

# EXPERIENCE AND THE PROSPECTS OF USING FREE SOFTWARE AT THE TEACHERS' TRAINING UNIVERSITY

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***Abstract:** The article deals with the issue of the use of free software in the educational process of Chernihiv Teachers' Training University. The authors summarise the peculiarities of the selection and use of freely distributed software, correction of the content and methodical support of training courses in the field of computer science in the conditions of the transition to free software in the higher educational institution. They also describe the components of the computer-oriented methodical system of pre-service teachers' professional training based on the integrated application of free software.*

**Keywords:** educational process, teacher training, free software, teaching computer science.

## INTRODUCTION

One of the main global trends in information society is the application of open standards in information technology.

In the market of desktop software in recent years, one can observe a slowdown in the development of professional paid software with a focus on the partial transfer of it to online services, which greatly complicates unauthorized use. At the same time there is an acceleration of the development of free software, which in its characteristics is not inferior to the paid software, and often exceeds it. Therefore, the perspective is to move away from paid to free software, from circulation of documents in closed formats to open formats of documents.

The use of free software in the educational process of higher education institutions provides a number of advantages, including the possibility of significant savings of budget funds, promotion of the formation of negative attitudes towards piracy among students; Giving the user the right to independently select the software in

further work; The possibility of independent modification and adaptation of existing software.

Systemic, pedagogically substantiated introduction of free software in educational institutions will help society as a whole avoid the dominance of IT corporations by facilitating competition in software development: graduates trained in the use of free software will be able to use it in further professional activity without additional funds.

Currently, in a number of countries, the feasibility of using free software in the public sector and education sector has been recognized. In particular, in Argentina, Georgia, Russia, South Korea in the Philippines there exist state programs for using free software in educational institutions. Similar programs are being started in Italy, India, Germany and other countries.

The recognition by the world community of the feasibility of using free software, the increase of the number of software available for free use in educational institutions, encourage the development of various aspects of the use of free software in secondary schools and high institutions. In particular, such studies include works by Horoshko Yu.V., Semerikov S.O., Teplytsky I.O., Gabrusev V.Yu., Pokryzhen D.A., Kostyuchenko A.O., Shkardybarda M.I. and many other scholars and practitioners. However, the problem of the development of a computer-oriented methodical system of professional training for future teachers of physical and mathematical specialties, based on the integrated application of free software, remained unresolved.

Realizing the relevance and prospectivity of this direction of development of informational education, the staff of the Chair of Computer Science and Engineering during the last fourteen years is carrying out a purposeful transition to the use of free software in the educational process at the Faculty of Physics and Mathematics and other faculties of Chernihiv Taras Shevchenko National Teachers' Training University. In order to summarize the gained experience, the staff of the department in 2012 started work on the scientific research "Development of components of the free software-based teaching methods of computer science for students of teachers' training institutes of higher education". The working hypothesis for this study is the assertion that only a teacher who has acquired his professional competences in higher education institution in the context of the integrated application of free software will be able to effectively implement free software in the process of his professional activity.

The purpose of the work: development of components of methodical system of training teachers of computer science that is based on the integrated application of free software and creates conditions for further use of this software by a specialist in professional activities.

The project was aimed at:

1. development of criteria for the selection of free software for its didactically substantiated application in the educational process of a pedagogical institution of higher education;
2. correction of content and methodical support of training courses of information orientation taking into account the integrated application of free software;
3. development of didactic materials on disciplines of computer science and checking their effectiveness in conditions of educational process.

The proposed research contributes to solving the actual problem of modern pedagogical higher education institutions - the training of a highly professional teacher and a specialist in the field of information and communication technologies, competitive in the modern labour market. The trained specialists will have experience in using free software, that will enable the school to meet the current requirements of the educational process.

## **RESEARCH METHODOLOGY**

The methodological basis of the research is the systematic scientific and methodological analysis of the problem, which was conducted through the study and testing of software, the processing of scientific articles, publications in the pedagogical and computer press, regulatory documents and study of the experience of leading specialists in the field of information and communication technologies and teachers of computer science and methods of teaching computer science.

The means of the study are structurally-logical analysis of the state of the problem and potential opportunities for the development of the idea of implementation of free software into the educational process and computer hardware park, corresponding to the problem.

To solving the research problem, system-analytical and constructive approaches were used that allowed to optimize the course of research.

## **1. SELECTION AND USE OF FREE SOFTWARE IN THE PROCESS OF PROFESSIONAL TRAINING OF THE TEACHERS OF COMPUTER SCIENCE**

In modern society, it is necessary to prepare a teacher who can effectively use in his professional activities a variety of software. It stimulates scientists and practitioners to reasonably select and apply software that meets the needs of a modern school. Solving the problem of implementing free software in educational institutions and state institutions in Ukraine requires a systematic approach and a certain set of activities.

Taking into account the experience of implementing free software in the educational process, the following problems can be distinguished:

- school curricula on computer science are mainly focused on the use of proprietary software;
- the amount of methodical literature is insufficient;
- the material base is obsolete, that limits the choice of current software;
- the management is not sufficiently interested in transition to the free software;
- some teachers have not an incentive to update teaching materials;
- the lack of motivation for students who are accustomed to use "the free" version of the most expensive software products;
- a large number of alternative software and at the same time an indefinite period of support (existence of a project).

Most of the above mentioned problems can be solved with a proper selection of free software for further use and study at the teachers' training university. In the course of the project implementation, the requirements were set for the selection of such software. In our opinion, selecting software involves solving the following tasks:

1. The software should provide the full range of services required by the users to perform their professional duties. Sometimes it is necessary to use a package of several free programs to replace the proprietary software.

For example, when transiting from the popular proprietary office suite Microsoft Office to the free LibreOffice, one should offer Scribus software as an alternative to Microsoft Office Publisher, as the LibreOffice package does not have a computer layout program.

2. The software must have an interface and a set of services similar to the product that the user has become accustomed to working with.

As practice shows, the transition to the use of anything new to the user is primarily related to overcoming the psychological barrier, which is a habit, even if this new set of services is much better than what they used to do. That is why, if the proposed new software product is close to that with which the user works, such barriers are much easier to overcome. Thus, the interface of the visual programming system Lazarus completely duplicates the Delphi interface. Therefore, the transition from Delphi to Lazarus does not cause a psychological barrier to its use.

3. The software must be cross-platform or such that allows easy use of emulation technology.

If a user already has a certain set of proprietary software, it is difficult to make him move to free software, taking into account the money spent on the paid product. And vice versa: if a user needs a set of programs that do not have the

appropriate free full-featured alternative (for example, "1C Enterprise"), he will need to use the appropriate platform. That is why it is necessary to use cross-platform products that allow to move freely from one platform to another. Also, there exist a lot of accumulated Windows-based applications that can be emulated using other operating systems (for example, Windows-based programs can be run on the GNU / Linux OS, Mac OS through the Wine emulation).

4. The software should be based on the use of open source code and document format.

Some closed-source software has been repeatedly seen in undocumented actions that violated the privacy of the user working with the computer. In particular, it is known that most Internet browsers transmit encrypted data packets to the developer, which includes information about the hardware component of the user, the sites that he visits, search engine queries, personal data, etc. Such software work is in fact uncontrollable by the user. The use of the open-source software product and the documents format enables, if desired, to control both the work of the software product and any operations with the document. In particular, in our opinion, after the adoption of the Open Document Format for Office Application (ODF) format as an international standard ISO / IEC 26300, it is promising to move away from circulation of documents in closed formats to open document formats.

5. The use of software should be pedagogically substantiated.

The developer of proprietary software for the purpose of selling should provide all possible tools that may be needed by a potential client. At the same time, the client himself cannot use 50% of this tool at all. On the other hand, the free software developer usually focuses on the main, most widely used tasks and tools that become the basis for learning.

6. The software should have a Ukrainian localization.

Practice shows that commercial software products are being localized only when the company-developer plans to get the appropriate return on sales. If one can do without a translation, the money for translation is usually not spent. This is largely due to the practical absence of software products with the Ukrainian-language interface: for most users there is enough already developed English-language or Russian-language interface. However, in the educational process, the use of such software products is pedagogically impractical. Free software in this case has significant advantages, since the majority of programs have the ability to use the Ukrainian-language interface.

Taking into account the above requirements, there was proposed a set of programs (Table 1) that allow, on the one hand, to perform a simple transition from proprietary to freely distributed software, and, on the other hand, do not reduce the

set of functional capabilities for the educational and production activities of the user.

The software listed in Table 1 has been successfully used for a long time in the organizational and educational process at the Faculty of Physics and Mathematics of Chernihiv Taras Shevchenko National Teachers' Training University.

**Table 1****Freely distributed software for use in the educational process**

<b>Software type</b>	<b>Name of open /free software</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Crossplatform</b>	<b>Alternatives</b>
Operating System	OSLinux (OpenSUSE, Debian)	Stability, reliability, convenient differentiation of rights	Somewhat higher hardware requirements for working with modern software		
Office suite	Libre Office	Better format support, more logical menu organization and document structure	Somewhat slower work, incomplete set of tools	*	KOffice, GNOME Office, Google Docs
Layout of documents	Scribus	More professional direction		*	
Archiver	7zip	Better compression ratio	Somewhat fewer additional features, a simpler interface	*	PeaZip, FreeArc
File manager	Konqueror, Nautilus, Far, Midnight Commander	No binding of the system to the file manager, better functionality			Dolphin, Thunar, Unreal Commander, Gnome commander
Pro-gramming system	Free Pascal, Lazarus	Full-time work in 32-bit mode, more libraries, work with Cyrillic		*	Geany, NetBeans, Eclipse

Declarative programming system	SWI Prolog			*	GNU Prolog
Email Client	Mozilla Thunderbird	Functionality, convenience		*	Sylpheed, Evolution
Raster graphic editor	Gimp	PhotoShop format support	Somewhat less functionality	*	Krita
Vector graphic editor	Inkscape	Wide features, ease of use	Somewhat less functionality	*	OO Draw, sK1
Audio editor	Audacity		Weaker functionality associated with licensing issues	*	
Video editor	KDEnlive, Avidemux, VirtualDubMod		Fewer "working" video formats		Kino, VideoSpin
Media player	VLC, Mplayer (and front-end), AIMP, Amarock	Great opportunities, significant support		*	Kaffeine, Audacious, cmus
Learning management systems	ITALC, LMS/LCMS: Moodle, Atutor, Efront	Simultaneous work with PC with different OS	Somewhat less functionality	*	VNC
Virtualization tool	VirtualBox	Advanced console features, convenience	Somewhat fewer additional features	*	QEMU
Text recognition tools	Online Software Version				CuneiForm, ocropus

The list of free educational software can considerably vary depending on the operating system and the learning course.

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*Source: Own work*

## **2. COMPONENTS OF THE FREE SOFTWARE-BASED METHODOLOGICAL SYSTEM OF COMPUTER SCIENCE TEACHERS TRAINING**

The implementation of free software in the educational process requires some changes and corrections in all branches of informatics education and their methods. As a result of the work on the project, the components of the methodical system of training the teacher of computer science were developed in the conditions of application of free software. The obtained results are reflected in the content of the textbooks used in the educational process of Chernihiv Taras Shevchenko National Teachers' Training University in order to accompany the training of professional disciplines of the curriculum. The content of each of the manuals is based on the many years of experience in teaching students of faculty of physics and mathematics and other faculties of the university relevant sections of the computer science course.

### **2.1. Elements of the methods of teaching freely distributed utilities**

The educational course "Information and Communication Technologies" deals with the issues related to the use of freely distributed program utilities, namely archivers on the example of the 7-Zip, file managers on the example of the Far Manager, browsers on the example of Mozilla FireFox, mail programs on the example of Mozilla Thunderbird, Virtual computers on the example of Oracle VM VirtualBox. The developed didactic materials can be used in the study of disciplines of computer a pedagogical educational institution, as well as in the independent mastering of the basics of work with such programs.

### **2.2. Elements of the methods of teaching office programs**

Elements of the methodology of office program training are used in the course "Computer science" and are intended to support the training of widely used office applications: the word processor, the spreadsheets, the program for creation of presentations on the example of a freely distributed office suite LibreOffice that has gained popularity in Ukraine and in the world.

The content of the LibreOffice's training materials covers the main functions of these software tools. When studying the word processor Writer the practical work of the following content is offered: input and formatting of text; creation and application of templates; processing objects (including getting acquainted with the editor of formulas Math); processing tables. The topics of practical work on the spreadsheets Calc, are the following: creating and formatting tables, performing calculations and graphic constructions; solving problems of the course of higher mathematics (matrix method for solving systems of linear equations, plotting functions, approximate solving equations with the help of parameter selection); solving optimization problems (for example, the problem of resource allocation and transport task); processing databases in the spreadsheets (sorting, filtering, summarizing, constructing a pivot table). The practical work of studying the



presentation design program Impress includes getting familiarized with the basic services of the program, and its contents relate to the review of the LibreOffice components, including the DBMS Base and the Draw graphics editor.

The task of each practical work is accompanied by basic theoretical information, as well as a detailed description of execution with indication of alternative methods. For control and self-control, a list of control questions is included that covers the content of all performed tasks. For each work there added ten variants of control practical tasks, divided on three levels of complexity that makes it possible to implement a differentiated approach to the formation of competencies to use the specific features of application software.

These teaching materials can be used during classroom classes, as well as for independent study of the features of freely distributed office packages, or as a collection of tasks for correspondence forms of study.

### **2.3. Elements of the methods of teaching databases**

The tendency of extensive use of databases exists in fact in all spheres of human activity. Such spreading of databases based on various data models in a wide variety of information technologies is the basis for in-depth study of database-related issues, and above all questions about data models, in the course of computer science at the pedagogical university.

Mastering the effective methods of processing data on the basis of their formalization and structuring with the help of information modelling becomes absolutely necessary for specialists of the diverse industries, and especially for future teachers of computer science.

In the theoretical part of the proposed teaching materials, the notion of data modelling is emphasized, in particular the formation of competencies in constructing conceptual data models. The practical part is focused on using the LibreOffice Base DBMS. This choice is due to the fact that this DBMS is part of the LibreOffice suite of office applications that is cross-platform (there are implementations for all popular operating systems: the family of Microsoft Windows operating systems, the Linux family, Mac OS X), and also freely distributed. At the same time, it is a powerful database processing tool.

The LibreOffice Base database is a powerful relational DBMS, which allows user to create complex databases and use the SQL language to generate queries. In current version 5, query for data selection can be created using the QBE language. But for requests for updates, addition and deletion of data, one must necessarily apply the SQL language, that implemented in a way that minimizes the possibility of unwise recurrence of such queries. This way of implementing database modification queries is more successful than MS ACCESS, for example, where modification queries can be triggered by inexperienced students many times without any restrictions, and the practice of MS ACCESS shows that this often leads to data distortion.

For the further formation of students' competencies in the analysis of the subject field of the problem, the construction of an information model (in this case, firstly ER-model, and then on its basis SQL-model), and the research of the resulting model, students are offered a series of three laboratory works. In the first work, students must, on the basis of the terms of a certain subject field, develop an adequate data model, and then define the entities of the subject field, their properties and the relationships between them. Then, on the base on this data model, students create appropriate tables, identify the keys of these tables, establish links between tables, create forms for inputting and editing data with the constraints on the values in the fields, and finally fill in tables with data.

In the second laboratory work students must develop queries to the database created in the previous work. Conditions for the queries are formulated in terms of the subject field. Queries for data selection and data calculation are proposed to be performed using the QBE language (in terms of the LibreOffice Base - in the query designer), and data modification queries must be described in SQL.

In the third laboratory work, students must develop reports (using computational fields) to the database created in the first laboratory work.

The tasks in laboratory work contain 12 options, so each student's subgroup performs its own version.

The considered materials are intended for students of physical and mathematical faculties of teachers' training universities, but they can be used by students of other specialties of universities, who study computer science, as well as teachers of computer science.

#### **2.4. Elements of the methods of teaching programming**

Due to the planned transition to the use of free software at the Faculty of Physics and Mathematics for the study of the basics of algorithmization were selected the programming languages Object Pascal and C ++ and, correspondingly, the programming environments Lazarus and Code::Blocks. The choice of these languages and environments is based on a large number of methodological manuals, sets of laboratory works, etc. It is important that these languages are the main languages at Olympiads in computer science for schoolchildren in Ukraine and in the world.

Like Delphi, Lazarus is an RAD environment (rapid application development), which allows user to quickly create a user interface. Unlike Delphi, Lazarus is a cross-platform application that supports OS such as GNU / Linux, Microsoft Windows, Mac OS X, FreeBSD, WinCE. IDE Code::Blocks is freely distributed and cross-platform as well.

The Lazarus environment is quite suitable for learning object-oriented programming, and its free and open source code, the ability to use this environment in commercial development legally, the ability to port their own applications on the

most popular platforms allows to use it for creation of rather complex cross-platform projects.

In the process of studying the basics of algorithmization and programming, students carry out a series of laboratory works, where the tasks are divided into three levels of complexity that makes possible the differentiated approach to the evaluation of learning results.

### **2.5. Elements of the methods of teaching modern operating systems**

In the process of teacher training with the systematic use of free software, it is extremely important for students to acquire competencies in the use and administration of modern, freely distributed operating systems. The GNU / Linux operating system has all the prospects to become the main operating system in the learning environment.

GNU / Linux is considered to be the most significant achievement in the field of free software. Today, the Linux family is in the forefront of server and server applications. At the same time, Linux is increasingly spreading as a regular office, home and gaming OS, like a free and honest operating system - GNU / Linux is becoming an operating system for education and training. As a result of the project, educational and methodological materials were developed to provide a new course of teaching operating systems that includes the main current trends in this field. The corresponding manual describes the theoretical content of the basic structure and functionality of modern operating systems, their main modules and components, as well as the main concepts, approaches to the organization and principles of operation in Linux operating system. The manual is intended for students of pedagogical universities studying the course "Modern operating systems" or similar one.

### **2.6. Elements of the methods of teaching e-learning courses creating**

One of the new learning technologies that is becoming widespread in an informative society is distance learning. In particular, Internet-based learning is most popular. Due to the development of the Internet and modern methods of communication and data exchange, it is possible to create and use new tools such as electronic notes, encyclopaedias, tests, glossaries, questionnaires, virtual laboratories, etc. One of the options for introducing such methods and technologies into the learning process is the use of learning management systems. The basics of using such systems are studied by students in the course "Creation and administration of distance educational resources". In order to accompany this course, educational and methodological materials are developed, which discuss the theoretical and practical issues of creating electronic training courses and manuals using free learning management systems. The presentation is based on LMS Moodle, eFront, Atutor, and EXE-Learning.

EFront is a new generation of e-learning systems that combines the functions of the Learning Management System (LMS) and the Learning Content Management System (LCMS).

The use of eFront helps to solve the tasks of organizing the educational process in educational institutions, as well as the tasks of professional development, certification and selection of employees in organizations of different sizes.

Moodle (Modular Object-Oriented Remote Learning Environment) is a free, open source distance learning system. The system implements the philosophy of "pedagogy of social constructivism" and focuses primarily on organizing the interaction between the teacher and the students, although it is also suitable for organizing traditional distance courses, as well as for continuing full-time learning.

Moodle is translated into dozens of languages, including a partial translation into Ukrainian. The system is used in 175 countries of the world.

The aim of the Moodle project is to provide teachers with the best tools for managing and accelerating learning.

LCMS ATutor makes it easy for teachers to organize various training courses. Students receive an adaptive and easy learning environment. Beside that ATutor is licensed under the GPL2 license, this program supports at the moment and in the future a number of standards that provide easy access to other software and easy third-party software development.

ATutor is a web-based system, easy to install, configure, and maintain for system administrators; Teachers (instructors) can easily create and transfer teaching materials and run their online courses. The system is modular, that is, it consists of separate functional units - modules, so it is open for modernization and expansion of functionality.

The developed teaching materials are used by students in the educational process. In addition, due to the modern requirements of the Ministry of Education of Ukraine, the teaching and methodical support of most curriculum disciplines should be submitted in the form of electronic learning resources. In this regard, at the Department of Computer Science and Engineering a workshop for teachers of all faculties for the development of electronic training courses and manuals has started. The participants of the workshop acquire the necessary competencies in using the developed methodical support.

## **2.7. Elements of the methods of teaching computer graphics and multimedia**

In the analysis of available free software and its selection for use in the course "Computer graphics and multimedia technologies" it was found that existing open-source programs can cover the entire spectrum of study of the elements of computer graphics and multimedia technologies in secondary schools and high institutions.

For the formation of students' competencies in the processing of graphic, audio and video data in the educational process freely distributed analogues of popular proprietary programs are used. In particular, the raster graphics editor, GIMP (GNU Image Manipulation Program), is a serious alternative to the Photoshop for semi-professional raster graphics processing. For vector graphics processing one can use the Draw program from the LibreOffice package, which can replace software products such as Corel Draw, Xara Designer, or Adobe Illustrator for high school needs. The Inkscape program is a vector graphic editor designed to create artistic and graphic illustrations (including animated), and can also be used as a general-purpose automated design system.

It is suggested that one should study the audio on the base of the Audacity program. This audio editor allows to work with multiple audio tracks at the same time, apply standard methods of sound processing, make sound recordings. Formation of competencies for video data processing is carried out using Avidemux video editor, which supports a large number of video file types, has a simple and convenient data processing tool, multilingual interface and a rich set of various filters.

It's worth noting that GIMP, Inkscape, Audacity, Avidemux software are cross-platform, that is, operate under different operating systems, including Linux, Free BSD, MacOS. Such independence from a platform gives significant benefits to the user in his further professional activities, increases the flexibility of the learning process and simplifies the transition to the use of various operating systems.

## CONCLUSION

The main results of the project "Development of components of the free software-based teaching methods of computer science for students of teachers' training institutes of higher education", are:

1. The didactic potential of free analogues of commercial software that is widely used in educational institutions has been substantiated.
2. Selection of free software for application in the educational process of the schools and pedagogical institutions of higher education has been carried out.
3. Educational software products have been developed and improved: a test program Tester has been created, a teaching and methodical complex Gran, recommended by the Ministry of Education and Science of Ukraine for use in the educational process of schools and universities, has been improved.
4. Methodical support of training courses of information orientation, aimed at preparing students for the effective use of free software in their further professional activities, has been developed.

5. The methodical system of teaching information modelling on the basis of the use of free software has been developed and tested. This work has led to a successful dissertation by Y. V. Horoshko "System of information modeling in the training of future teachers of mathematics and computer science" for the scientific degree of the Doctor of Pedagogical Sciences in specialty 13.00.02 – Theory and Methods of Teaching (computer science).
6. The methodical system of teaching programming based on the application of free software has been developed and tested. This work has led to a successful dissertation by A. O. Kostyuchenko "Methodical system of training pre-service teachers of mathematics and computer science for the development of educational software tools" for the scientific degree of the Candidate of Pedagogical Sciences in specialty 13.00.02 – Theory and Methods of Teaching (computer science).

Experience and results of the research are presented in 24 publications in scientific editions of Ukraine and abroad.

The didactic materials developed during the work on the project were implemented into the educational process of Chernihiv Taras Shevchenko National Teachers' Training University, Chernihiv K.D. Ushinsky Regional Institute of Postgraduate Pedagogical Education, National Pedagogical Dragomanov University.

As a direction of further research the team of project implementers consider work on the problem of developing components of the methodical system of teaching computer science, that will form the pre-service teachers' professional competence not only in the use of available free software, but also in the creation of author educational software for organizing an effective learning process in a modern school.

## REFERENCES

- Assemblée nationale, [on-line] at <http://www.assemblee-nationale.fr/14/ta/ta0180.asp>, (accessed 2 August 2017)
- Goroshko, Yu.V., 2015: *Theory and methodology of working with databases*. Chernihiv, 2015. P. 78. [In Ukraine]
- Goroshko, Yu.V., Kostyuchenko, A.O, 2011: *Theory and methodology of pedagogical software development*. Manufacturing Yermolenko O. M., Chernihiv, 2011. P. 144. [In Ukraine]
- Goroshko, Yu.V., Tsybko, G.Yu., Vinnychenko, E.F., Shkardybarda M.I., Kostyuchenko, A.O., Penkov, A.V., 2013: *Selection of freely distributed software for use in pedagogical university*, The Bulletin of Chernihiv Taras Shevchenko National Teachers' Training University Series: Pedagogical Sciences, issue 113. P.125-129. [In Ukraine]

- Goroshko, Yu.V., Tsybko, G.Yu., Vinnychenko, E.F., Shkardybarda M.I., Kostyuchenko, A.O., 2013: *Method of using freely distributed utilities*. Publisher Lozovy V.M., Chernihiv: 2013. P.50. [In Ukraine]
- Kostyuchenko, A.O., Shkardybarda M.I., 2013: *Theory and method of creation of electronic tutorials*. Publisher Lozovy V.M., Chernihiv: 2013. P.104. [In Ukraine]
- Shkardybarda, M.I., 2013: *Modern operating systems. Linux: Tutorial for Students* Publisher Lozovy V.M., Chernihiv: 2013. P. 133. [In Ukraine]
- Tsybko, G.Yu. 2013: *Office Suite LibreOffice. Workshop: A manual for students/* Publisher Lozovy V.M., Chernihiv: 2013. P.136. [In Ukraine]
- Tsybko, G.Yu., 2013: *On the concept of the work of the Department of Computer Science at the Chernihiv Pedagogical University*. The Bulletin of Chernihiv Taras Shevchenko National Teachers' Training University Series: Pedagogical Sciences, issue 113. P. 157-159. [In Ukraine]
- Vinnychenko, E. F., 2015: *Basics of computer graphics*. Chernihiv, 2015. P. 52. [In Ukraine]