

## Methodical aspects of preparation of educational content on the basis of distance education platforms

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**Abstract.** The urgency of application of technologies and means of distance learning in educational process of higher educational institutions is designated. The growing frequency of using cloud services and electronic textbooks in mobile and distance learning is noted. The importance of building educational environment is highlighted, where the key element is e-learning resources in digital form, including structure, subject content and metadata about the course. For higher educational institutions, the need for methodical support for the preparation of educational content on the basis of distance education platforms is determined. The experience of using the free distance education platform Moodle within the framework of the higher educational institution Donbass State Engineering Academy is considered. Methodical aspects of training content preparation on the basis of distance education platforms on the example of MoodleDDMA system are given. The General structure of the distance course and an example of evaluation of test tasks of the distance course (module) on topics are considered. An example of the presentation of the course on the basis of distance education platform MoodleDDMA is given. Conclusions about the experience of using the Moodle distance education system at the Donbass State Engineering Academy from the point of view of teachers and students are drawn. The perspective directions of researches and development of the Moodle distance education platform in completion and expansion of educational materials by multimedia elements and links, and also creation of the application for mobile devices for possibility of more effective use of the platform are allocated.

**Keywords:** educational content, electronic textbook, distance education, distance education platform, mobile learning, Moodle.

## 1 Introduction

Distance education as a form of education is now quite widespread in the training system. The introduction of distance learning in the educational process allows you to solve a number of problems facing higher education institutions. The priority among them can be attributed:

- ensuring equal access of young people to a full quality education in accordance with their interests and inclinations, regardless of the material wealth of the family, place of residence, nationality and health status;
- ensuring the flexibility of the education system, expressed in its organization, taking into account the individual schedule of classes of the student;
- ensuring the possibility of obtaining “lifelong education”;
- elimination of problems of regional higher education institutions consisting in supply of regions with qualified engineering personnel according to the changing strategy of development of the region.

That is why the use of technologies and means of distance learning in the educational process of higher educational institutions is reflected in the works of a large number of researchers.

## 2 Review

Active use of cloud data storage in distance education is becoming more and more common and even necessary. The use of cloud services and electronic textbooks in mobile and distance learning has been reflected in the works of many scientists. So, in [15] the directions of educational researches of cloud systems of training are studied. In [7] V. Ivashova, V. Goncharov, A. Erokhin, O. Kolosova, M. Migacheva and V. Berkovsky discuss the general problems of education in a digital society, including electronic educational environments of educational organizations.

In [4] Isaías González, Antonio José Calderón, João Figueiredo and João M. C. Sousa are presented an overview of the latest open communication platforms for various fields, research projects, education. In the analysis, the authors pay special attention to new paradigms related to the Internet of things, cyber-physical systems, Industry 4.0 and emphasize the need to take them into account in the work of such open systems.

In [6] Purwono Hendradi, M. Khanapi and Siti Nurul Mahfuzah Mohamad is considered the architecture of e-learning system based on cloud computing in Education 4.0. However, consideration of problems and errors used for virtual training systems remains not sufficiently open. In addition, there is an important question of the quality of electronic textbooks and the possibility of access to them from mobile devices both on the Internet and in specialized applications and distance education platforms, methodical aspects of the preparation of educational content on the basis of such platforms.

Continuous improvement of mobile devices and intensive development of cloud

technologies and cloud computing has led to the emergence of a new direction of application of information technologies in education – mobile learning or m-learning, which is closely related to the concept of distance education. The main technical tools of such training are mobile Internet devices [12], such as tablet computers, smartphones, navigators, readers and other devices that provide work with information, i.e. devices that have IMEI (international identifier of mobile equipment, running on mobile operating system iOS, Android etc.), supporting work in mobile networks (preferably 3G and 4G generations) and Wi-Fi technology.

Meeting the above requirements for mobile devices and communication channels and allows you to implement information and educational environment of mobile learning based on cloud services. The advantage of such devices is that they always accompany modern man, have a small size and can be connected to the Internet almost anywhere in the world. From this perspective, mobile learning can be considered to be any learning activity that primarily or exclusively uses mobile devices and networking technologies, but not conventional desktop computers with installed software.

The success of such training for which the main factor is independent work depends on the development of the information educational environment, where the key element is e-learning resources in digital form, including structure, subject content, and metadata about them. Most often, electronic educational resources in mobile and distance learning are presented in the form of electronic courses, the principles of which are constantly changing [13]. Currently, there is an intensive tendency to replace closed courses with open ones, accessible not only to a certain circle of users, but also to all interested students. For higher educational institutions in such conditions, it is important to provide methodical support for the preparation of educational content on the basis of distance education platforms.

### **3 Discussion and results**

There are many applications (most of which are web applications) available under an open source license for the development of e-courses. They also include platforms for creating interactive books or textbooks.

Integration of electronic textbooks and cloud services into the learning management system is one of the most important tasks in higher education institutions. Building a virtual learning system based on cloud services allows you to use new methods of managing educational content and organizing interaction with students. But for its high-quality use, it is also necessary to prepare high-quality electronic textbooks themselves.

Electronic textbook – (E-book) is a software and methodical training complex corresponding to the standard curriculum and providing the opportunity for the student to master the training course or its section independently or with the help of a teacher. This product is created with built-in structure, dictionaries, search's capability. An electronic textbook is an information product of an educational nature, unlike a "paper" textbook in that it can be viewed only with the help of a computer. It can be designed for self-study of educational material in a particular discipline or to support a lecture course for its in-depth study.

E-books come in several types:

1. Full or partial copies of paper editions. As a rule, these copies are distributed not quite legally, because the authors of the publication wanted to sell a paper book, and did not plan to engage in charity. It is even difficult to imagine a person scanning a textbook on 800 sheets and placing it on the network for free, but there are such. Scanned textbooks, magazines and other literature can be found electronically on the Internet.
2. Free e-books and magazines. Most often, authors release them to create viral traffic. The essence of viral traffic is as follows: users download e-books, which have links to the author's website and advertising of the author. If users like the book, they give links to the book on forums, blogs, on their websites, and thus contribute to the distribution of the book. Thus, it turns out some flow of visitors to the author's website and response to advertising in the book. Examples of books for creating viral traffic can be downloaded from the link at the bottom of the article. This is usually a small volume of the book, though there are large. If you take the sellers of electronic books and manuals, they either make translations of books by foreign authors, or make collections of articles.
3. Paid e-books. Authors write them for the purpose of the subsequent sale. These are various manuals and guides, often in one way or another related to earnings. In terms of volume, books often fall short of paper editions, but can be much more informative [5].

E-books allow you to save time and get up-to-date information. In e-books, you can find more concentrated and useful information, in this case, the price will be justified. It would seem that the cost of an e-book may exceed the cost of paper books, but the paper counterpart you can simply not find, or find, but not quite what you need. E-books can be an important source of information. E-book has a number of fundamental differences from the textbook made by the typographic method: the possibility of multimedia; providing virtual reality; a high degree of interactivity; the possibility of an individual approach to the student. The introduction of multimedia elements into the structure of the electronic textbook allows simultaneous transmission of various types of information. This usually means a combination of text, sound, graphics, animation, and video. Many processes and objects in the electronic textbook can be represented in the dynamics of their development, as well as in the form of 2D or 3D models, which causes the user the illusion of reality of the objects depicted [9]. Interactivity allows you to establish feedback from the user of information (student) to its source (teacher). For interactive interaction is characterized by immediate response and visually confirmed reaction to the action, message [1].

Electronic textbook has certain advantages over traditional types of textbooks:

1. The study of the material may not be related to the time frame (schedule of classroom classes).
2. It can develop skills of independent work by students.
3. The structure of the textbook helps to establish control over the study of certain blocks of topics.

4. Electronic textbooks may have additional features compared to the paper version. One such possibility is the use of links to access the Internet. The teacher connects the PC to the network and can comment on certain Internet sites with literature.

Currently, the Internet is replete with offers of many electronic textbooks for universities. The teacher, before applying a particular textbook in the educational process, must understand the program of the subject and the textbook itself.

Electronic textbooks (ET) of the new generation should be focused on new teaching methods, especially distance learning, active knowledge of the world of students, increasing the role of independent work of students with information, filling the shortage of laboratory equipment in some universities. They should provide methodical support for the learning process, using the full range of multimedia capabilities of the ET to create new tools and forms of learning. The electronic textbook should meet the tasks of forming a new content of education and new models of educational activity using information and telecommunication technologies, models of formation and application of information and communication competence of students in educational activities, taking into account the variability and individualization of education.

The next generation of ET should include (as minimum) the following systems:

- the nucleus (the control module) course;
- illustrated educational and reference complex;
- complex of virtual laboratories and interactive models;
- testing complex integrated with the task database;
- search complex;
- help system;
- methodical support system;
- search system for similar information on the Internet.

The principles of mobile and distance learning using cloud services and electronic textbooks are increasingly being implemented in the practice of higher education by students. Thus, in the Donbass State Engineering Academy of the Ministry of Education and Science of Ukraine (DSEA, Kramatorsk), students have the opportunity to use the distance education platform Moodle (<http://moodle.dgma.donetsk.ua/>) have access to electronic textbooks and other teaching materials on the Internet, including on mobile devices. The choice of the Moodle system is justified by the fact that Moodle is open source software (under the GNU Public License). This means that Moodle is protected by copyright law, but users have ample opportunities to use it. Moodle can be installed on any computer on which a Web server that supports PHP is installed, as well as a SQL-type database (for example, MySQL). It can be started on Windows and Mac operating systems and many versions of Linux (such as Red Hat or Debian) [13]. Moodle has a large number of partners who works with Moodle and can help in working with it. Main features of Moodle: the system implements the philosophy of “Pedagogy of social constructionism” (cooperation, action, critical thinking, etc.); 100% suitable for the organization of online classes, as well as suitable for the organization of traditional learning; distance learning system Moodle is: simple, easy, effective, compatible with various products, making low requirements to the browser; the system

is easily installed on most platforms that support PHP; the system requires only one database; the list of courses hosted in the Moodle distance learning system contains a description for each course; distance courses can be categorized; searchable by distance courses; special attention is paid to the high level of security of the system; most pages can be edited with the built-in editor [2; 3; 11; 14; 17].

The main advantage of Moodle distance learning system is the possibility of its free using. At the same time, the functionality of the distance learning system in the Moodle system is not inferior to commercial analogues. Another important advantage of the distance learning system Moodle is that it is distributed in open source, which allows you to adapt it to the specifics of the tasks that must be solved with its help. Distance learning tools built into the Moodle distance learning system reduce the cost of developing educational content and solve compatibility problems of distance learning courses [11; 15].

Methodical aspects of the preparation of educational content on the basis of the Moodle platform involve the development of specialized distance learning courses by higher education institutions. In the Donbass State Engineering Academy, appropriate plans for such courses are developed and approved at the departments. The structure and content of the distance course must meet the requirements that are put forward by the decision of the specialized Methodical Council of the Academy. Thus, the distance learning course should be considered as an information product developed on the basis of Internet technologies (Moodle platform), which provides presentation of the content of training, organization of interaction of participants of the educational process, support for management and monitoring of independent educational activities of students. For technical and methodical reasons, optimal the block-modular structure of distance learning software is considered. The Moodle platform is designed as a set of modules and allows you freely to add or remove elements at different levels, and therefore fully complies with the specified requirements.

Taking into account the above the general structure of the distance course is as follows (Table 1).

**Table 1.** The general structure of the distance course

Discipline forum (created automatically by the Moodle system)	
Educational and Methodical Complex of Discipline	
Goals and objectives of the discipline	
Module 1	Module N
Theme 1.1	Theme N.1
Question 1.1.1, Question 1.1.2	Question N.1.1, Question N.1.2
*** Question 1.1.m	*** Question N.1.m
Conclusions on the theme	Conclusions on the theme
Question for self-control	Question for self-control
Test (training) exercises for theme 1.1	Test (training) exercises for theme N.1
Literature for theme 1.1	Literature for theme N.1
Theme 1.2 *** Theme 1.k	Theme N.2 *** Theme N.k
Final control on the theme	Final control on the theme
Glossary	

The formation of web-pages with lecture material within the information and

reference block is proposed to be implemented with the help of an internal text editor of the Moodle system. The display of mathematical formulas and chemical reactions in the course topics is provided by the using of add-ons – Math & Science by WIRIS and Chemistry editor. The functionality of the add-ons almost completely corresponds to the capabilities of the formula editor Microsoft Equation 3.0.

An additional possibility of transformation of complex mathematical formulas created in the Microsoft Word editor into a format compatible with the Moodle system is provided by the Math Type 6.9 program. The formation of drawings and graphic illustrations is recommended to implement through the program Lightshot 5.1.4.1 for Windows (open-source). The link to these programs is presented on the main page of the MoodleDDMA platform.

A prerequisite for the effective functioning of the control and evaluation unit of the distance course is the presence and sufficient filling of the “Bank of questions”. “Bank of questions” provides integration of tests as control elements in separate subjects of a course or formation of final (training) testing. The formation of the “Bank of questions” is possible directly in the Moodle environment, or by importing tests prepared in an external program “Izido-Converter”. Each course topic is expected to end with 20 practice tests. The sample of the assessment of test problems for the course (module) from 10 topics is given in Table 2.

**Table 2.** Assessment of test tasks of a distance course (module) on 10 topics

Course component	Points	Explanations
Training part of the course 10 themes * 20 tests = 200 tests	200*0,1= 20 points	Passing the training part is possible at any time during the study of the course (module) and is not required. (At the same time, only training testing allows the student to get acquainted with the tests and the correct answers to them). The student has several attempts (from 3 to 5) to provide the correct answer to the tests. After exhausting the attempts, the student is credited with the points actually received and the Moodle system provides a bug report and correct answers.
The control part of the course (module) - 20 tests [formed randomly] of a theoretical and practical orientation (including in the form of an essay that can be independently assessed by the teacher)	20*4= 80 points	The passage of the control part is possible only at a certain and limited time on the eve of the examination session. The student has one attempt to provide the correct answer to the tests. After passing the control test, the student is credited with the points actually received and the Moodle system provides a bug report and the correct answers.
Total	100 points	Remote study of the course (module) is considered credited if the student receives a minimum of 55 points. In case of insufficient points, an additional attempt to pass the control test is provided.

Thus, it is proposed to use the proposed distance course structure and the principle of assessment of test items as the basis for the formation of courses in the MoodleDDMA system. At the same time, when developing distance learning courses, it is necessary to take into account the requirements of the basic structure of the distance learning course and the volume of test tasks in the Question Bank.

On the Fig. 1 is shown as an example the structure of course The Methods of Mathematical Processing of Medical Biological Data System of MoodleDDMA. Example of placement of the course program of the discipline The Methods of Mathematical Processing of Medical Biological Data system MoodleDDMA is presented on the Fig. 2.

The screenshot shows the MoodleDDMA course interface. At the top, there is a blue header with the course title 'Платформа дистанційної освіти ДДМА' and the course name 'Methods of mathematical processing of medical biological data'. Below the header, there is a navigation menu with options like 'Dashboard', 'English (en)', 'My courses', and 'This course'. The main content area is divided into several sections: 'Course program' with a 'SYLLABUS' icon, 'Methodically secure theoretical part' with a 'Tutorial' icon, 'Methodically secure laboratory part' with a 'Tutorial' icon, and 'Control knowledge of students' with a 'Test' icon. On the right side, there is a sidebar with 'NAVIGATION' and 'ADMINISTRATION' sections. The 'NAVIGATION' section includes links to 'Dashboard', 'Site home', 'Site pages', 'Current course', 'MMPMBD', 'Participants', 'Badges', 'General', 'Course program', 'Methodically secure theoretical part', 'Methodically secure laboratory part', and 'Control knowledge of students'. The 'ADMINISTRATION' section includes links to 'Course administration', 'Turn editing on', 'Edit settings', 'Users', 'Filters', 'Reports', 'Grades', 'Gradebook setup', 'Badges', 'Backup', 'Restore', 'Import', 'Reset', 'Question bank', 'Competencies', 'Recycle bin', and 'Switch role to...'. There is also a search bar and a 'Go' button at the top right of the main content area.

**Fig. 1.** The typical structure of learning courses as an example of discipline The Methods of Mathematical Processing of Medical Biological Data of distance education platform MoodleDDMA

The advantages of the Moodle distance learning system include ease of installation, as well as updates when switching to new versions.

Learning with using of the Moodle platform allows:

- to organize productive independent work of the student on mastering of an educational discipline;



- to contribute to the formation of professional competencies, mobility, ability to seek and acquire new knowledge;
- to give a new quality to learning, providing constant access to information at any time;
- to promote flexible learning based on new opportunities (cloud services, e-books, video conferencing and video lectures);
- to provide effective feedback.

The screenshot shows a Moodle course page with a sidebar on the left containing several document thumbnails. The main content area displays the following information:

**DESCRIPTION/Syllabi of Curricula/Module**

Short Name of the University/Country code Date (Month / Year)	DSEA/ P11 Jan 2019
<b>TITLE OF THE MODULE</b>	
Methods of mathematical processing of medical biological data	

Teacher(s)	Department
Coordinating: Iryna Getman, PhD Others:	Department of Computer and Information Technology (CIT)

Study cycle (B.A/M.A)	Level of the module (Semester number)	Type of the module (compulsary/elective)
Bachelor	6 <sup>th</sup> semester (third year) for Bachelor	elective

Form of delivery (theory/lab/exercises)	Duration (weeks/months)	Language(s)
lectures, lab	18 weeks 6 <sup>th</sup> semester	Ukrainian / English

Prerequisites	
Prerequisites: the study of the disciplines "Probability theory, probability processes and mathematical statistics", "Digital Processing of Biomedical Signals"	Co-requisites (if necessary): Statistics, MS Excel

Page 1 of 4

Fig. 2. The example of placement of the course program of the discipline The Methods of Mathematical Processing of Medical Biological Data System MoodleDDMA

The use of the educational platform Moodle in teaching students contributes to the implementation of the principles of consciousness and activity in learning, the development of self-consciousness. At the same time, consciousness in mastering the material by students largely depends on the activities of the teacher, who needs to

constantly monitor the attention of students in the learning process, stimulate it with the formulation of problem situations. The advantage of such training is the emergence of opportunities for students to perform training tasks in any convenient place and in their spare time. In addition, the use of modern computer technology in the learning process allows you to get skills that will be useful in work and everyday life.

The experience of using such courses in the correspondence Department with distance learning allows us to conclude that in addition to the progress of the course program, the student has the opportunity to access the material that is given for independent study. The system also provides the ability to test their knowledge by testing, which makes more effective using of electronic learning materials.

A typical disadvantage of distance education systems is the lack of contact with the physical object of the educational process. MoodleDDMA is no exception. This problem can be eliminated by providing an interface between the system and the physical object using specialized application packages, however, as a rule, they are paid [8; 10]. In addition, augmented reality technologies are not currently presented in the MoodleDDMA system. Such technologies can be provided using development platforms for creating multi-platform 2D and 3D interactive content such as Unity3D [8; 10; 18].

On the other hand, not all students are comfortable working with digital sources presented in the MoodleDDMA system. For this reason, many students print materials and work with printed versions of courses downloaded in the MoodleDDMA system. In addition, there are a number of conflicting opinions about the use of digital material for teaching, in particular the Manfred Spitzer study [16].

However, the predominance of the advantages of using the MoodleDDMA distance learning platform and the ability to eliminate the indicated system shortcomings allow us to conclude that the use of such systems is effective for organizing the educational process in modern higher education.

## 4 Conclusions

Thus, to improve the quality of distance learning, the use of cloud services and electronic textbooks in mobile learning is promising and effective for students, such as:

- facilitates the understanding of the study material due to other than in the printed educational literature, methods of presentation of the material;
- allows adaptation according to the needs of the student, his level of training, intellectual abilities and ambitions;
- allows you to focus on the essence of the subject, consider more examples and solve more problems;
- provides a wide range of opportunities for self-examination at all stages of the study of educational literature;
- plays the role of an infinitely patient mentor, providing almost unlimited number of explanations, repetitions, hints.

The electronic manual will allow the student in the process of using cloud services and

electronic textbooks in mobile and distance learning to gain strong and comprehensive knowledge and skills in the subjects.

In turn the use of cloud services and electronic textbooks in mobile and distance learning by teachers shows the effectiveness and usefulness as follows:

- allows the teacher to conduct classes in the form of independent work on various mobile devices, reserving the role of leader and consultant;
- allows the teacher to use mobile devices to effectively monitor the knowledge of students, set the content and level of complexity of the control event;
- allows to make lectures and practical classes material at its discretion, perhaps smaller in volume, but the most significant in content, leaving for independent work with the electronic manual that was outside the classroom;
- frees from the tedious checking of homework, typical calculations and control works, transferring the effectiveness with the help of mobile devices by testing;
- allows to optimize the ratio of the number and content of examples and tasks considered in the audience and asked at home;
- allows you to individualize work with students, especially in terms of homework and control activities.

The experience of using the Moodle distance education system at the Donbass State Engineering Academy allows us to conclude that the new generation of electronic textbooks should be focused on new methods of teaching, active knowledge of the world, increase the role of independent work of students with information. They should provide methodical support for the educational process, using a full set of multimedia capabilities to create new tools and forms of learning and should comply with the following rules:

- information on the chosen subject or course should be well structured, and represented complete fragments of the course with a limited number of new concepts;
- key topics with hypertext, illustrations, audio and video comments should correspond to the structural elements of the training course;
- the main parts of the textbook along with the text should contain video and audio recordings containing material on the topic under study;
- the text information should be able to print out the required text fragments. It should be possible to adapt the font used to the user's needs;
- a system containing complex models must contain instantaneous hints that appear and disappear in sync with the movement of the cursor to the individual elements of the program, in addition to the ability to increase the individual elements of illustrations and copying;
- a multi-window interface should be used, with each window presenting related information;
- the text part should be built on the basis of cross-references, allowing to reduce the search time of the necessary information, as well as a powerful search center and index;
- it is useful to connect audio signals to indicate the correct navigation of the electronic

textbook;

- the entire course should contain the ability to copy the selected information, as well as its editing and printing on the printer;
- electronic textbook should have fundamentally new qualities compared to a traditional textbook.

Thus, the use of cloud services and electronic textbooks in mobile and distance learning is a modern and effective means of obtaining higher education. Training using the Moodle platform and the proposed methodical aspects of the preparation of educational content allows you to organize a productive independent work of the student to master the discipline, contributes to the formation of professional competence, mobility, the ability to seek and acquire new knowledge, gives a new quality of learning with constant access to information at any time, and also contributes to the formation of flexible learning based on new opportunities (cloud services, electronic textbooks, video conferencing and video lectures) and allows you to provide effective feedback of the teacher and the student.

Typical shortcomings of distance learning platforms, including the lack of contact with the physical object of the educational process, the temporary lack of presentation of augmented reality technologies in some systems, the presence of conflicting opinions on the use of digital material for learning, do not reduce the relevance and effectiveness of their use for organizing the educational process in modern higher education.

A promising area of research and development of the MoodleDDMA distance education platform is the refinement and expansion of educational materials with multimedia elements and links, as well as the creation of an application for mobile devices to enable more efficient use of the platform.

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