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USE OF CLOUD COMPUTING FOR DEVELOPMENT OF TEACHERS' INFORMATION AND COMMUNICATION COMPETENCE

The article deals with the problem for development of techers' information and communication competence and use of cloud computing for it. The analysis of the modern approaches to the use of cloud technologies and projects for professional development of teachers and development of teachers' information and communication competence have been presented.There are the main characteristics of software as a service on the Internet for education leading companies Google, Microsoft, IBM. There are described some actions of these companies, which are conducted to help teachers to master cloud technology for improving the professional activities and development of teachers' information and communication competence. The examples of ways of development of teachers' information and communication competence and training teachers to use modern ICT in the professional activity are given in the paper. The Cloud based model for development of teachers' information and communication competence has been proposed.

Keywords: *Cloud computing, cloud technology, professional development of teachers, teacher information and communication competence, software, software as a service.*

Introduction

It is a necessary process of adapting and implementing new information services based on competitive technologies with the rapid development of information and communication technology (ICT) and increased requirements to the quality of education.

Anthony Salcito, Vice President for Microsoft in the field of education, [1] determined the effects of unsystematic informatization of education on the «Education in the 21st Century" Microsoft Conference:

- need for additional investments in education;
- dependence of the efficiency and monitoring of education on quality and quantity of necessary tools, including ICT;
- inability to use the technologies applied in the educational process for teaching contemporary, up-to-date educational material.

He noted actuality of information technology-services (IT services) outsourcing in education.

The concept of "IT Outsourcing" is determined [1; 2] as company transfering any IT process (functions work) or its part to a third-party organization that provides professional IT services. This may be as followed: supporting the functioning of information systems, information security companies, storing and processing large data content, servicing hardware and others. First of all, the outsourcing solves the problem of reducing costs to implementation, maintenance and modernization of IT infrastructure. It is conditioned by [2]:

- convergence of information environment, that is the convergence of diverse electronic technologies as a result of their rapid development and interaction;
- need for joint working of professionals regardless of time and their location;
- increasing demands for IT services stability and availability.

So, the use of cloud technology in learning, particularly in the professional development of teachers, who are the main element for the educational system modernization, is becoming more significant.

The article aims at analyzing the modern approaches to the use of cloud technologies as services for professional development of teachers and development of teachers' information and communication competence.

The Ukrainian scientists like V. Yu. Bykov [2], M.I. Zhaldak, T. F. Koval, N.V.Morze, O.V. Ovcharuk, O.M. Spirin, E.S. Polat, M.L. Smulson et al. dedicated their works to problems of the formation of information and communication competence and training teachers to use Information and Communication Technology (ICT) in the teaching process.

Scientists Justin Reich, Thomas Daccord, Alan November [3], Virginia A. Scott [4], Alec M. Bodzin, Beth Shiner Klein, Starlin Weaver [5] and others investigated peculiarities of the cloud technology implementation in professional activities of teachers.

Problem Definition

In modern scientific discussions the concept of competence involves a complex content, which integrates professional, social, educational, psychological, legal, and other personal characteristics.

According to the research of International Board of Standards for Training, Performance and Instruction (IBSTPI) Representatives the concept of competence is defined as the ability for qualified performing a task or job, and includes a system of knowledge, skills and attitudes that enable a person to operate effectively in accordance with standards of a profession or a certain activity. [6].

In the framework of the Federal Department of Statistics of Sweden and the National Center for Education Statistics of the United States and Canada there was launched "Defenition and Selection of Competencies: Theoretical and Conceptual Foundations" (DeSeCo) program [7]. It defines the concept of competence as the ability to meet individual and social needs and fulfill the tasks successfully. According to DeSeCo experts, the internal structure of competence includes knowledge, cognitive and practical skills, attitudes, emotions, values and ethics, motivation.

Competence is defined as a special ability, which is necessary to perform a particular action in a particular domain, and which includes specific knowledge, skills, ways of thinking and sense of responsibility for the actions. The competence is the degree of involvement of a person in the activity in which knowledge is not characterized as a set of information, but as a mean to convert various situations.

Information and communication competency takes a special place in the international documents and conceptual strategies. The recommendations of the Parliament and of the Council of 18 December 2006 (Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962/EC)) highlighted eight key competences (Key Competences) for lifelong learning (Lifelong Learning [LLL]), among which are listed so-called "digital competence" [8]. This competence involves the confident and critical use of information society technologies for work, education, leisure and communication. In the framework of this competence, elements of information and communication competence, namely, the ability to search, collect and process information, its system and critical use, assess the relevance of information resources with certain options, the ability to use tools, including software and Internet services, for creating, presenting and understanding information.

Information and communication competence is the ability to use modern ICT for solutions of training and scientific issues, to handle different sources, the information, as well as the relevant knowledge and skills, the ability to apply them in practice.

According to studies information and communication competence is the result of a variety of abilities and has the following components:

a) skills and abilities:
– to obtain information from various sources clearly;
– to work with a variety of data;

  – evaluate information critically;
  – use ICT in professional activity;
  b) knowledge:
  – features of information flow in a certain field;
  – basic knowledge of ergonomics and information security;
  – specific skills to use computer technology;
  – persons' responsible attitude to use ICT.

In 2008, a group of experts from UNESCO identified the main approaches to the development of Information and communication competence of teachers in primary and secondary education (the development of technical literacy, knowledge deepening and creation of new knowledge) in the six areas (policy, program and evaluation, education, ICT, organization and administration, professional development) [8]. In 2011, this document was complemented by them. There was considered in detail and described 18 modules for three approaches of information and communication competence of teachers which are based on information and communication competence six aspects (understanding ICT in education, curriculum and assessment, pedagogy, ICT, organization and administration,teacher professional learning) [9].

Examples of Ways of development of teachers' information and communication competence

For the analysis of global development strategies of teachers' information and communication competence there were selected major projects that have an impact on the revitalization of the researchers in this field.

In 1995, the European Commission launched the Lifelong Learning Programme. In the framework of this program the following projects should be highlighted: "Socrates" and its sub-categories ("Comenius", "Grundtvig", "Minerva" and etc.), "Leonardo da Vinci" and ect.

In the framework of the "Socrates" (http://europa.eu.int/comm/education/socrates.html) addresses issues related to current discussions and developments in school policy. For example: the motivation of students to learn and active approach to learning, with special attention to the training of the development of key competences, digital educational content, inclusive education, etc.Subcategory "Socrates - Comenius" directly devoted to the development and support of joint activities of primary and secondary school levels. The main content is the networking between schools internationally, primarily in the form of various social activities and projects, the creation of equal opportunities for all. By focusing on the development of the information and communication competence as students and teachers in supporting lifelong learning.

Teacher professional learning is an important part of the "Socrates – Comenius" progect. A full list of courses can be found on the main server of Brussels (http://europa.eu.int/comm/education/socrates/comenius/), which is updated every year. Special attention is given to the ICT courses, which focus on the methodology of using computers in education.

In the framework of this project there was created an online community whose goals are: a) introducing participants before they meet in the courses; b) strengthening the leaders who will participate and lead the discussion, which will give an opportunity to correct the course content according to the level of participants readiness for ICT using in professional activities; c) discussion of technical issues, such as travel and accommodation, by the course participants.

The most course sessions are practical. The participants will learn how to use the various ICT tools, but also they have an opportunity to discuss how and in what situations a particular tool can be replaced by another one. All sessions are interactive, allowing participants to learn software and discuss its use with each other.

The "Leonardo da Vinci" programme aims at improving teacher skills, the development of innovation activity, experience exchange and development of key competencies (http://www.llp.eupa.org.mt/content.php?id=17). The particular attention should be paid to the problem of improving teacher professional competence, in particular information and communication competence.

This problem has been substantiated on the International UNESCO report "Teachers and Teaching in a Changing World" in 1998. There are analysed ways of using ICT in education; explained the necessary of certain changes in the organization of teaching and learning with ICT use, and ways of accessing to the information with ICT use in training. There were proposed ways for teachers training to use ICT, for example, special courses training in certain training centers or universities, their curricula, which are prepared by national or regional education institutions.

This practice has become actual in many countries.

The "ICT training of teachers" project of the UNESCO Institute for Information Technologies in Education is directly aimed at the development of teacher information and communication competence [9]. Its purpose is improving the practice of teachers training to raise the quality of education, which, in its turn, will influence on the information literacy of the population and, consequently, on the development of economic and social situation in the country. At the same time, the attention was paid not only to improving their knowledge of ICT in professional activity. The experts assign a special role to the pedagogical skills in the teaching process with ICT use for developing student information and communication competence.

Among the tasks of the UNESCO project there are as following:
  − to make the main actions plan for the development of various skills within the teacher information and communication competence;
  − to develop training materials that will be available at the global level;
  − to provide basic skills that will enable teachers to integrate ICT into their teaching activities;
  − to carry out the teacher professional enhancement to develop their information and communication competence;
  − to coordinate approaches, terminology, training models with the use of ICT.

There should be noted the Microsoft "Partners in Learning" project which resulted in a network of "Microsoft Ukraine" (http://www.microsoft.com/ukraine/education/partnersinlearning/education_network.mspx). This is a professional online resource for teachers of Ukraine. The educational network "Partners in Learning" is an online community for teachers, by which educators can learn more about the use of ICT to enhance learning. The online community provides an opportunity to share materials and ideas, participate in discussion forums and provides access to educational resources. The Microsoft "Partners in Learning" network unites teachers who use innovative approaches in teaching; it provides an opportunity for teachers to present publicly their innovative works and receive tips, comments and recommendations from colleagues or from all over Ukraine, to exchange ideas, news, and their experience in applying innovative tools in professional activities.

The significant contribution was made into the development experience for teacher information and communication competence in the system of teacher postgraduate education and teaching practice within the Intel "Teach to the Future" program. This program is used for teacher training by the institutes of postgraduate pedagogical education, in particular, University of Management Education at NAPS of Ukraine (http://www.umo.edu.ua), Borys Grinchenko Kyiv Institute of Postgraduate Pedagogical Education (http://ippo.org.ua/index.php?option=com_content&task=blogcategory&id=230&Itemid=266), Donetsk Regional Institute of Postgraduate Pedagogical Education (http://ippo.dn.ua/perelik-kursiv/CourseSearch), Kharkov Academy of Continuing Education (http://edu-post-diploma.kharkov.ua), Ternopil Regional Community Institute Postgraduate Pedagogical Education (http://www.ippo.edu.te.ua), Khmelnytsky Regional Institute of Postgraduate Pedagogical Education (http://hoippo.km.ua/intel_navchannja.html), Dnepropetrovsk Regional Institute of Postgraduate Pedagogical Education (http://doippo.dp.ua) and others.

The courses, having been offered within the Intel "Teach to the Future" and "Road to Success" programs, are built on a modular basis and run in the form of training. At the same time the model of "peer-to-peer", which is described by researchers T. Metcalf, E. Martinez, R. Gizzardi, G. Wagner [10]. It provides training on the training methods of knowledge and skills transmission

to their colleagues of the teachers, who have the basic knowledge and skills at a special forum or course for the leaders, where he received the tutor status.

Training teachers to use modern ICT in the professional activity

Modern information and communication systems are based on new technology that allows you to navigate quickly and spread information in various areas, particularly in the education system over the Internet.

The "cloud computing", as a modern ICT, should be given a special place.

The cloud computing (cloud technology) is defined as a dynamically scalable way to free access to external computing information resources in the form of services provided via the Internet [11].

For the first time the term was used in this context in 1997 on a lecture of Ramnath Chellappa. He defined it as a new computing paradigm, in which the boundaries of computing elements depend on feasibility, not only on the technical limitations [12].

The first cloudy technology was developed by the "Salesforce.com" company, which was founded in 1999. It provided access to its application via the website on the Software as a Service [SaaS] principle. The next step was the development of cloud web service by Amazon in 2002. This service made it possible to store information and make calculations. In 2006, Amazon offered a service called Elastic Compute cloud (EC2) as a Web service that enabled its users to run their own programs. In the same year, Google began implementing SaaS service called «Google Apps» and platform as a service (Platform as a Service [PaaS]) called «Google App Engine». [12] Microsoft made its first presentation PaaS called «Azure Services Platform» on Professional Developer's Conferens in 2008. It became essential in the development of cloud technology [13].

Currently, these technologies are becoming increasingly important in professional activity of schools teachers.

It is mainly explained by new possibilities for representing dynamic and relevant electronic applications for education, which are based on Internet technology. [2 – 5]

Major companies namely, Google, Microsoft, IBM, which are involved in the development of this product, try to improve cloud technologies for their implementation into the teaching process at school. [12]

The company TechExpert (http://www.microsoft.com/mof) offers integration of services Microsoft Office 365, formerly known as «Microsoft Live @ edu», in the information structure of the teaching process at school. The cloud technology Microsoft Office 365 is a free solution for email, cooperation and teamwork of training participants. [3, 14]

This solves the following problems:
– organization of e-mail address within the institution, accessible to any browser, mobile phone, or mail client that uses standard Exchange, Imap, POP3;
– organization of online scheduling lessons, which is available directly from the mail;
– organization personal and shared file storage;
– creation space for working relationship and so on.

The TechExpert company offers the following services:
– analysis of existing IT infrastructure;
– creating or establishing IT infrastructure to meet the challenges of the educational process;
– configuring mail services;
– setting access levels;
– accounts database migration from the existing system to the new system and the development of automatic account creation;
– training of users and administrators;
– instructions for a user;
– recommendations for more effective work with Microsoft Office 365 services.

Microsoft Office 365 functionality [14]:
– E-mail Live Outlook – usual interface Microsoft Outlook is available in any browser, provides 10 GB of space to store messages and the maximum attachment size 10 MB;

- File repository SkyDrive – 25 GB of storage space of any files up to 100 MB, with the ability to set access level to each folder;
- Office Live – possibilities of Word, Excel, PowerPoint and OneNote in the user's browser, without installing software on the PC and buying licenses;
- Windows Live (Figure 1) – the workspace for teamwork, 5 GB for shared files storage, the ability to teamwork on documents and the general calendar.
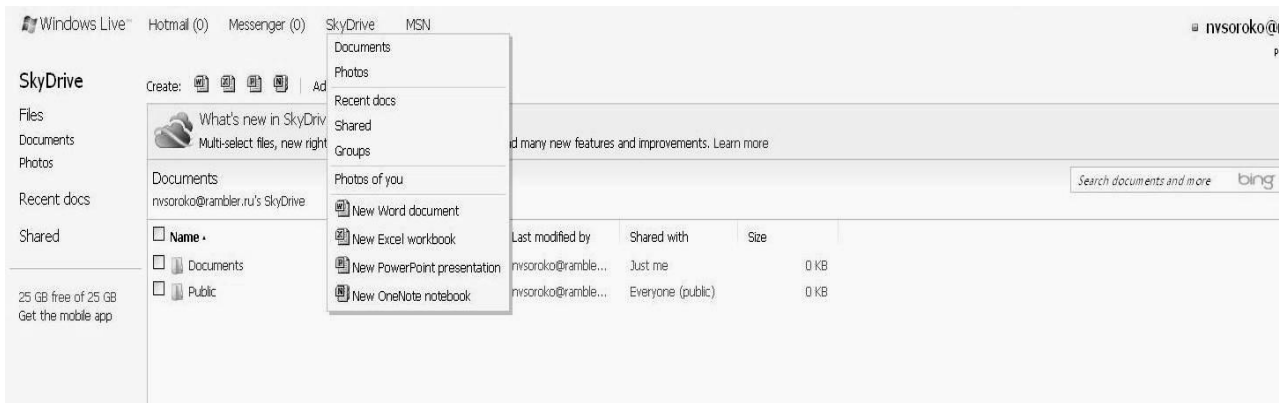

Figure 1. Workspace Windows Live

Microsoft Partners established educational community "Growing Learning Communities". It is the global network (http://www.pil-network.com), which already serves more than two million teachers and school admistrators around the world. The mission of the community is to help teachers to succeed by uniting them in professional development societies.

IBM Corporation (http://www.ibm.com/solutions/education/cloudacademy/us/en) also made the announcement of cloud services for Education (IBM SmartCloud for Education), through which students, pupils, teachers and researchers can gain access to modern information resources and computing laboratories services without involving relevant experts. Thus, schools were able to compensate the lack of IT resources for training, research and professional development.

In addition, according to IBM Corporation (IBM), by using the services of IBM SmartCloud for Education, schools and universities can solve problems related to the control of studenteducational achievements and funding grants.

With the new SPSS-models and tools schools can analyze their data for early detection of the students belonging to risk groups. Additional cloud computing tools of the social network simplify search for finances and staff for research projects. As one of the examples of the IBM cloud technology implementation in education we can note project for the Spanish Foundation Fundacion German Sanchez Ruiperez, which was launched in 2010. Its mission is to support the education and culture of the population [15]. By using IBM cloud technology there was planned to provide students access to the courses from any device via the Internet.

IBM Smart Business Desktop Cloud service was used by the pupils aged 7 to 13 years from Fundacion German Sanchez Ruiperez within their summer programs. They got an access to training materials, including tools to support their courses and create their own contents, the oppotunity to communicate with students in other schools using social networks, online communities and Web- and videoconferencing. Through this project, teachers were able to fully concentrate on the content of training programs, rather than solving IT problems. Since the 1980s IBM [8] has actively been engaged in the development of special courses for the improvement of teacher information and communication competence. The objectives were, firstly, their professional development and, secondly, the integration of new information technology, such as cloud technology, in education.

On site IBM (http://www.ibm.com/us/en) in "Training" there are conducted distance learning courses for users including teachers.

The courses are as following:
- development of metadata (Cognos);

    – the technical principles of virtualization etc. IBM (IBM Systems);
    – administration and use of the IBM FileNet P8 platform (Industry solutions);
    – configuration and administration of DB2: Linux, Unix, Windows products (Information Management);
    – work with the IBM Lotus product (Lotus);
    – rational use of software tools (Rational Software);
    – administration (Tivoli);
    – Web sites creation (WebSphere).

Thus, free courses for teachers are conducted only within certain projects, such as the Spanish Foundation Fundacion German Sanchez Ruiperez project [15].

In 2009 IBM Cloud Academy (http://www.ibm.com/solutions/education/ cloudacademy/us/en) opened a forum for the exchange of best practices to accelerate the successful implementation of the cloud computing model, which has to significantly improve teaching and learning, management and research at the university level.

The members of this Academy are working together guided by the objectives:
    – to ensure the sharing of best practices for accelerate the successful implementation of cloud computing models that enhance the training quality;
    – to provide free access to the up-to-date IBM cloud computing technology for organizations of Academy members;
    – to establish links and development of repositories, applications, tools, and resources for cloud computing to improve the skills of participants;
    – to foster pilot projects and programs as a result of cooperation between Academy members to evaluate the cloud computing technical, financial and quality characteristics;
    – to extend ideas of using cloud computing through reports, official documents, presentations, and other scientific and technical communications.

We should note the following functionalities of Google's core products, which are widely used in the trainig process at school [8; 14]:
    – creating web sites – Google Sites;
    – keeping a calendar, a schedule, making curricula, etc. – Google Calendar;
    – creating documents in various formats Google Docs;
    – compliant editing documents in various formats Google Cloud Connect;
    – E-mail with a search engine and spam protection Google mail (Gmail);
    – creating 3D-models SketchUp;
    – keeping diaries teaching projects Blogger;
    – creating photo albums, editing photos, compliant work with other graphic files editing programs Picasa;
    – monitoring traffic on a web site and the effectiveness of various marketing activities Google Analytics;
    – automatic translating web pages from different languages Google translate.

On the Google Apps Education Training Center site there are conducted training webinars and courses for teachers, which purpose is to show the feasibility of using cloud technology in the teaching process at school (http://edutraining.googleapps.com/Training-Home). The courses also provide theoretical and practical knowledge, examples from the experience of teachers of different subjects who used the company's products in a professional practice.

We have classified the IBM, Microsoft, Google products according to their using in the teaching process (Table 1), regarding their functionality analysis.

Table 1.

The classification of some cloud computing products, according to their use in the teaching process

Products companies			Functions	Using in the teaching process
IBM	Microsoft	Google		
1	2	3	4	5
WebSphere, FileNet Content Services	SharePoint Online	Google Docs	Transferring to the Internet applications that are run on the PC; access to the package applications for the high computing	Opportunity to work with files in different formats for visual curricular materials
WebSphere, FileNet Content Services	SharePoint Online, Lync Online (Lync Client)	Google Cloud Connect, Google Drawings	Compliant access of several users to editing documents in different formats	Collaboration work of students and teachers on laboratory works, projects, etc.
WebSphere, InfoSphere Warehouse, LotusLive Connections	Lync Online, Exchange Online	Google Wave, Google Groups, Gmail	Communication	Web conferences and webinars, audio and video maintenance
WebSphere, InfoSphere Warehouse, LotusLive Connections	SharePoint Online, Lync Online (Lync Client), Exchange Online	Google Wave, Google Groups, Gmail, Google Sites, Blogger	Support of mechanism for the exchange of messages between users	Communication support in distance courses, counseling
Cognos Connection	Systems Management Server, Hyper-V (Viridian)	Google Code	Support for control systems of cloud computing products versions, tools, project management and error tracking	Free access to information resources within a particular group of training participants

1	2	3	4	5
InfoSphere Warehouse	Systems Management Server, Hyper-V	SketchUp	Interactive modeling tools	Creation and implementation of object-oriented research laboratories; the creation of curricula, programs, and resources to support training courses
WebSphere, InfoSphere Warehouse	SQL Server, Lync Online, Exchange Online	Google Wave, Google Groups, Gmail, Google Sites, Blogger	Social network for users	Creating distance learning courses
WebSphere, InfoSphere Warehouse	SQL Azure, SQL Server	Google Wave, Google Groups	Creation and integration on the basis of computing infrastructure services of different levels	Creation and implementation of object-oriented scientific research laboratories
Tivoli Netcool/OMNIbus, Tivoli Live Monitoring Services	System Center Server Management Suites, System Center Client Management Suite System Center Essentials Plus	Google Analytics	Monitoring of traffic on a web site and marketing effectiveness	Control of the visits of certain sites, sections of distance learning courses by course participants, etc.

Cloud based model for development of teachers' information and communication competence

The analysis of experiences of teachers' training and use of cloud computing in education can highlight common approaches and principles that needed to build models for teachers' training:

- Student-centered approach to the training process;
- Differentiated approach;
- Activity, initiativeness and motivation of the development of teacher-participant of the studying process;
- Compilation and dissemination of advanced teaching experience;
- Including teachers in research activity;
- Continuity of training;
- Using experience of teachers-innovators.

Taking into account the above mentioned ideas, it is necessary to distinguish the basic requirements for creating cloud based model for development of teachers' information and communication competence:

1. The central position in the construction of the model belongs to those who study, that is a teacher who wants to attend courses to develop information and communication

competence. There is also taken into account the employment of participants of training process, their teaching interests and involvment in learning ICT.

2. Interaction between teachers (tutors) and course students is based on consulting according to a subject-subject relations principle.

3. Focusing on achieving a high level of the distinguished model components of information and communication competence, they are: value-motivational, cognitive, activity-reflective, adaptive and creative.

4. A generalization of the creative experience of participants of training process and exchange of this experience, constant feedback occur during professional development.

5. Training should be continuing, that is, except for those courses that are offered for teachers in advanced training system; there should be organized seminars, conferences, master-classes and so on for supporting lifelong learning.

6. Providing various forms of education, including distance learning

Cloud based model for development of teachers' information and communication competence should include (figur 2):

− Professional activity that involves ICT using;
− Supporting the development of professional skills of teachers;
− Pedagogical conditions of IC competence of teachers;
− Content of advanced training aimed at learning modern methods of processing information and data by means of ICT and their appropriate use in professional work of teachers;
− Intellectualization of training activities;
− Preparation to use ICT to solve pressing problems in a specific educational institution;
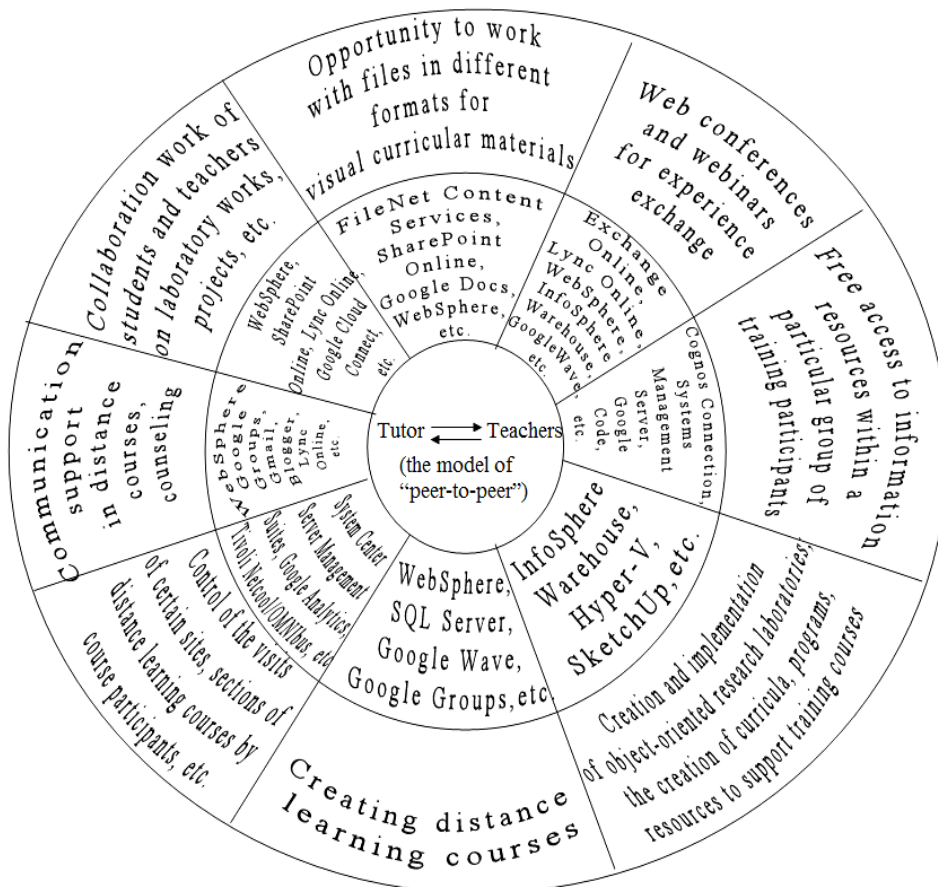− Properly selected cloud computing tools in conformity with training purposes.

Figure 2. Cloud based model for development of teachers' information and communication competence.

In our opinion, the formation of Cloud based model for development of teaches'r information and communication competence implies determining the main

purpose of creating methodological subsystem for building a computer-based environment,fundamental objectives and principles for teachers' training, the baseline content of the developed special courses and basic training activities to provide teachers' information and communication competence development.

Conclusion

1. The relevance of teacher information and communication competence is determined by: the changing conditions and requirements imposed both on the educational institution level and the level of international organizations, the need for supporting the proper lifelong teacher professional level, his/her professional competence, improving teaching practice for teachers to raise the education quality.

2. The international organizations and programs in the framework of the United Nations, UNESCO, the Council of Europe and other international organizations play the main role in the development of modern strategies of teacher information and communication competence improvment. The problem of teacher information and communication competence concerns the participation of teachers in the use of forms and tools of computer-oriented environment, which can be both open and closed (to exist within the school).

3. The main strategies of teacher information and communication competence development:
- conducting distance education courses;
- teacher motivation to participate in various training projects;
- conducting seminars, webinars, conferences with teachers of different disciplines on the use of ICT in the professional pedagogical activity;
- holding workshops on the use of ICT in the professional activity of teachers of different disciplines;
- conducting specialized courses in teachers postgraduate education;
- creating online teachers communities;
- organizing of forums and consultations on the Internet on the use of ICT in teaching various disciplines;
- developing digital libraries;
- initiation of teachers to research and projects.

4. Cloud computing is an important system through which certain educational environment for training teachers and developing their professionalism is created.

Distance learning as learning in the cloud is becoming actual.

The cloud technologies functionality significantly expands the options of distance learning courses (for example, using the service Google Groups), analysts systems (for example, using Google Analytics), monitoring the quality of education (for example, using Google Doc), etc.

Using SaaS, IaaS, PaaS solutions will raise school IT services to a new quality level.

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ИСПОЛЬЗОВАНИЕ ОБЛАЧНЫХ ВЫЧИСЛЕНИЙ ДЛЯ РАЗВИТИЯ ИНФОРМАЦИОННО-КОММУНИКАЦИОННЫЕ КОМПЕТЕНТНОСТИ УЧИТЕЛЕЙ

Статья посвящена проблеме развития информационно-коммуникационной компетентности учителей посредством использования облачных вычислений. Осуществляется анализ современных подходов к использованию облачных технологий и проектов для профессионального развития учителей и развития информационно-коммуникационной компетентности учителей. Предлагаются основные характеристики облачных вычислений ведущих компаний Google, Microsoft, IBM, с точки зрения их необходимости для осуществления учебного процесса в сети Интернет. Описываются действия этих компаний и другие учебные проекты, целью которых является развитие информационно-коммуникационной компетентности учителей посредством облачных вычислений. Приводятся примеры путей решения проблемы развития информационно-коммуникационной компетентности учителей посредством использования современных информационно-коммуникационных технологий. Предлагается модель развития информационно-коммуникационной компетентности учителей на базе облачных вычислений, при этом выделяются основные требования и элементы этой модели.

Ключевые слова: облачные вычисления, облачные технологии, повышение квалификации учителей, информационные и коммуникационные компетенция, программное обеспечение, программное обеспечение как услуга.

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ВИКОРИСТАННЯ ХМАРНИХ ОБЧИСЛЕНЬ ДЛЯ РОЗВИТКУ ІНФОРМАЦІЙНО-КОМУНІКАЦІЙНОЇ КОМПЕТЕНТНОСТІ ВЧИТЕЛІВ

Стаття присвячена проблемі розвитку інформаційно-комунікаційної компетентності вчителів за допомогою використання хмарних обчислень. Здійснюється аналіз сучасних підходів до використання хмарних технологій та проектів для професійного розвитку

вчителів та розвитку інформаційно-комунікаційної компетентності вчителів. Пропонуються основні характеристики хмарних обчислень провідних компаній Google, Microsoft, IBM, з точки зори їх необхідності для здійснення навчального процесу в мережі Інтернет. Описуються дії цих компаній та інші навчальні проекти, метою яких є розвиток інформаційно-комунікаційної компетентності вчителів за допомогою хмарних обчислень. Наводяться приклади шляхів рішення проблеми розвитку інформаційно-комунікаційної компетентності вчителів за допомогою використання сучасних інформаційно-комунікаційних технологій. Запропонована модель розвитку інформаційно-комунікаційної компетентності вчителів на базі хмарних обчислень, виділені основні вимоги та елементи цієї моделі.

Ключові слова: хмарні обчислення, хмарні технології, підвищення кваліфікації вчителів, інформаційні та комунікаційні компетенція, програмне забезпечення, програмне забезпечення як послуга.