it has been analyzed the content of the needed training of the

future teacher of Biology in the field of ICT from the position of professional standard, appropriate working activities, functions and knowledge, acquisition of which implies the use of information technologies by the teacher.

The peculiarity of studying this discipline consists in its integrated importance as it is based on the knowledge acquired by the students while studying the other disciplines of professional training at the same time this knowledge is analyzed, it is stimulated the creation of stable relation between knowledge from different subjects.

According to the results of investigation of self-rating of ICT-competence of the future Biology teachers in which the Bachelor-students from Kazan (Volga) Federal University and also 1776 of working teachers from 54 regions of the Russian Federation have taken part, the educators get growing awareness of the advantage of competent and effective use of up-to-date information and communication technologies in the sphere of general education. It is systematically applied the existing skills of using ICT in everyday and professional context by 79% of respondents. However, now only 50% of respondents fulfil educational work in information environment and constantly reflect it in information environment. Unfortunately, we have to state a fact that the respondents' understanding of organization of educational process on the basis of ICT is rather mixed. The respondents understand the organization of educational process on the basis of ICT in the following way (Fig. 1):

C Understanding 1: Working out and use of the task for the students/pupils in the course of lesson
C Understanding 2: Checking up the tasks of the students/pupils

C   Understanding 3: Fixing intermediate and final results
C   Understanding 4: Compiling electronic annotated portfolio of the student
C   Understanding 5: Compiling annotated personal portfolio
C   Understanding 6: Distance consulting

The achievement by the teacher of professional ICT-competence is provided, according to the respondents, by the following factors (Fig. 2):

C   Factor 1: Availability of sufficient technological base
C   Factor 2: Availability of broadband channel of the internet
C   Factor 3: Anytime access to mobile computer
C   Factor 4: The tools of information environment, established in educational organization
C   Factor 5: The need of the teacher to improve his ICT-competence
C   Factor 6: Installation of the administration of educational organization
C   Factor 7: Adoption of local normative acts on the work of the staff of educational organization in IE
C   Factor 8: Initial mastering by the teacher of the basic ICT-competence in the system of advanced training

It cannot be neglected that the ICT use motivation of the Biology teachers has changed. The teacher today tries to look less archaistic in comparison with the pupil, wants to be more mobile interesting for the pupil. It follows from the answers of the teachers being questioned:

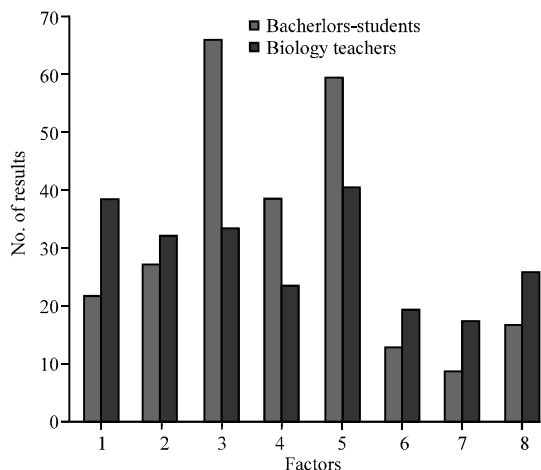C   We must be well up on innovations keep up with the time in order to be interesting to the pupils

Fig. 2: The results of the analyzed understandings about factors providing achievement by the Biology teacher of the professional ICT-competence

C   "The teacher must be only the best to his pupils, the teacher must be a good psychologist, not be standing with the rag and piece of chalk at the board but be standing at the interactive board fitting out with the internet, digital resources"
C   "I can use a prodigious amount of information, speak "one language" with the children"
C   "ICT helps to become more mobile"
C   "The educator is changing"

Today, we can draw the main conclusion: the Biology teachers have not been afraid of the computer anymore. In spite of the fact that, to the teachers' thinking, the pupils have higher level of competence in the field of ICT-technologies in comparison with them, the teachers have stopped treating this tutorial as something extrinsic, alien. Considerable part of the Biology teachers is fully interested and professionally demonstrates their achievements in the field of using ICT at lessons and outside regular hours, confidently formulates their requests. Overwhelming majority of the teachers realizes computer applicability in educational process. The question about attitude to the use of ICT in educational process is answered by 88% of the respondents positively and only 12% of them say that they have to use ICT during classes due to external circumstances, regulations and so on.

We have attempted to assess the change of standards of working of the Biology teacher, concerning the use of ICT at the lesson. We asked the pupils to assess the level of ICT-competence of the teacher, giving their teachers who use the information technologies at lesson the marks from -2 to 2. The mark turned out to be higher than average that may be indicative of change of understanding by the specialist teachers of educational potential of information-communication technologies and of obvious premises of change of standard of efficiency (Table 3).

Many teachers of Biology began to use ICT at the lessons and out-of-school activities more often, demonstrating thereby the change of attitude to the computer. At the same time, at lessons both the

Table 3: Assessment by the pupils of the level of ICT-competence of the teacher

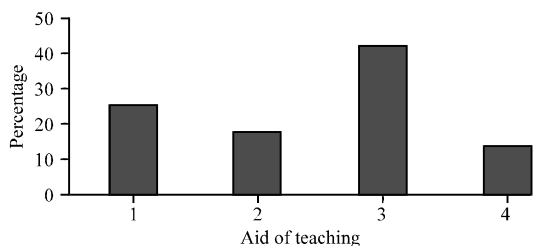| Assessment of the level of ICT-competence of the teacher	Respondents (%)
-1.6	0
-1.4	0
-1.2	0
1.0	18
1.2	32
1.4	24
1.6	26

Fig. 3: The use of electronic aids of teaching at the lesson by the teachers and the pupils; 1) electronic training aids are used at the lesson only by the teacher; 2) electronic training aids are used at the lesson more often by the teacher than by the pupils; 3) electronic training aids are used at the lesson by the teacher and by the pupil equally; 4) electronic training aids are used at the lesson more often by the pupils than by the teacher)

After the change of motivation of the Biology teacher when he began to treat the computer as a strong multifunctional training aid, the teaching methods have inevitably changed, new practices have appeared at the lesson and in the spare time, the working conditions of the teacher and the pupil have changed as well.

Alongside with the process of raising the activity of using ICT at the lessons by the teachers of Biology, it is impossible to unmark as noteworthy that a certain part of the teachers have "to stew in their own juice" with no necessary targeted methodological and partner support to give them from municipal and regional methodological services and colleagues of the subject. The educators need somewhat another system of further ICT training in form and content, new forms of extension courses on part time basis, the courses held on the basis of school.

CONCLUSION

Integration of ICT within classes requires from the Biology teachers of mastering of absolutely different approach to learning, namely, changes of the role of the teacher from the function of the lecturer to the practice of the developer as the educator is to develop digital materials for the lessons and to apply them during the lessons to use totally new methods of teaching and training on the basis of ICT. To study how to work out and develop educational environments based on ICT before using them in class, it needs much more time than it is given in traditional courses of advanced training and much more expert help. It is necessary to grant considerable time to the teachers to develop their ideas, skills and projects.

As it is difficult and perhaps, even uneffective to engage all the educators into the innovation process, it would be better to apply step-by-step strategy, first getting those involved who introduce the new and apply innovations. These are usually the tutors, who are ready to take the efforts of introducing innovation practice. The process of forming the society of the teachers-tutors includes the measures such as:

C Determination of the legal status of the teacher-tutor (for example to open up more possibilities for such activity as working out the classes, supporting the other teachers; to raise wages; to present personal advanced ICT ware and free access to the Internet and so on)
C Revelation of the teachers-tutors in the regional system of education
C Creation of support system for this society
C Elaboration of the initiatives on professional development with effort to attract the teachers-tutors
C Creation of virtual academic societies of the teachers-tutors of the appropriate ICT platform and Internet- methodologists
C Creation of societies of the teachers-tutors

To for the necessary abilities and skills it is reasonable to use such techniques of thinking as:

C Insight into problem
C Formulation of hypotheses
C Anticipation
C Determination of the main point
C Analysis, evaluation, interpretation and fixation of the ideas
C Flexibility in approaches
C Use of heuristics
C Understanding of uneasy relations
C Use of general models
C Transfer of methods of solution onto new situations

It should be selected the content and methods of teaching that further forming such personal qualities as:

C Independence
C Discipline
C Systematicness
C Intrinsic motivation
C Reflection
C Flexibility
C Vnitiativeness

The program of advancing the level of ICT-competence is needed to be built basing on the following didactic principles:

C Real context
C Realistic tasks
C Avoidance of routine tasks
C Constant control
C Logical division of the material into parts
C Integration of knowledge, abilities and skills
C Creative role of the teacher
C Collectivism
C Spirit of innovation (ICO, 2012)

The schools are necessary to determine institutional strategy which will identify the importance of the process of preparation by the teacher of disciplines. According to this strategy, it should be worked out the system of encouragement of those teachers who devise and adapt interesting teaching materials including in form of granting them time to devise the ideas. The educators engaged in the development of content must be provided with good technical equipment and free access to the internet. Any activity of the educators oriented to professional development in the field of content advance should be encouraged. The digital content must become a part of common totality of pedagogical societies of teachers' practices. The teachers-tutors are to take part in extension courses in order to master the methods of devising qualitative digital materials. The pedagogical societies of teachers' practices can be formed by means of courses of electronic training on the basis of virtual educational societies. In schools, the teachers can form producer groups for development, adaptation and assessment of digital content.

The use of ICT in school summons to team-work and the teachers with different level of training should work together, creating temporary or permanent teams, contributing their knowledge from different subject areas and personal qualities. Equality of interaction and collective nature contribute to greater extent, giving support to the teachers in accordance with new methods of education. According to new role to be played by the teachers they should contribute more time to project activity, therefore, it must be taken into account the balance of working time spent by the educator on the very lessons and preparation for the lessons (ICO, 2012). The results of the investigation of professional activity of a modern teacher in terms of self-rating of his ICT-competence enable to conclude that ICT-competence of the modern teacher of Biology is one of the most important indicators of efficiency of his activity and at the same time necessary precondition for further development of the level of his professional competence that defines the significance of engineering of the system of advanced training of the modern teacher oriented to the system use of ICT.

The models of further training to be proposed today enable to solve some tasks of raising the level of ICT-competence of the modern Biology teacher but possess a number of disadvantages and do not allow to solve the problems of active use of ICT by the teacher in his professional activity in full. It makes it possible to speak on the necessity of devising the model of further training of the teacher based on the idea of integration of the existing models and personalized requests of the modern teacher.

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