

Theoretical and methodical aspects of the organization of students' independent study activities together with the use of ICT and tools

Olena O. Lavrentieva¹[0000-0002-0609-5894], Lina M. Rybalko²[0000-9442-6092-0001],
Oleh O. Tsys¹[0000-0003-1496-1331] and Aleksandr D. Uchitel³[0000-0002-9969-0149]

¹ Kryvyi Rih State Pedagogical University, 54, Gagarin Ave., Kryvyi Rih, 50086, Ukraine

² Poltava National Technical Yuri Kondratyuk University,
24, Pershotravnevyi Ave., Poltava, 69121, Ukraine

³ Kryvyi Rih Metallurgical Institute of the National Metallurgical Academy of Ukraine,
5, Stepana Tilhy Str., Kryvyi Rih, 50006, Ukraine
helav68@gmail.com, lina-rybalko@ukr.net, o.d.uchitel@i.ua

Abstract. In the article the possibilities and classification of ICTs and tools that can be used in organizing students' independent study activities of higher education institutions has been explored.

It is determined the students' independent study activities is individual, group, collective activity and is implemented within the process of education under the condition of no pedagogy's direct involvement. It complies with the requirements of the curriculum and syllabus and is aimed at students' acquisition of some social experiences in line with the learning objectives of vocational training.

The analysis of the latest information and technological approaches to the organization of students' independent study activities made it possible to determine the means of realization of the leading forms of organization for this activity (independent and research work, lectures, consultations and non-formal education), to characterize and classify the ICTs and tools that support presentation of teaching materials, electronic communication, mastering of learning material, monitoring of students' learning and cognitive activity, such as ones that serve for the sake of development and support of automated training courses, systems of remote virtual education with elements of artificial intelligence, which implement the principle of adaptive management of learning and the organization of students' independent study activities.

The paper provides the insight into the essence of the conducted investigation on the assesses of the effectiveness of ICTs and tools in the process of organizing students' independent study activities.

Keywords: students' independent study activity, process of activity's organization, ICT, ICTs and tools.

1 Introduction

1.1 Statement of the problem

The globalization and informatization processes are widely recognized to have led to a steady increase in the volume of information, have significantly raised the intensity and power of information flows, have highlighted the problem of content, volume, logic, means and ways of organizing the mastering of knowledge and experience of humans in the higher education institutions. The problem of organizing the students' independent study activities has become a matter of importance and significance in the conditions of changes in educational paradigms from the concept of knowledge-oriented education "for life" to education through life, that is, continuous education, that is mainly carried out on the basis of person's self-initiative and activism.

Obviously, the nominal increase in the volume of students' independent work without introducing changes in the structure and content of the educational process has resulted in most cases in a decrease in cognitive motivation among students, impedes the development of important personality traits and characteristics, impacts on the specialists' competitiveness and their professional mobility, doesn't ensure appropriate evolution of students' abilities in learning throughout their life and doesn't allow them to master new technologies. In terms of information society researchers are seeing new wide perspectives in the active introduction of modern information and communication and network technologies, computer based technology, tools of transfer and exchange of information. At the same time the development and mass application of ICTs is seem to have caused significant changes in the informational and educational spheres of a higher education institution.

Therefore, the introduction of a new structure, the latest ICT tools into the administration and self-management of the students' independent study activities requires investigation and research.

1.2 Analysis of recent research and publications

By the thorough researches of the scientists in the past and present days (Anatolii M. Aleksiuk [1], Ivan M. Bendera [3], Volodymyr I. Bondar [6], Volodymyr K. Buriak [51], Oleksandr H. Kolgatin [20], Vitalii A. Kozakov [22], Oleksandr V. Malykhin [28], Aleksandr G. Molibog [33], Pavel I. Pidkasisty [38], Serhii V. Sharov [43], Mykola M. Soldatenko [46], Nataliia P. Volkova [36], Viktor I. Yevdokymov [40], etc.) it was found that the independent study activities are not only a continuation of the student's study work, but it is also conditioned and is means of forming the personality traits that are especially valuable for specialist-and-experts in their personal and professional self-improvement such as e.g. self-organization, self-actualization, self-identification, self-evaluation, self-control, self-reflection, etc. [3; 28].

Evidently, in the context of reforming the system of higher education in Ukraine, due to the need to bring it in line with the best world standards the problem of effective designing and organization of independent study activities is acquired of particular

significance. The documents of the Bologna process, international research projects as well as the adoption of the “National Qualifications Framework” (2011), the Laws of Ukraine “On Higher Education” (2014) and “On Education” (2017), etc. have become a powerful foundation for the conceptual changes in national educational system. It caused the revision of the traditionally formed basis of students’ study activities in the direction of increasing their personal and competent orientation, activity and independence in the choice of goals and priorities, orientation towards the construction of individual educational trajectories [5; 12; 13; 16; 39].

According to Yuriy O. Zhuk, the mass ICT implementation in the educational process has required the development of special tools, which, according to the pedagogical situation, offer a certain set of options and means that extend the spectrum and enrich the students’ study activity [59, p. 40].

Over and above, and also more extensive opportunities for academic mobility of teachers and students, the increasing role and importance of non-formal, distance and dual education [48], have led to the development of qualitatively new educational standards and programs as well as integrated and hybrid academic disciplines, which cannot be high-quality learnt without use of the modern ICT (Aleksandr A. Andreev [2], Valerii Yu. Bykov [9], Roman S. Hurevych [19], Maiia Yu. Kademiia [19], Petrus A. M. Kommers [21], Mykhailo M. Koziar [19], Volodymyr M. Kukhareenko [23], Olekasndr V. Merzlykin [30], Natalia V. Morze [21], Serhiy O. Semerikov [42], Eugenia M. Smyrnova-Trybulska [21], Yuriy V. Tryus [51], Ivan M. Tsidylo [8] and etc. [8]).

It should be noted, nowadays in higher education institutions the gradual abandonment takes place to the widespread use of traditional non-electronic study technologies whereas the ICTs continuous implementation in all forms and types of students’ independent study activities. However, a significant amount of information resources that has developed and is used by lecturers is usually applied unsystematically, and this fact does not contribute to the proper performance of vocational training’s tasks.

1.3 The purpose of the article

The purpose of the article is to explore the possibilities and classification of ICTs and tools, as well as to analyze the degree of productivity of their application in organizing students' independent study activities in higher education institutions.

2 The theoretical backgrounds

Due to the results of the analysis of the primary sources, it has been established the *independent study activity* is such activity, which is a logical continuation of study work, it embodies the educational and cognitive minimum ensuring the autonomously mastery of students by determined level of professional competences. In line with its content, it is individual, group, collective activity and is implemented within the process of education under the condition of no lecturer’s direct involvement. It complies with

the requirements of the curriculum and syllabus and are aimed at students' acquisition of some societal practices in accordance with the learning objectives of vocational training (Anatolii M. Aleksiuk [1], Ivan M. Bendera [3], Nataliia I. Boiko [4], Volodymyr I. Bondar [6], Volodymyr K. Buriak [51], Vitalii A. Kozakov [22], Serhii M. Kustovskiy [24], Anatolii I. Kuzminskiy [25], Oleksandr V. Malykhin [28], Aleksandr G. Molibog [33], Pavel I. Pidkastyi [38], Iia M. Shymko [44], Mykola M. Soldatenko [46], Oleh O. Tsys [52], Svitlana H. Zaskalieta [58], etc.).

By virtue of the content analysis of initial categories, such as "information technologies", "computer based technologies", "communication technologies", as well as existing numerous researches, in the context of the investigated problem of organizing students' independent study activities we consider the *ICTs* as a systematic range of techniques and forms of knowledge acquisition and ways of learning on the basis of lecturer-student and ICT tools interaction aimed at the achievement of expected accomplishments of the educational process (Svitlana M. Hryshchenko [34], Yevhenii O. Modlo [31], Yuri L. Novikov [50], Polina A. Novikova [50], Ivan O. Petrytsyn [37], Tatiana V. Rudenko [41], Andrii M. Striuk [29], Valentyn M. Tomashevskiy [50], Ivan M. Tsydylo [8], Serhii M. Yashanov [56], Elena V. Zakharova [57], etc.).

The conducted our own research of the content and essence of organization of students' independent study activities with the use of ICT has made it possible to identify and characterize the *leading forms of its organization*: independent and research work, lectures (electronic, multimedia, video, audio ones), consultations (synchronous, asynchronous, delayed, remote, network, local, online, offline ones) and non-formal learning (electronic, user, distance learning courses) [52].

The essence of ICTs is represented as a system which includes: technical, methodological, substantive environment and software and hardware which accompany and support different aspects of the organization of students' independent study activities via appropriate ICT and tools (see Fig. 1).

Useful ICTs in the organization of students' independent study activities are multimedia, interactive, hypertext, cloud computing, telecommunication, Internet technologies, SMART technologies, web technologies, as well as technologies of virtual information space and automated library-and-information systems [52].

3 Findings

Nowadays there are many software products, widely available open author's apps, cloud and local services that offer a variety of ICT and tools. They can be embedded in existing forms and what's more caused perfect methods of students' self-learning without any significant additional time expenditures. In our study, we consider ICT and tools in the scope of minimal, desirable and predictive ones. First of all, the basic ICT and tools include the software and hardware part of multimedia. There are PC, the input, output and communication devices, the devices of storage and transmission of large amounts of information and their software, and over and above the tools of mobile ICT. Additionally, we take into account such ICT and tools that enable the recognition and synthesis of human speech together with multilingual support.

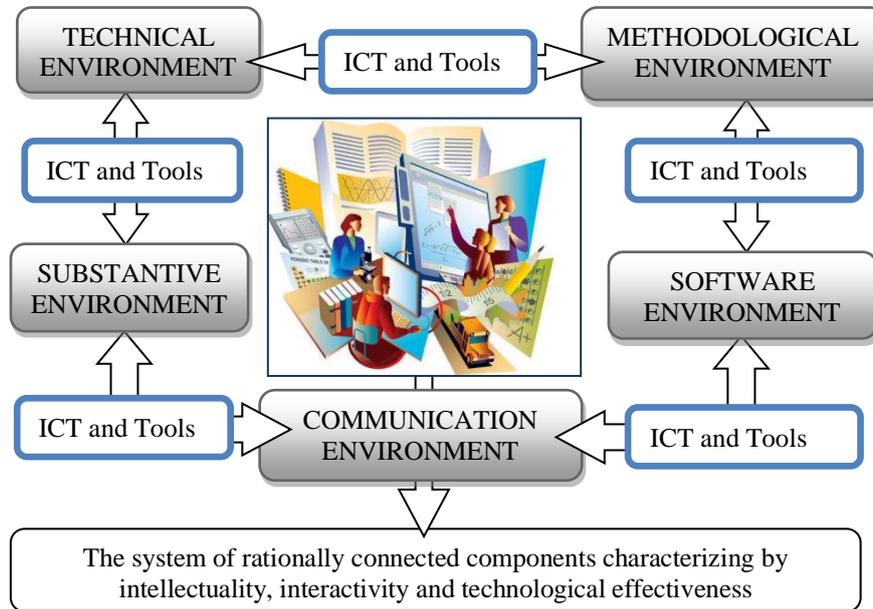


Fig. 1. Contents of information and communication technologies

Consideration the specifics students' independent study activities in institutions of higher education, we present the ICT and tools' classification (see Fig. 2).

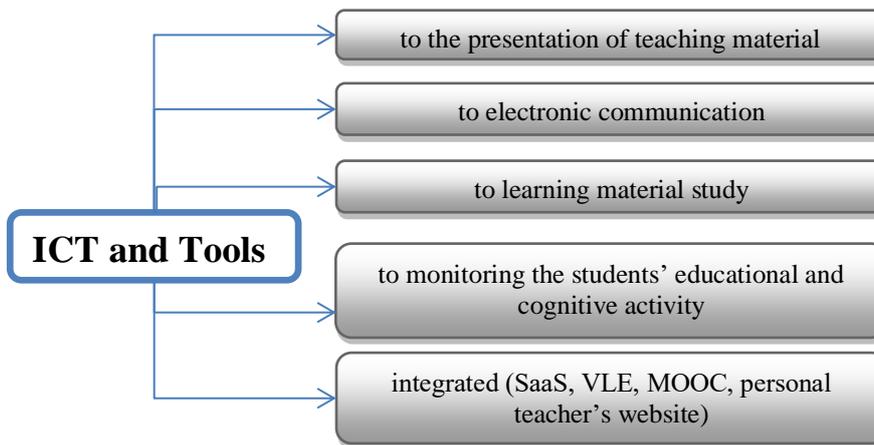


Fig. 2. The classification the ICTs and tools for organizing students' independent study activities

Offer you to consider further each group of ICT and tools in more detail.

3.1 ICT and tools for the presentation of teaching material

The all existing diversity of software and hardware tools for creating and presenting certain educational content and general methodological support that students could use in their own autonomous learning may be united in *ICT and tools for the presentation of teaching material*.

As just before computer occurrence and its widespread distribution now lecturer both creates a methodological support for leaning the discipline or its separate sections and develops educational content. With the use of ICT this process slowly but surely gets more automation and flexibility. The author's software products, prepared by the lecturer, are the result of processing a certain technology with using office packages, text and graphic editors, automated design tools. In fact, today the lecturer's relevant information competence is not only desirable, but is considered as demands of the times [55]. At the same time, the most trained in this regard, scientific-and-pedagogical personnel represents their educational and methodological text-books in the form of electronic lectures, study presentations, electronic teaching aids, they place educational information on the pages of personal websites and use thematic blogs of social networks.

To prepare the multimedia presentation today, the Microsoft PowerPoint product could be used, as well as applications for creating animated video presentations in the format of "hand drawn" (Algodo, Sparcol VideoScribe, and PowToon), cloud services GoAnimate, Prezi, Google Slides, Zoho Show, Haiku Deck, Visme and many others that allow not only to make presentations but also receive real-time help to improve them [47].

It is generally accepted that a learning book remains the most important source of knowledge. Theoretically, an e-book can be prepared using a text editor and, by means of hypertext technology, it can be structured for the benefit of quick navigation on it. At the same time, modern ICT and tools enable the creation of full-time didactic means for students' self-learning activities. There are both the simple HTML documents (HTML Help Workshop, HTML Help ActiveX control, HTML Help Viewer, Microsoft HTML Help Image Editor, HTML Help Java applet, HTML Help compiler, HelpMaker) and full-fledged textbooks in such formats as html, chm, pdf and exe that support speech, animation, video and simulation (SunRav BookOffice, eBooksWriter LITE, Help & Manual, Sophie, ExeBook, Maestro STANDARD, HTML Book Maker, Document X), as well as other leaning materials, trainings, courses, demonstrations, help manuals (Adobe Captivate), etc. [2].

With the object of teaching materials' granting there are the repositories for data sharing and knowledge sharing, the educational resources, the electronic libraries, the file sharing networks (Usenet, Citrix), the knowledge bases, the distributed knowledge bases, the cloud storages (Dropbox, Google Drive, 4shared, Amazon S3, CloudMe, etc.) on the Internet [42].

The stream multimedia is far and away a great opportunity for students to organize their independent study activities by themselves. It means the information in a

multimedia format that is continuously received by the user from the provider which offering streaming broadcasts (Internet radio, Internet-TV, video collections, educational programs, etc.) [42].

Significant advantages for the organization of student's independent study activities are next:

- thematic channels of YouTube, where there are collections of video tutorials, presentations, educational videos, multimedia lectures, created directly by teachers and individual training centers (<https://www.youtube.com>);
- TED (Technology Entertainment Design) presentations, they are lectures collection on topics of science, art, design, politics, culture, business, global issues, technology and entertainment industry (<https://www.ted.com>);
- the Khan Academy, it is open online platform featuring short video tutorials (5-15 minutes) on various subjects as well as tests helping visitors to measure the level consciousness of leaning information (<https://www.khanacademy.org>);
- Wolfram|Alpha, it is knowledge base, a set of computational knowledge engine and a question-based system, containing, in particular, the necessary information for the mastery of engineering, technical, technological, computer knowledge (<http://www.wolframalpha.com>);
- the services of corporate social networks (Podio, Yammer, Chatter, SocialCast, Bitrix24) that allow users to centrally store all working materials in one place, attach files and add comments;
- the services and tools for creating thematic websites for the demands of teachers and students (WordPress, Ucoz, Strikingly, Imcreator, etc.). They can build a site using a template set and in any case, they don't need web programming knowledge.

3.2 ICT and tools for electronic communication

The next step in organizing students' independent study activities is to establish feedback, planning and carrying out consultations. This process can be provided by *tools of electronic communication*.

The leading direction of consulting is the use of electronic network communicators and IP-telephony. The actual state of the development of network technologies allows to apply the free features of Skype, Viber, WhatsApp, Google Talk, Facebook Messenger, iMessages for the organization of study work both individually and in chat, as well as thanks to email and cellular communication.

Webinars, web-forums, web-conferences, teleconferences, which are implemented in both synchronous and asynchronous regimes, are effective means of communication organization; in particular within the framework of students' research work. It enables students to organize the communication on a specific topic of their interest in a convenient time. Such platforms as BigBlueButton, V-Class, GoToMeeting, iMind, WebEx [23] can be used for technical support of web-conferences.

It should be taken into account that the virtual boards (Padlet) are fairly well-approved in organizing students' independent study activities. These are web sites allowing to communicate with other students via text messages, photos, links, etc., that

placed on such a virtual message board. This tool enables to set up equal access for multiple users who can view and add their materials.

What's more with the development of the Internet technologies, feedback and counseling in the system of students' independent study activities can be provided in thematic groups of social networks namely Facebook, Twitter, Instagram, etc.

3.3 ICT and tools for learning material study

It is well known ICTs provide exceptional opportunities for autonomous student learning. This quality is supported by *ICT and tools for learning material study*.

It should be noted the hardware and software capabilities of ICT can effectively organize independent carry out by students of multilevel educational tasks in virtual (digital) laboratories in a number of academic subjects, both technical and humanitarian [51].

In fact, the virtual lab has a complete set of properties typical of the traditional organization of scientific research. Its application in the learning process allows to expand the range of solved tasks, helps students to create mathematical models of devices, to test different modes of their work, to explore a wide range of phenomena and processes, to carry out an instrumental diagnostics and detailed analysis of the results with together using computer software – electronic calculators, graphs, summary tables, diagrams, models and others. In this case, the advantage of virtual laboratories is the possibility of independent and remote conducting of researches with significant saving of material equipment and training means, observance of the requirements of protection and occupational health [35].

Among the virtual labs, one can identify those that function on the basis of software emulators reproducing software or hardware, or a combination of the work of other programs or devices, and simulation programs simulating the state of the modeled system for executing the original machine code [37].

It is supposed the examples of ICT and tools for the creation of virtual research and teaching laboratories are STAR (Software Tools for Academics and Researchers), VirtualLab, Algodoo, PhET, Wolfram Demonstrations Project, there are also many cloud services that enable users to directly conduct both virtual laboratory researches and to process mathematical statistics with applying their results (MATLAB, Statistics). It should be noted that these tools let to development and functionate full-fledged pedagogical software means for the methodological provision of students' independent study activities [35].

An important place in the system of training specialists in technical area is engineering, design and technological activities. Their formation covers the assimilation and application of modern automatic designing systems, and not only during the study of certain academic subjects, but also in terms of supporting coursework and qualification design (drawing, sketching, animation of processes, preparation of sketches) [18].

CAD system is a program for designing and issuance of working project documentation allowing to study project ideas and visualize concepts through photorealistic visualization, as well as to model the behavior of products in real-world

conditions [31]. There are the most commonly used CAD tools – AutoCAD, NanoCAD, Compass 3D, FreeCAD, T-FLEX CAD, SolidWorks, Simulink, on top of the animation programs – Maya, 3ds Max, Corel Draw, CorelCAD, University MD Motion Bundle, etc.

The students' supervision from the direction of lecturers can be provided through a project management system. The service enables the reproduction of a complete design cycle: objectives and results trees, project life structure phases, organizational structure of the project, matrix of distribution of responsibility and allocation of works between the performers (if the project is collective), network model of the sequence of project execution, resource tree, cost tree, description of project risks, etc. Among the ICT and tools supporting project management are Microsoft Project, Casual, Bullet Journal, Evernote, Trello, SCIM.ru and others [54].

Implementation of learning projects, conducting research in the network is being supported by Web 2.0 technology, through which such systems operate, that, by accounting for network interactions, they become the better, a lot of people use them [49]. These technologies, including the wiki, Google, Flickr, Digg.com, and blogging services, allow students to engage in self-search research on specialized sites as contributors, copywriters, critics, bloggers, commentators, etc. Therefore, together with the acquisition of educational information, this kind of independent study activity contributes to the formation of self-esteem, broadens the horizons, and develops students' communication skills.

3.4 ICT and tools for monitoring the students' educational and cognitive activity

The scientific based organization of students' independent study activity involves systematic control, self-control and correction. For this purpose the special means with ICTs for *monitoring the students' educational and cognitive activity* are being used.

Predictably the most successful and effective is test control appreciating the knowledge that students mastered by themselves, since it enables to objectively, impartially and promptly find out the quality of assimilation of learning information. The software market provides a wide range of ICT and tools for computer testing that let the user to select different test presentation formats, the test structure, and how to evaluate its execution (tempo, time, use of tips), styles of input and choice of answers, type of organization under time of testing knowledge (number of attempts, time limit, arbitrary choice of questions for the answer, the possibility to randomly select a certain number of questions from the general database of tasks, the introduction of statistics), the ways giving of the test results (in general, for each task with the demonstration of the correct answers, the formation of group information) [52].

The study-and-control programs of linear and branched-off character are considered to have the most widespread. The programmed learning's concept founded their expediency and optimality. The purpose of such programs is to prevent students' errors. If branched-off study-and-control programs are being used, after the test the student is provided with the analysis of the results, as appropriate the correct answers are shown, explanation to the assumed errors is given, the references to those aspects of the

learning material that need to be finalized is pointed out. In that case the student has the opportunity to independently determine both the order of passing the test and studying portions of the learning material. In our opinion, such a variant of study-and-control programs is more adapted to the individual characteristics of students, but there is danger of losing control over the performance of independent work. So, each type of study control program must find its place in the system of students' independent study activities [55].

In a nutshell we would like to cite the ICTs and tools as an example that could be used to build testing control of students' knowledge. These are MyTest, MiniTest-SL, ExeTest-SL, OpenTEST, Quick Exam, FreeXTest, Assistant, Test Designer, etc.

Furthermore, the Internet offers a number of cloud-based services that create on-line quizzes by virtue of the principle of gamification. The quite professional and versatile services in this respect are Kahoot (<https://getkahoot.com>) and Quizizz (<https://quizizz.com>) that contribute to build and conduct quizzes and surveys, with the use of mobile devices. The tool lets the test organizer adjust the tempo, speed, time limits for each task, and add additional marks for the estimation of speed or sequence of tasks performed by each student [14].

Certainly, above we considered the most well-known and promising ICTs and tools in terms of organization of students' independent study activity.

3.5 Integrated ICT and tools

At the same time, we would like to emphasize specially created ICTs with educational purposes, they are *integrated ICT and tools* that cover all of the above listed aspects of organization students' independent study activities.

These include Internet technologies and SaaS (software as a service) cloud-based technologies [17]. They allow storing data and associated applications on specialist servers that let solving the tasks of organizing students' independent study activities. The most common are Microsoft Office 365 Education and Google Apps for Education, as well as cloud-based services have been made on their basis. Their benefits are next: they are either full or in a practical manner free as well as availability and widespread [23].

In particular, the Google Apps for Education cloud platform offers the following ICTs and tools: text, voice, and video, chat, email; Google Drive – a data warehouse (15 to 30 Gb) for storing files, setting access rights to them with the possibility to post to the Internet; as well as a number of tools – Google Docs for making documents, spreadsheets and presentations; Google Group to create mailing lists and discussion groups; Google Calendar – a calendar for planning and managing meetings, tasks, and event sharing; Google Forms for surveys and tests, Google Sites – for generation sites using templates. It should be taken into account the fact that the list of tools is constantly expanding.

According to experts, the use of ICT in the organization of study activities was based on general-purpose services. Then special services appeared and integrated the individual functions of e-learning (for example, the “virtual class” model); their

evolution led to the creation of the concept of Virtual Learning Environments (VLE) [23]. Its main representatives are:

1. Learning Content Management System (LCMS) enabling the placement and manipulation of electronic teaching materials in various formats. This system is convenient in the case when the created system of educational courses uses a lot of common fragments of educational information;
2. Learning Management System (LMS) is mainly applied in distance learning.

In the educational process today, various platforms for managing integral training courses are being actively used, including Moodle, Claronline, ATutor, SharePointLMS, Live@EDU, eFront, Prometheus, Dokeos, etc. Their advantages and disadvantages are considered in detail in their publications of Bohdan A. Demyda [11], Halyna I. Haidur [55], Andrii I. Hladyr [11], Mykola P. Hnidenko [55], Oleh O. Ilin [55], Polina A. Novikova [50], Yurii L. Novikov [50], Serhii O. Sahaydak [11], Valentyn M. Tomashevskiy [50], Viktor V. Vyshnivskiy [55], Nataliia V. Zachepa [15] and many others [23].

Among the principles of social constructivism [49], which is the basis of the LMS project, we emphasize one very important for our study, it is the opinion that the learning environment should be flexible and should provide a simple tool for the participants in the educational process to fulfill their learning needs [55]. This certainly makes LMS a powerful tool for organizing students' independent study activities.

Any distance learning system is being based on the context-modular principle and covers, as indicated by Bohdan A. Demyda, Serhii O. Sahaydak and Irena Kopyl, such modules as: administration of the system; organization and support of the educational process; development and maintenance of testing; design and presentation of all kinds of learning materials in the system; export-import of their various formats; interactive user cooperation; user potency registry [11]. These sections, blocks and modules can be applied separately and together in line with specific goals and tasks of studying those or other subjects.

The analysis of the functional capabilities of these interactive modules makes it possible to identify their essential advantages for the organization of students' independent study activities in all its forms – independent and research work, types of consultations, as well as to build on its basis a functional electronic resource that reflects and supports academic discipline.

What's more, there are commercial Blackboard, WebCT, Microsoft Learning Gateway, Prometheus, WebTutor, Virtual University, and freeware ATutor, ILIAS, Sakai among widespread virtual learning environments [55]. The distance education functions on these platforms and creates chances for organizing students' non-formal education.

It is a peculiarity of online education that students and lecturers are separated in space and time, and the interaction between them takes place in a virtual environment [42]. Online Educational institutions are commonly referred to as "virtual universities". Their functioning is being based on the four systemic principles of open education: they are formulated by Valerii Yu. Bykov, namely: mobility of subjects of the educational

process; equal access to educational systems; providing quality education; formation of the structure and implementation of educational services [9, p. 55–56].

Massive open online courses (MOOC) allow students to be taught by lecturers from leading world universities, to join a multinational student community, and to receive a document confirming the successful completion of the entire course. The largest online platforms offer electronic lessons with subtitles and printed learning material; video materials; enable conduct a meaningful evaluation of the knowledge gained. To help the student methodical and reference material is given, the opportunity to discuss learning issues and tasks at the forum is added, credit for regulate the speed, the pace of training are taken. They are Coursera, Khan Academy, EdX, Udacity, Canvas Network, Udemy, FutureLearn, FUN, Prometheus on-line platforms that provide such user-friendly courses [42; 11].

When all's said and done above we mark that the processes of ICTs' unification and universalization of eventually ensured the development of various types' separate universal training modules. Ones could be part of several technologies for the organization of students' independent study activities [45, p. 85].

The personal teacher's website is a means of interactive distance cooperation between participants in the educational process. It could be considered as the holistic ICTs that capable of providing pedagogical management to the organization of students' independent study activities [26, p. 66]. It is an interactive didactic tool through which the cooperation between all participants in the pedagogical process – teachers, lecturers, students, potential entrants, employers, graduates, etc., is organized. An equally important aspect of such interaction is the possibility of individualization of independent study in the view of student's cognitive or professional perspective.

On their content there are several types of teachers' websites, in particular:

- the *business card site* presents the image of the teacher, his scientific interests, the most profound scientific and methodological works, photo-collections, it contains general information about him/her and the courses that he teaches. In addition, such a type of site enables the implementation of operative feedback with students for consulting and organizing their research work;
- *portfolio site* that usually includes general information about person, results of scientific and pedagogical activities, scientific and methodological works, lecture notes, electronic textbooks, examples, reference samples, and tasks for students' independent work, multimedia collections, leaning models, etc.;
- the *subjective site* that is a specialized online resource for the organization and control of students' independent study activities for a fixed educational discipline. Typically, the structure of such type of site is determined either by thematic lines of the course, or by types and forms of students' independent work (section for ongoing work, for conducting a study project, preparation of term paper, web-quest, for laboratory and practical classes, lead-up for exams or credits, etc.). The quality of subject site is determined by the presence in its structure of information relevant to students, dynamic and multimedia models of investigated phenomena, video materials, references to digital educational resources, cloud services; presentations, automated tools for self-control;

- the *educational site* is considered to have wider possibilities, in comparison with the above presented one, in the organization of students' independent study activities. Its main purpose is to help students build their own educational trajectories, to promote deepening and expanding knowledge in the chosen specialty. Here could will be found top news and announcements, latest video materials, links to educational, scientific, library and other resources, will be introduced to holistic self-education electronic courses, it will be possible to organize interest communication in specialized chats;
- the *combined site* that has two or more of the above types of sites in its structure [26].

The technological basis of such websites can serve as specially developed platforms for distance learning that are provided to the user almost for free: they are Moodle, Google services, Edmodo, Studyboard, etc., and moreover ordinary social networks. In their structure, the main features of management of students' independent study activities are laid.

When creating a site, a specialist programmer uses specially designed programming languages (PHP, HTML, JavaScript, etc.). However, a website builder tools can generate a site applying user-friendly simple settings. There is the possibility of making sites, both on the basis of Content Management Systems (CMS) and applying SaaS platforms, although in this case, the service is paid [55].

3.6 Criteria for the effectiveness organizing of students' independent study activities via the use of ICTs and tools

It is observed that the organizing of independent study activities with the use ICTs tools is considered an effective one if the students gain a certain amount of knowledge at the appropriate general scientific and professional level, forming the important features of their personality, necessary for further intellectual and professional development. At the same time, the independent study activities has been carried out on the basis of self-management by students and the systemic indirect mediated management by lecturers as well as rates of mental labor, sanitary and hygienic and ergonomic requirements in the application of ICTs have been taken into account.

The effectiveness of the organization of students' independent study activities can be assessed by a number of criteria. Obviously, the students' motives and motivation determine their personal meaning, are the main factors of one's effectiveness, especially in terms when the classroom training has been reducing. Starting independently, based on their needs, the student has put forward a specific goal. Therefore, the goal is being defined as a conscious need, as a marking of a desired result that is being directed the student's activity towards achievement it [53]. Thus, activating the students' cognitive interests, initiating their creative initiative, and the desire to perform the proposed learning tasks in a qualitative and timely manner, to master and apply for the sake of these newest ICTs is the first urgent step in organizing an effective students' independent study activity [3]. The next step is to build a content and instrumental basis for independent study activities. This involves, firstly, the formation

of students' teaching and methodological knowledge for the organization of autonomous learning, as well as methods, techniques and skills for solving the set of educational tasks with the wide application of ICTs. In the end, the effectiveness of the functioning of such a system is assessed by educational, cognitive and personally significant products of students' independent study activities.

In that way, based by the structure and content of the system of students' independent study activities, *criteria for its effective organizing* are: *motivational, substantive, organizational and productive* one. At the same time, considering the general state of the effectiveness of the organization of the studied activities, one requires a separate study and investigates the *technological ability criterion* of the educational process. Thanks to it we could be estimate the motivational provision of the students' and lecturers' functioning in the organization of independent study activities together with the use ICTs and tools; make diagnostic and appreciate efficiency of the investigated process; design the content of independent study activity by way of a system of cognitive and practical tasks as well as an indicative basis and methods of their solution; achieve algorithmicity, optimality, integrity and controllability of the process organizing students' independent study activity with the use of ICT and tools; amount the effectiveness and developmental nature of students' self-study and whatever (Dmitrii V. Chernilevskii [10, p. 18–25] and others).

Describing the level of efficiency organizing of students' independent study activity via the use of ICTs and tools we proceed from the features of educational activity as a process that can have different degrees of implementation and the subject of management. Therefore, taking into account the above-mentioned, we distinguish four levels, these are insufficient, critical, sufficient and proficiency one.

3.7 Brief description of the content of the pilot-and-experimental study of the effectiveness the use of ICTs and tools in the organizing of students' independent study activities

Pilot work has been carrying out for the years 2016-2017 and has covered 240 students of 2-3-courses of technological and pedagogical area of expertise of 2 HEI of Ukraine; they were Kryvyi Rih State Pedagogical University and Poltava National Technical Yuri Kondratyuk University [27].

After a theoretical justification the components of the informational and educational environment of higher educational establishments aimed at satisfying the educational needs of students in the organizing of independent study activities have been defined and specified. They cover:

- the website of the institution, which includes presentation and teaching materials of the institution and individual specialties, library repository, automated library frames, built-in platforms for the use the Learning Management Systems (in particular, Moodle), systems for automated learning inspection;
- the departments' educational-methodical complexes;
- the specialized web-sites of departments and personal lecturers' web-sites for organizing students' independent study activities from disciplines of curriculum;

- the open electronic educational resources.

In the framework of the forming experiment, the selection of ICTs and tools as well as the corresponding technological models that described above has been carried out. The criteria for their choice were as follows:

- *the general didactical* ones providing scientific, professional orientation, systemic, consistency, connexion a theory with a practice, computer and “traditional” visualization of the educational information, consciousness, activeness and independence of students in knowledge acquisition;
- *the general psychological* ones that allow for friendly dialogue interface, quality of screen design (color, contrast, clarity, size, speed of change of information, etc.), taking into account the students’ age and individual characteristics, bring in both of motivation means for their independent study activities, and pedagogical and computer support in organizing their autonomous learning;
- *the methodical* ones providing planned, algorithmic, staged and sequence in the study of learning information, as well as feedback between the lecturer and student, last and not least the unified approach to the organizing independent study activities in any learning environment;
- *the technical* ones, these are accordance hardware tools with software and operational documentation, the ability to create a seamless learning environment, produce a synchronous and asynchronous training communication mode, provide software stability for incorrect users actions;
- *the ergonomic* ones by virtue of them the functional comfort in work, correspondence of aesthetic design of certain learning objects to their functional purpose are being guaranteed [55].

We also took into account such specific requirements as the ability to use ICTs and tools on portable mobile and media devices without software interference in their content.

For the scientifically grounded management by students’ independent study activities of technological and pedagogical area of expertise the steps to distribute the ICTs and tools according to the leading forms its organization have been taken; we means the independent and research work, lectures, consultations and non-formal learning (see Table 1).

In addition, the didactic supply of the organization of students’ independent study activities of technological and pedagogical area of expertise with the use of ICTs and tools have been created and adapted. They were the electronic educational content, if in a nutshell – electronic lectures, electronic educational books, electronic educational kits and whatever. At last the electronic, mobile, combined, mixed learning technologies as well as ones of training, coaching, gaming, design, test, rating have been tested and endorsed.

It has been tested the models of blended learning. First of all, it was the stream model that via an educational web-site has concentrated in itself an invariant core of students’ independent study activities and has integrated with traditional technologies through so called model “Flipped classroom”. The potentials of axial model that included user's

custom electronic courses of curriculum disciplines as interactive educational modules on the Moodle platform has been studied. The variety of ways for mixed self-study learning has also been implemented.

Table 1. Ways of implementation the forms organizing the students' independent study activity via the use of ICTs and tools

The forms organizing the students' independent study activity				
Independent work	Research work	Lectures	Consultations	Non-formal learning
<ul style="list-style-type: none"> • Lecturer's Web-site • Web-quest • Portfolio • Training project • Virtual Laboratory Classes • Training simulators • Study-and-control programs • Electronic educational resource • CAD • Systems for automatic control of objects and models • Knowledge bases • Databases <p>ICTs and tools: for the presentation and learning of teaching material, for monitoring the students' educational and cognitive activity</p>	<ul style="list-style-type: none"> • Service projects • Presentation portfolio • Project's portfolio • Web-forum • Web-conference • Webinars • Network publications • Wiki-projects • Web-based programming • Multi-design <p>ICTs and tools: for providing an electronic communication, for virtual education with elements of artificial intelligence</p>	<ul style="list-style-type: none"> • Multimedia lectures • E-lectures • Lecture-and-visualization • Video tutorials • Micro-lessons • Thematic blogs • EBook • Electronic library • E-learning resources • Useful educational resources • Thematic library collections • Knowledge bases • Databases • Infographics • Virtual museum • Video channels <p>ICTs and tools: for the presentation of teaching material</p>	<ul style="list-style-type: none"> • Video tutorials • Workshops • IP telephony • Interactive counseling • Network consulting • Correspondence • Work in the list of links • Chat • Blog • Video-chat • Virtual bulletin board • Useful educational resources • Administration and management as a service • Webinars • Gamification (web-quests) • SMART Table Training Center <p>ICTs and tools: for provide electronic communication</p>	<ul style="list-style-type: none"> • User e-course • On-line course • Distant education • Thematic educational channel • Virtual universities • Planetary classes • MOOC <p>ICTs and tools: for creating and managing automated learning courses, remote virtual education systems with elements of artificial intelligence</p>

3.8 Analysis of the effectiveness of the use of ICTs and tools in the organization of students' independent study activities

Focusing on this task we have investigated the changes that occurred in the levels organizing of students' independent study activities with the use of ICTs and tools on the grounds of productive and technological ability criteria. Such work meant the study of the quality of mastered by students the knowledge about disciplines of the curriculum, the specific types their professional activity in the system of independent work, research work and non-formal learning, as well as the degree of technological efficiency of these processes.

Diagnostics on a productive criterion has carried out on the basis of “Rating card of the student’s self-study activities”. In this mean we have included such following positions: the standardized components of the basic level of organization of independent study activities (current student’s learning progress, systematic independent work, accorded independent work (educational projects), work in the informational educational environment of higher educational establishments); components of an in-depth and professionally oriented level (student’s research work, work with electronic educational resources of subjects); non-formal learning (study in user and additional electronic courses developed by both the lecturers and in the system of open distance education).

While the experimental research, we have been able to determine thanks to such the card, the degree of activity, autonomy and systematic, effectiveness and productive performance of each student’s individual study activities. Due to this card we have standardized the performance of each type of work by virtue of addition to basic students’ result both supplementary and penalty marks.

The obtained results are presented in the Table 2 as well as on Fig. 3.

Table 2. Comparative dynamics of levels organizing the students' independent study activities with use of ICTs and tools in line with productive criterion (%)

Levels	Experimental group		Control group	
	Output Stage	Final Stage	Output Stage	Final Stage
Insufficient	15.0	3.3	13.3	11.6
Critical	25.0	13.3	23.3	20.0
Sufficient	43.3	55.0	45.1	48.4
Proficiency	16.7	28.4	18.3	20.0
Pierson χ^2 -criterion	25.9 > 11.3, $p = 0.001$		1.1 < 11.3, $p = 0.001$	

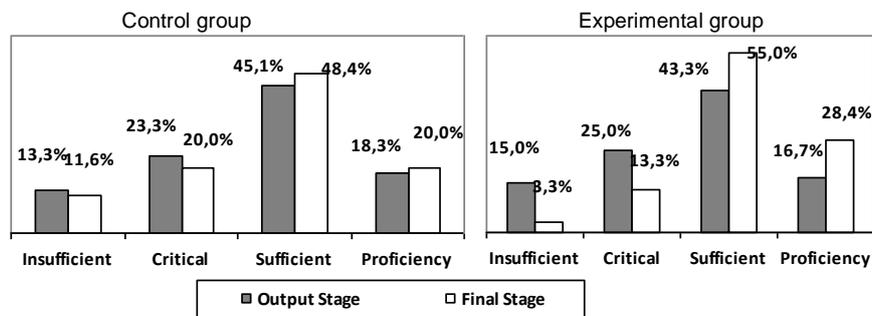


Fig. 3. Dynamics of the levels organization the students’ independent study activity with the use of ICTs and tools according to productive criteria

As you can see the quantitative data analysis of Table 2 reflects the changes in the attitude of students in the experimental group to independent study activities with together use of ICTs and tools in its organization. Predictably, the introduction of special control and diagnostic procedures, systematic differentiated inspection and evaluation have contributed to increasing the level of students’ activity in research

work, as well as the application of qualitative new forms of its organization into the system of the students' independent study activities. We mean the webinars, workshops, video tutorials, thematic websites, user courses, electronic educational resources, whatever.

The students have noted the expediency of developing a department's thematic website, the variety of offered courses for the acquisition of knowledge about ICTs and tools for educational and professional purposes, as well as orientation to opened online e-courses.

As you can see for data of Fig. 3, there is a positive, statistically significant dynamics in the levels organizing independent study activity for students in the experimental group in contrast to the students of the control group: 11.6% more students have shown the proficiency and sufficient levels of organization of the investigated activity via the use ICTs and tools.

The level of productivity of the organizing the students' independent study activities with together use of ICTs and tools has been estimated by the coefficient of efficiency:

$$K_t = \frac{K_c}{K_p}, \quad (1)$$

where K_c and K_p are in respectively coefficients of completeness of the fulfilled tasks by students with the used ICT and non-computer pedagogical technologies.

The data obtained are summarized in Table 3. We must notice, evaluating the efficiency, we did not take into account the use of ICT by students for text editing, automatic calculation, etc.

Table 3. The coefficient of effectiveness the use of ICTs and tools in the process of organizing students' independent study activities of technological and pedagogical area of expertise

Types of tasks	The coefficient	
	Output stage	Final stage
Organization of educational communication in the "lecturer-student" system	1.5	1.8
Information search	1.2	1.8
Graphic, computational and practical tasks	0.7	1.2
Educational projects	0.8	1.3
Preparation of plans-synopsis of lessons for labor training and technologies	0.6	1.1
Laboratory and experimental research	0.6	1.5
Creation of portfolio	0.5	1.1
Creation of schemes, technological cards, consolidated tables, charts and diagrams	0.7	1.5
Self-monitoring, test control	0.9	2.0
Solving the technical creativity tasks	0.6	1.1
Working with the library catalog	0.7	1.5
Participation in the quest	0.7	1.1

As you can see, in experimental groups there has been a significant increase in the use of ICTs and tools by students for solving educational problems. Such results were

made possible by introducing into the educational process the varieties of ICTs and their technological models that have made it possible to integrate traditional and electronic tools into blended and mixed learning systems.

For the control group statistical analysis shows the changes in the level organizing students' independent study activities are being random and related to the general evolution of the individual students in the vocation training process.

4 Conclusions and prospects for further research

Consequently, the analysis of the latest information and technological approaches to the organization of students' independent study activities made it possible to determine the means of realization of the leading forms of organization for this activity (independent and research work, lectures, consultations and non-formal education).

In the current context, when the development and replication of educational software products becomes a business, the market is being filled with quite diverse and multiple products. Identification of the criteria for their quality and selection is getting increasingly issue of the day. Often, the criteria for such an assessment are the technical characteristics of software products that not directly related to the pedagogical and methodical terms for their creation. The quality of graphic design, reliability, availability and quality of documentation, etc. – all these criteria are definitely important, but in our opinion, they do not determine the main characteristics of educational software products. Therefore, the programmatic and methodological support of students' independent study activities based on ICT should include both software tools for teaching support and means that enable the lecturer to manage the learning process, its rational organization.

As for result of this study, the ICTs and tools for the organization of students' independent study activities have been characterized and classified. It was shown and described the ICTs and tools that support presentation of teaching materials, electronic communication, mastering of learning material, monitoring of students' learning and cognitive activity, such as ones that serve for the sake of development and support of automated training courses, systems of remote virtual education with elements of artificial intelligence, which implement the principle of adaptive management of learning and the organization of students' independent study activities.

In this publications the elements of the system of pedagogical work on the creation of informational educational environment of higher educational establishments functioning on the basis of the same educational principles in the process of organizing students' independent study activities with the use of ICTs and tools have been presented. The content and functional components of such a medium have been developed and tested in the framework of pilot-and-experimental work. They have enabled to effectively implement the leading forms and technologies via appropriate ICTs and tools, as well as have given statistically significant dynamics in the levels of organizing students' independent study activities in line with for productive and technological ability criteria.

Summarizing the analysis of the possibilities of integrating traditional and newest ICT into the organization of students' independent study activities, take credit that not only ICTs are important, but how their use serves the achievement of educational goals. Usually, the best educational result is being provided by a feasible combination of well-proven time traditional and innovative means of organizing students' self-study. Expediently, when ICT are being selected one should take into account their maximum compliance with the specifics of the students' training in a particular area of expertise.

Perspective in the development of this area, we consider the research content of students' independent study activities in the distance, dual and e-learning educational systems.

References

1. Aleksiuk, A.M.: Pedahohika vyshchoi osvity Ukrainy. Istoriia. Teoriia (Pedagogy of higher education of Ukraine. History. Theory). Lybid, Kyiv (1998)
2. Andreev, A.A.: Vvedenie v Internet-obrazovanie [Introduction to Online Education]. Logos, Moscow (2003)
3. Bendera, I.M.: The theory and methods of future specialists in agricultural mechanization individual work in educational institutions. Dissertation, The Pedagogical education institute and adults' education APS of Ukraine (2009)
4. Boiko, N.I.: Orhanizatsiia samostiinoi roboty studentiv vyshchych navchalnykh zakladiv v umovakh zastosuvannia informatsiino-komunikatsiinykh tekhnolohii (Formation of skills and abilities of pedagogical university students independent work by incans of library technologies). Dissertation, National Pedagogical Dragomanov University (2008)
5. Bologna Working Group on Qualifications Frameworks: A Framework for Qualifications of the European Higher Education Area. Ministry of Science, Technology and Innovation, Copenhagen. http://ecahe.eu/w/images/7/76/A_Framework_for_Qualifications_for_the_European_Higher_Education_Area.pdf (2005). Accessed 21 Mar 2109
6. Bondar, V.I.: Dydaktyka: efektyvni tekhnolohii navchannia studentiv (Didactics: effective technologies of teaching students.). Veresen, Kyiv (1996)
7. Buriak, V.K.: Teoriia i praktika samostoiatelnoi uchebnoi raboty shkolnikov (na materialakh estestvennonauchnykh distsiplin) (The theory and practice of independent educational work of schoolchildren (on the materials of natural sciences)). Dissertation, Krivoi Rog State Pedagogical Institute (1986)
8. Buyak, B.B., Tsidylo, I.M., Repskyi, V.I., Lyalyuk, V.P.: Stages of Conceptualization and Formalization in the Design of the Model of the Neuro-Fuzzy Expert System of Professional Selection of Pupils. In: Kiv, A.E., Soloviev, V.N. (eds.) Proceedings of the 1st International Workshop on Augmented Reality in Education (AREdu 2018), Kryvyi Rih, Ukraine, October 2, 2018. CEUR Workshop Proceedings **2257**, 112–121. <http://ceur-ws.org/Vol-2257/paper13.pdf> (2018). Accessed 30 Nov 2018
9. Bykov, V.Yu.: Modeli orhanizatsiinykh system vidkrytoi osvity (Models of Organizational Systems of Open Education). Atika, Kyiv (2009)
10. Chernilevskii, D.V.: Didakticheskie tekhnologii v vysshei shkole (Didactic technologies in higher education). IuNITI, Moscow (2002)
11. Demyda B., Sahaidak S., Kopyl I.: Systemy dystantsiinoho navchannia: ohliad, analiz, vybir (Distance learning systems: review, analysis, choice). Bulletin of the National

- University “Lviv Polytechnic”, Computer Science and Information Technology 694, 98–107 (2011)
12. European Centre for the Development of Vocational Training: Terminology of European education and training policy. A selection of 130 key terms. Publications Office of the European Union, Luxembourg (2014)
 13. European Ministers in charge of Higher Education: The Bologna Process 2020 – The European Higher Education Area in the new decade. Communiqué of the Conference of European Ministers Responsible for Higher Education. Leuven and Louvain-la-Neuve, 28-29 April 2009. https://www.eurashe.eu/library/modernising-phe/Bologna_2009_Leuven-Communique.pdf (2009). Accessed 21 Mar 2018
 14. Gibson, S.: Why Kahoot is one of my favourite classroom tools. URL: <http://tomorrowlearners.com/why-kahoot-is-one-of-my-favourite-classroom-tools> (2015). Accessed 10 Nov 2018
 15. Gladyr, A., Zachepa, N., Motrunich, O.: Systemy dystantsiinoho navchannia – ohliad prohramnykh platform (Learning Management Systems – software overview). In: Electromechanical and energy systems, modeling and optimization methods. The 10th International conference of students and young researchers in Kremenchuk march 28–29, 2012, pp. 43–44. KrNU, Kremenchuk (2012)
 16. González, J., Wagenaa, R. (eds.): Tuning Education Structures in Europe. Final Report, Pilot Project – Phase I. Universidad de Deusto Apartado, Bilbao. http://tuningacademy.org/wp-content/uploads/2014/02/TuningEUI_Final-Report_EN.pdf (2003). Accessed 21 Mar 2018
 17. Hlukhodid, M.V., Linnik, O.P., Semerikov, S.O., Shokaliuk, S.V.: Realizatsiia modeli SaaS v systemi mobilnoho navchannia informatychnykh dystsyplin (Implementing of SaaS model in the system of mobile learning of computer sciences). New computer technology 8, 156–158 (2010)
 18. Horbatiuk, R.M.: Formuvannia proektnoi diialnosti maibutnykh inzheneriv-pedahohiv kompiuternoho profilu (Formation of the project activity of future engineer-and-pedagogies computer area of expertise). In: Pedahohichni nauky 52, 433–439 (2009)
 19. Hurevykh, R.S., Kademiiia, M.Iu., Koziar, M.M.: Informatsiino-komunikatsiini tekhnolohii v profesiinii osviti maibutnykh fakhivtsiv (Information and communication technologies in the professional education of future specialists). LDU BZhD, Lviv (2012)
 20. Kolgatin, O.H., Kolgatina, L.S., Ponomareva, N.S., Shmeltser, E.O.: Systematicity of students’ independent work in cloud learning environment. In: CEUR Workshop Proceedings (CEUR-WS.org) (2019, in press)
 21. Kommers P.A.M., Smyrnova-Trybulska E., Morze N., Noskova, T., Pavlova, T., Yakovleva, O.: First Outcomes of WP2 Research Carried Out Within the Framework of the IRNet Project – International Research Network. In: Turcani, M., Drlik, M., Kapusta, J., Svec, P. (eds.) DIVAI 2014: 10th International Scientific Conference on Distance Learning in Applied Informatics (DIVAI), Hotel Thermal Recreation Complex Vadaš, Sturovo, Slovakia, Slovakia, 5–7 May 2014, pp. 357-371. Wolters Kluwer, Sturovo (2014)
 22. Kozakov, V.A.: Samostoiatelnaia rabota studentov i ee informaciiionno-metodicheskoe obespechenie (Independent work of students and its information and methodological support). Vyshcha shkola, Kiev (1990)
 23. Kukharenko, V.M. (ed.), Berezenska, S.M., Buhaichuk K.L., Oliinyk, N.Yu., Oliinyk, T.O., Rybalko, O.V., Syrotenko, N.H., Stoliarevska, A.L.: Teoriiia ta praktyka zmishanoho navchannia (The theory and practice of blended learning). Miskdruk, Kharkiv (2016)
 24. Kustovskiy, S.M.: Dydaktychni umovy orhanizatsii samostiinoi navchalno-piznavalnoi diialnosti maibutnykh ekonomistiv u vyshchykh navchalnykh zakladakh (Didactic factors

- of organization of independent educational perceptive activity of the future economists in institutions of higher education). Dissertation, Vinnytsia State Pedagogical University named by Mykhaylo Kotsiubynsky (2005)
25. Kuzminskyi, A.: Studentske samovriaduvannia u vyshchii shkoli (retsepsiia vitchyznianoho i yevropeiskoho dosvidu) (Student government in higher school (reception of domestic and european experience)). *Estetyka i etyka pedahohichnoi dii* 5, 165–183 (2013)
 26. Kyrchikova, D.A., Smolnikova, N.S.: Personalnyi web-sait uchitelia kak sovremennoe didakticheskoe sredstvo (Personal web site of the teacher as a modern didactic tool). *Chelovek v mire kultury* 3, 65–71 (2013)
 27. Lavrentieva, O.O., Tsys, O.O.: Metodichni pidkhody doorhanizatsii samostiinoi navchalnoi diialnosti studentivtekhnolo-ho-pedahohichnykh i inzhenerno-pedahohichnykh spetsialnostei v informatsiinomu navchalnomu seredovyschii zakladu vyshchoi osvity (Methodical Approaches to Organization of Students' Independent Study Activities of the Technological-Pedagogical and Engineering-Pedagogical Area of Expertise into the Information Learning Environment of Higher Education Institution). *Naukovyi visnyk Lotnoi akademii, Serii: Pedahohichni nauky* 5, 161–168 (2019). doi:10.33251/2522-1477-2019-5-161-167
 28. Malychin, O.V., Pavlenko, I.H., Lavrentieva, O.O., Matukova, H.I.: *Metodyka vykladannia u vyshchii shkoli* (Methods of teaching in higher school). KNT, Kyiv (2014)
 29. Markova, O.M., Semerikov, S.O., Striuk, A.M., Shalatska, H.M., Nechypurenko, P.P., Tron, V.V.: Implementation of cloud service models in training of future information technology specialists. In: *CEUR Workshop Proceedings (CEUR-WS.org)* (2019, in press)
 30. Merzlykin, O.V., Semerikov, S.O.: Perspektivni khmarni tekhnologii v osviti (Prospective Cloud Technologies in Education). In: *Proceedings of the scientific and practical workshop on Cloud Technologies in Modern University, Cherkasy, 24 Mar 2015*, pp. 31–33. ChDTU, Cherkasy (2015)
 31. Modlo, Ye.O., Semerikov, S.O., Nechypurenko, P.P., Bondarevskiy, S.L., Bondarevska, O.M., Tolmachev, S.T.: The use of mobile Internet devices in the formation of ICT component of bachelors in electromechanics competency in modeling of technical objects. In: *CEUR Workshop Proceedings (CEUR-WS.org)* (2019, in press)
 32. Modlo, Ye.O., Semerikov, S.O., Shmeltzer, E.O.: Modernization of Professional Training of Electromechanics Bachelors: ICT-based Competence Approach. In: Kiv, A.E., Soloviev, V.N. (eds.) *Proceedings of the 1st International Workshop on Augmented Reality in Education (AREdu 2018)*, Kryvyi Rih, Ukraine, October 2, 2018. *CEUR Workshop Proceedings* 2257, 148–172. <http://ceur-ws.org/Vol-2257/paper15.pdf> (2018). Accessed 21 Mar 2019
 33. Molibog, A.G.: *Osnovy nauchnoi organizatsii uchebnogo truda studentov* (Fundamentals of scientific organization of educational work of students). BPI, Minsk (1975)
 34. Morkun, V.S., Semerikov, S.O., Morkun, N.V., Hryshchenko, S.M., Kiv, A.E.: Defining the Structure of Environmental Competence of Future Mining Engineers: ICT Approach. In: Kiv, A.E., Soloviev, V.N. (eds.) *Proceedings of the 1st International Workshop on Augmented Reality in Education (AREdu 2018)*, Kryvyi Rih, Ukraine, October 2, 2018. *CEUR Workshop Proceedings* 2257, 198–203. <http://ceur-ws.org/Vol-2257/paper19.pdf> (2018). Accessed 21 Dec 2018
 35. Nechypurenko, P.P., Semerikov, S.O., Tomilina, L.I.: Theoretical and methodical foundations of using ICT as a tools of forming the senior pupils' research competencies in the chemistry profile learning. *Vydavnychi viddil DVNZ "Kryvorizkyi natsionalnyi universytet"*, Kryvyi Rih (2018)

36. Petrova, M.Ye., Mintii, M.M., Semerikov, S.O., Volkova, N.P.: Development of adaptive educational software on the topic of “Fractional Numbers” for students in grade 5. In: Kiv, A.E., Semerikov, S.O., Soloviev, V.N., Striuk, A.M. (eds.) Proceedings of the 1st Student Workshop on Computer Science & Software Engineering (CS&SE@SW 2018), Kryvyi Rih, Ukraine, November 30, 2018. CEUR Workshop Proceedings **2292**, 162–192. <http://ceur-ws.org/Vol-2292/paper19.pdf> (2018). Accessed 21 Mar 2019
37. Petrytsyn, I.: Zastosuvannia kompiuternoho modeliuвання u protsesielektrotekhnichnoi pidhotovky maibutnoho vchytelia tekhnolohii (The application of computer modeling in the process of the electrical training of future teachers of technology). *Molod i rynek* 1(144), 60–64 (2017)
38. Pidkastyi, P.I.: Protcess i struktura samostoitelnoi deiatelnosti uchashchikhsia v obuchenii (The process and structure of students’ independent activities in learning). Dissertation, Moskovskii gosudarstvennyi pedagogicheskii institut imeni V. I. Lenina (1974)
39. Pro Natsionalnu stratehiiu rozvytku osvity v Ukraini na period do 2021 roku (On the National Strategy for the Development of Education in Ukraine until 2021). Legislation of Ukraine. <http://zakon.rada.gov.ua/laws/show/344/2013> (2013). Accessed 21 Mar 2019
40. Prokopenko, I.F. (ed.), Ionova, O.M., Yevdokymov, V.I., Lozova, V.I., Popova, O.V.: Pedahohichni tekhnolohii v pidhotovtsi vchyteliv (Pedagogical technologies in teacher training.). Mitra, Kharkiv (2018)
41. Rudenko, T.V.: Didakticheskie funktsii i vozmozhnosti primeneniia informatsionno-kommunikatsionnykh tekhnologii v obrazovanii (Didactic functions and possibilities using ICTs’ in education). http://ido.tsu.ru/other_res/ep/ikt_umk (2006). Accessed 21 Nov 2018
42. Semerikov, S.O., Shyshkina, M.P.: Preface. In: Semerikov, S.O., Shyshkina, M.P. (eds.) Proceedings of the 5th Workshop on Cloud Technologies in Education (CTE 2017), Kryvyi Rih, Ukraine, April 28, 2017. CEUR Workshop Proceedings **2168**. <http://ceur-ws.org/Vol-2168/preface.pdf> (2018). Accessed 21 Mar 2019
43. Sharov, S.V.: Rozvytok hotovnosti studentiv do samostiinoi navchalnoi diialnosti yak neobkhidna umova yii zdiisnennia (Development of students’ readiness for independent educational activity as a necessary condition for its realization). *Pedahohika i psykholohiia formuvannia tvorchoi osobystosti: Problemy ta poshuky* 68, 395–398 (2011)
44. Shymko, I.M.: Dydaktychni umovy orhanizatsii samostiinoi navchalnoi roboty studentiv vyshchykh pedahohichnykh navchalnykh zakladiv (Didactic conditions of organization of independent academic work of students of the university). Dissertation, Kryvyi Rih State Pedagogical University (2002)
45. Shyshkina, M.P.: Tendentsii rozvytku ta vykorystannia informatsiinykh tekhnolohii u konteksti formuvannia osvitnoho seredovishcha (Trends in the development and use of information technology in the context of the educational environment’s formation). In: Bykov, V.Yu., Zhuk, Yu.O. (eds.) *Zasoby i tekhnolohii yedynoho informatsiinoho osvitnoho prostoru*, pp. 81–88. Atika, Kyiv (2004)
46. Soldatenko, M.M.: Teoriia i praktyka samostiinoi piznavalnoi diialnosti (Theory and practice of independent cognitive activity). Vydavnytstvo NPU imeni M. P. Drahomanova, Kyiv (2006)
47. Spencer, L.: 16 Over 20 Best Presentation Making Software Alternatives to PowerPoint (2019). URL: <https://business.tutsplus.com/articles/best-presentation-software-alternatives-to-powerpoint--cms-28697> (2019). Accessed 25 May 2019
48. Striuk, M.I., Semerikov, S.O., Striuk, A.M.: Mobility: a systems approach. *Information Technologies and Learning Tools* **49**(5), 37–70 (2015). doi: 10.33407/itl.v49i5.1263

49. Teplytskyi, O.I., Teplytskyi, I.O., Semerikov, S.O., Soloviev, V.N.: Training future teachers in natural sciences and mathematics by means of computer simulation: a social constructivist approach. *Vydavnychi viddil DVNZ "Kryvorizkyi natsionalnyi universytet"*, Kryvyi Rih (2015)
50. Tomashevskiy, V.M., Novikov, Yu.L., Kaminska, P.A.: Ohliad suchasnoho stanu system dystantsiinoho navchannia (An overview of the current state of distance learning systems). *Naukovi pratsi Chornomorskoho derzhavnoho universytetu imeni Petra Mohyly, Ser. Kompiuterni tekhnologii* **160**(148), 146–157 (2011)
51. Tryus, Yu.V., Herasymenko, I.V.: Blended learning as an innovative educational technology in high school. *Theory and methods of e-learning* **3**, 299–308 (2012)
52. Tsys, O.O.: Dydaktychni umovy zastosuvannia informatsiino-komunikatsiinykh tekhnologii v orhanizatsii samostiinoi navchalnoi diialnosti studentiv (Didactic terms of the use of information and communication technologies in the process of organizing students' independent study activities of technological and pedagogical area of expertise). Dissertation, Ternopil Volodymyr Hnatiuk National Pedagogical University (2018)
53. Volkova, N.P.: Samostijna robota studentiv yak zasib pidgotovky majbutnix uchyteliv do zdijnsennya profesijno-pedagogichnoyi komunikaciyi (Independent work of students as a means of training future teachers for the implementation of vocational and pedagogical communication). *Humanitarnyi zhurnal* 3-4 (35-36), 159–165 (2007)
54. Vorona, T.: 6 luchshikh prilozenii dlia upravleniia proektami, vkluchaia sozdannyi ukrainciami (6 best project management applications, including those created by Ukrainians). URL: <https://ain.ua/2014/10/16/6-luchshix-prilozenij-dlya-upravleniya-proektami-vklyuchaya-sozdannyj-ukrainciami> (2014). Accessed 25 Oct 2017
55. Vyshnivskiy, V.V., Hnidenko, M.P., Haidur, H.I., Ilin O.O.: Orhanizatsiia dystantsiinoho navchannia. Stvorennia elektronnykh navchalnykh kursiv ta elektronnykh testiv (Organization of distance learning. Creating e-learning courses and electronic tests). DUT, Kyiv (2014)
56. Yashanov, S.M.: Formuvannia u maibutnikh uchyteliv umin i navychok samostiinoi navchalnoi roboty u protsesi vykorystannia novykh informatsiinykh tekhnologii (Formation of skills and habits of self-educational work with usage of new informational technologies for the future teachers). Dissertation, National Pedagogical Dragomanov University (2003)
57. Zakharova, E.V.: Organizatsiia samostoiatelnoi raboty studentov s ispolzovaniem informatcionno-kommunikatsionnykh tekhnologii (na primere inostrannogo iazyka) (Organization of students' independent work using information and communication technologies (on the example of a foreign language)). Dissertation, Yakutsk State University (2008)
58. Zaskalieta, S.H.: Orhanizatsiia samostiinoi piznavalnoi diialnosti studentiv silskohospodarskoho instytutu (za materialamy vyvchennia inozemnykh mov) (Organization of independent cognition activity of students in Agricultural Institute (in the process of foreign languages studing)). Dissertation, The Institute of Pedagogics and Psychology of Professional Education of the Academy of Pedagogical Science of Ukraine (2000)
59. Zhuk, Yu.O.: Metodyka analizu navchalno-informatsiinoho seredovyscha, stvorenoho sukupnistiu pidruchnykiv (A methodology for analyzing the educational and informational environment created by the collection of textbooks). *Problemy suchasnoho pidruchnyka* 11, 36–49 (2011)