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APPLICATION OF MODERN INFORMATION AND COMMUNICATION TECHNOLOGIES TO CREATE A VIRTUAL LEARNING ENVIRONMENT AT THE UKRAINIAN NATIONAL FORESTRY UNIVERSITY

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Abstract

This paper describes a didactic model, developed by the authors, of Electronic Training Courses (ETCs) and the main approaches to their creation in the Moodle Learning Management System (LMS). This model has been applied during the development of ETCs for blended learning during the introduction of distance learning at the Ukrainian National Forestry University (UNFU). As a result of applying this model, we integrated 80-90% of ETC data into the Moodle LMS by using a package of cloud services “G Suite for Education” by Google.

In addition, an improved hybrid model is proposed that shows the relations of information and communication technologies with which the Virtual Learning Environment (VLE) was created at UNFU. This model improves the coordination of the use of human and material resources in the process of implementing distance learning at UNFU. The developed hybrid model, which is the basis of the VLE at UNFU, was successfully tested during the academic years 2015-2019 at the Department of Information Technologies of UNFU. This model ensured a successful and rapid transition from face-to-face learning (traditional learning) to distance learning throughout the university at the beginning of the Covid-19 pandemic.

Keywords: Distance Learning, Didactic model of ETCs, Electronic Training Courses, Moodle LMS.

Introduction

Electronic Training Courses (ETCs) belong to the main components of information and communication technologies. They use technologies providing an opportunity to implement the process of individual and group distance learning in educational institutions. These technologies should be used not only in distance learning as a specific form of learning, but also for the organization of the learning process in any other form of learning. The combination of traditional learning with distance learning technologies creates a new type of learning, namely, the "Blended Learning System" (Bonk and Graham, 2006). The Covid-19 pandemic, starting in 2020, has provoked the transition of programmes of educational institutions around the world from face-

to-face to distance learning and further use of a mixed form of education as the quarantine measures will get relaxed.

The lack of standards in Ukraine regulating the creation of ETCs means that each educational institution is supposed to develop its own regulations and guidelines (Fedasyuk, 2013). As a result, educational communications between higher education institutions of Ukraine and the exchange of ETCs has become more complicated. Under these conditions, it is important to standardize ETCs within universities from the first stage of the distance learning implementation.

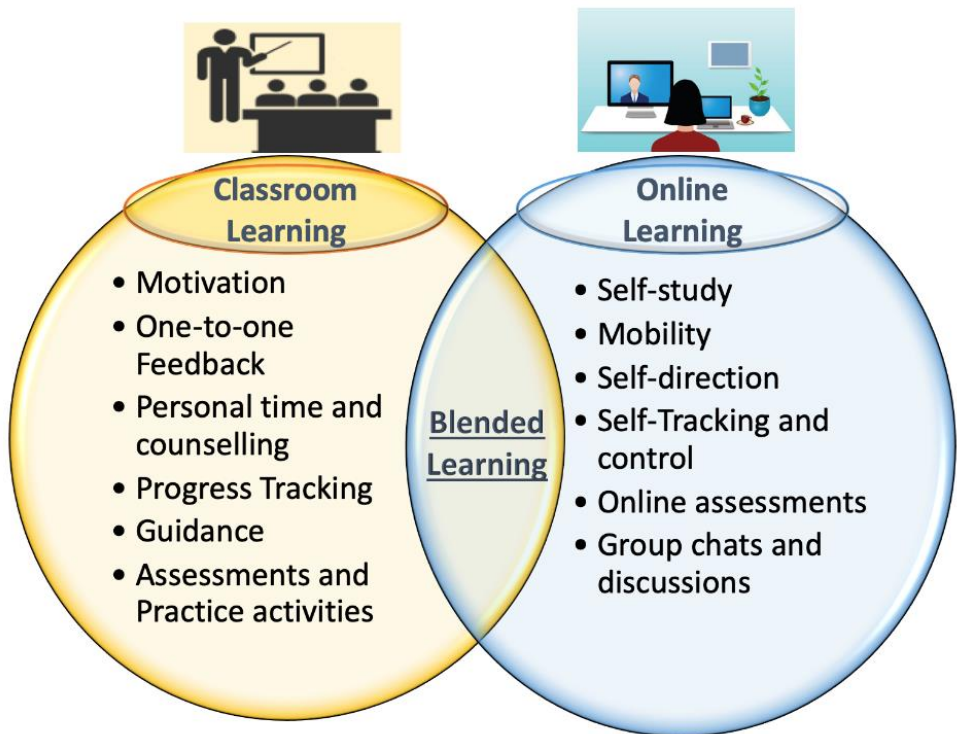


Figure 1. A new type of learning – the "Blended Learning System". (from Blended Learning, 2022).

ETCs have long been major components of modern information and communication technologies. Such ETCs allow teachers to use modern technologies in the implementation of the process of individual and group distance learning in higher education. It is clear that such technologies can be used to organize the learning process in any other form of learning and not only in distance learning. In turn, to create a "Blended Learning System" (Figure 1) it is necessary to combine traditional and distance learning technologies (Blended Learning, 2022). In 2010, the process of transition from traditional learning to blended learning was initiated at the Department of Information Technologies of the Ukrainian National Forestry University (UNFU). At the initial stage, three teachers of this department took part in this experiment. In

2012, the number of teachers who took part increased significantly. This was directly related to UNFU getting a subscription to the package of cloud services "Google Apps for Education" (currently "G Suite for Education") from Google Inc. In general, blended learning brings fundamental changes to the education system by combining digital technologies and active learning methods, which in turn significantly improves the entire learning process.

Approaches to the implementation of distance learning

The system of distance learning at UNFU at the beginning was implemented based on a hybrid service model that is shown in Figure 2. This model was chosen as a basis of the Virtual Learning Environment (VLE) of the Department of Information Technology.

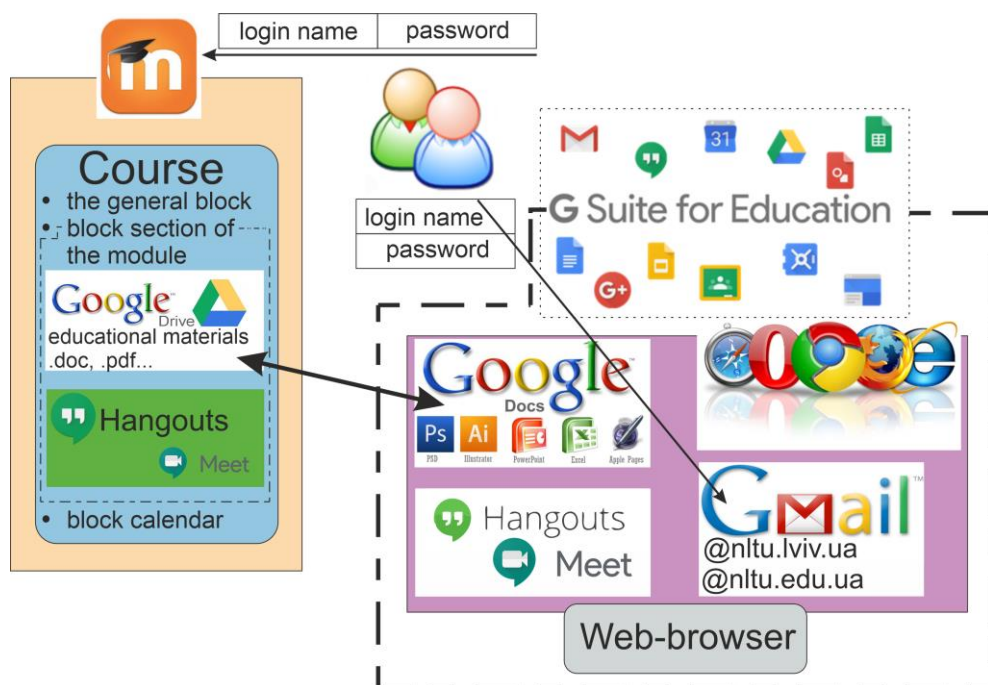


Figure 2. The initial version of hybrid model of communications in the cloud environment developed by the authors and tested at the Department of Information Technologies of UNFU (from Sokolovskyy et al., 2015a).

The proposed hybrid model allows us to use information technologies in the learning process in any form. To use Google Apps services, students and teachers get an e-mail address, which is both an account for all Google services and the VLE of UNFU. E-mail addresses for students are grouped, which makes it easier to communicate with them, for instance to send an e-mail to all students, to invite them for a meeting or to send educational material to all.

After completing the authorization procedure, the student gets access to the courses taught to him in the current semester. To support the standardization of ETCs, it was decided to make a structure of a typical course which includes:

- General block, which is formed from:
 - News;
 - Information about teachers;
 - Work programme of the course;
 - List of control questions;
 - Other.
- Module section block (a complete block of information that comprises a complex didactic goal) that contains:
 - The name of the module;
 - Information resources of the module;
 - Lecture materials;
 - Instructions for laboratory or practical works;
 - Other.
- Calendar block which displays events relating dates and times, including:
 - Course consultations;
 - Conducting tests;
 - Control measures;
 - Other.

The “Module Section Block” is a constituent part of an ETC. Educational materials in an ETC for the student are displayed as HTML (Hyper Text Markup Language) links; by default HTML links are displayed as underlined blue text. These HTML links open educational materials located on Google Drive. Google Drive provides a view of the educational materials without the need to install special software on laptops, mobile phones and other electronic devices used by students and teachers to work with the ETC.

In order to gain access to educational materials, a student must go through a two-stage authorization procedure. At the first stage, the student needs to enter a password, and at the second stage, the student needs to confirm his login in the form of a notification that comes to his phone from Google. This approach significantly increases content security. Since the content is accessed and stored using Google cloud services, it helps reduce the load on the server hosting Moodle. The Hangouts service allows us to conduct classes in video conference or webinar mode.

Didactic model of distance learning structure

The lack of standards in Ukraine regulating the creation of ETCs leads to the development of own regulations of each educational institution. As a result, cooperation between higher education institutions of Ukraine and the exchange of

ETCs is complicated. In addition, the structure of a standard course, taking into account the requirements for information security and protection of intellectual property, structure and data format of ETCs, was synthesized by using a didactic model that is shown in Figure 3. With this model, 90% of an ETC is integrated into Moodle by using the G Suite for Education cloud service package, including Google Drive, Google Docs and Google Hangouts. To perform tests, it is necessary that the test questions must be stored in the question bank, which is an integral part of the ETC and is located on the server where the Moodle LMS is located.

To sum up: 90% of the educational material of the ETCs is hosted in Google cloud services, and 10% on the server where the Moodle LMS is hosted. This approach provides the possibility of data exchange between different platforms to support distance learning, such as Moodle, ATutor, ILIAS, Claroline, Dokeos and others. As mentioned earlier, another advantage is viewing of educational materials (including on smartphones) without special software. For example: Google Drive cloud service supports more than 40 popular file formats, including videos, images, Microsoft Office documents and PDF. It allows us to look at educational materials located on Google Drive directly in a web browser. It is worth noting that to use all the features, Google recommends using the Chrome web browser, but this is only a recommendation.

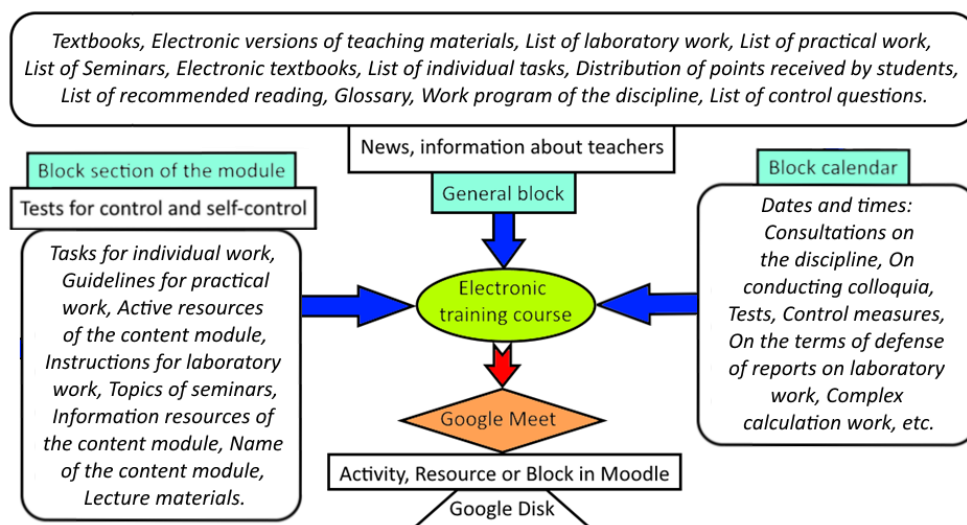


Figure 3. The didactic model of ETCs as developed by the authors and applied at the Department of Information Technologies of UNFU.

After getting a free subscription to the specialized cloud software package G Suite for Education by Google in 2012, UNFU got the opportunity to create shared access to content hosted on Google servers only for users of the @nltu.lviv.ua and @nltu.edu.ua domains. Mailboxes for students are issued for the period of study and have the

domain @ntu.lviv.ua, and for teachers the domain is @ntu.edu.ua. Worth noting is that all mailboxes are hosted by Google.

It is recommended to give access rights to educational materials on Google Drive: only for users of the @ntu.lviv.ua and @ntu.edu.ua domains. This approach increases security, because when the link is opened by a third party (in case it becomes known illegally), the authentication system of Google services will ask to enter the e-mail name and password. Using Google Drive also reduces the server load because the content is accessed and stored using G Suite for Education cloud services.

Using the WORKSECTION project management service

In Figure 4 we can see a hybrid model that shows the relationships of information and communication technologies in the distance learning process. In this model, we use the project management system Worksection (<https://worksection.com>) for coordinating the use of human and material resources (Sokolovskyy et al., 2015b).

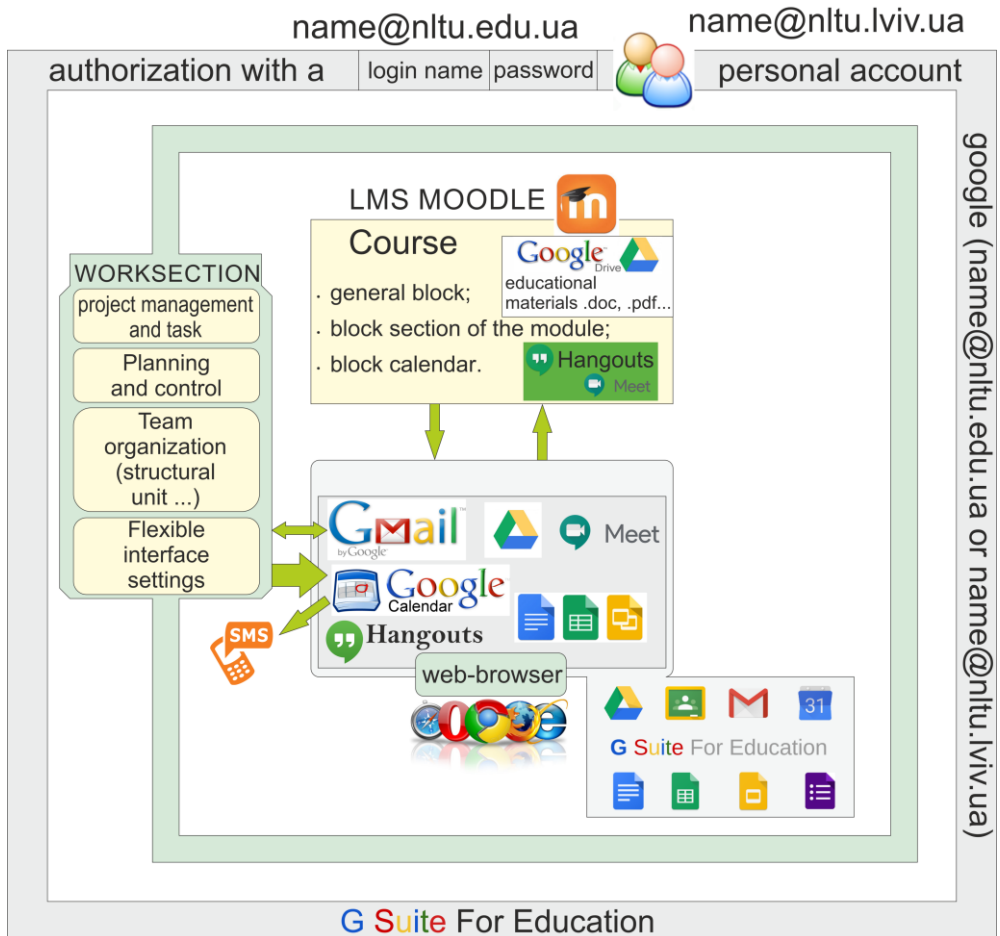


Figure 4. The improved hybrid model developed by the authors, which shows the relationships between information and communication technologies, which are the basis of the created VLE of UNFU.

The proposed hybrid model allows us to use information technologies in the learning process in any form of learning. The authors developed an initial (Figure 2) and this improved (Figure 4) hybrid model, which was successfully tested at the Department of Information Technologies of UNFU. In addition, this model was also tested at the Center for Distance Learning of UNFU and proposed for use during the implementation of distance learning in our university.

Employees of different structural units of the university work part-time, so they also used the Worksection project management service. This service provided fast communication between employees and clear structure of tasks to control all stages of their implementation. As part of the Worksection system, a mobile version for smartphones was developed, based on iOS (mobile operating system from Apple) and Android operation systems. In addition, the Worksection system has an adaptive design that allows us to use it with a regular browser on a smartphone or tablet. Another convenience of the system is duplication of all tasks by e-mail. After creating a task, the responsible employee assigned get an e-mail with a description and deadline for its completion. The list of tasks can be viewed both in the Worksection system itself and in personal e-mail.

At the Department of Information Technologies of UNFU, this system is used in the process of preparing for distance learning in various specialties and forms of education. In Worksection, the basis of any project is a task, which in turn can have subtasks (Moodle, 2022a). This is a step-by-step approach to the goal, because after setting new tasks, we can always analyze already completed ones. Worksection allows us to organize and manage resources in order to successfully achieve goals and complete project tasks. Also, project participants communicate through tasks. For example: A subject specific ETC is to be developed. In the Worksection, a project called "Item development" is created. Teachers who will develop the ETC from this subject are determined. Their accounts are connected to the created project in Worksection. Tasks are created in the project, their description, deadlines are entered, and responsible persons are appointed. All further communication between performers is provided by the Worksection system. In the same way we can create a project for writing a diploma thesis by a student. A student and his graduate supervisor are involved in such a project.

Features of creating curricula

One of the main advantages of the Moodle LMS is the possibility to modify it for specific needs. As a rule, this is done with the help of special additions – plugins. These plugins help us change the design and extend the functionality of Moodle. Plugins are developed by members of the Moodle community.

In this project, we also proposed to use the plugins "Learning Plan" and "Subcourse" to create curricula in the VLE of UNFU. This environment is based on a hybrid model showing the integration of Moodle version 3 with the Google G Suite for Education and the Worksection cloud services package.

The "Learning plans" functionality has appeared in the basic configuration of the Moodle system since version 3.1. "Learning plans" allow us to create curriculum templates based on a system of competencies assigned to a group of students. The students see in their curriculum the related competencies and the progress in their study. Accordingly, each course should have a set of initial competencies.

Currently, the educational and professional programme lists the mandatory competencies of the graduate. Upon successful completion of the course, the student gets a single final grade that doesn't reflect the percentage of successful study of individual competencies acquired as a result. The final grade for the course reflects the totality of competencies acquired by the student.

To create educational plans, it is advisable to use the module "Sub-course" (Moodle, 2022b). This module implements a very simple and useful functionality. With this module it is possible to add sub-courses to the course as included activities. The final grades that the student will get in the sub-courses will be reflected in the base course, called the target course. It allows us to divide courses into separate blocks or to create a more complex course structure. So, this module allows us to form the final tables of success and calculate the ratings of students in all courses of the curriculum. We also can use the "Learning plan" to create curricula. It is designed for Moodle versions 2 and 3. This plugin allows us to create the curriculum of an ETC and displays data on the terms and methods of studying each course, according to Figure 5. This module also allows us to form curricula for groups of students with a certain list of courses and the terms of their study.

CS-11
Report as at 10 Nov 2018

Show entries Search:

S.No. ▲	Course name	Learning method	Start date	End date	Status	Remarks
1	Computer Graphics	eLearning	4.03.19	16.06.19	Not Yet Started	
2	Theory of algorithms	eLearning	4.03.19	16.06.19	Not Yet Started	
3	Algorithmization and programming	eLearning	3.09.18	9.12.18	In-Progress	
4	Discrete Math	eLearning	3.09.18	9.12.18	In-Progress	

Showing 1 to 4 of 4 entries Previous Next

Figure 5. Example of student's personal page of the "Learning plan" plugin.

Organization of individual student work

Specified in the work programme of the course, in traditional education the assumed ratio of the number of hours in classroom to individual work is about 1 to 1. This ratio is determined taking into account the specifics and the content of a particular course, its place and importance for the training of specialists. In total, we have the following possible types of independent and individual work of students:

- Practical and laboratory work;
- Research work;
- Internship at an enterprise.

The application of the proposed didactic model as shown in Figure 6 improves the teacher's control over the independent and individual work of students.

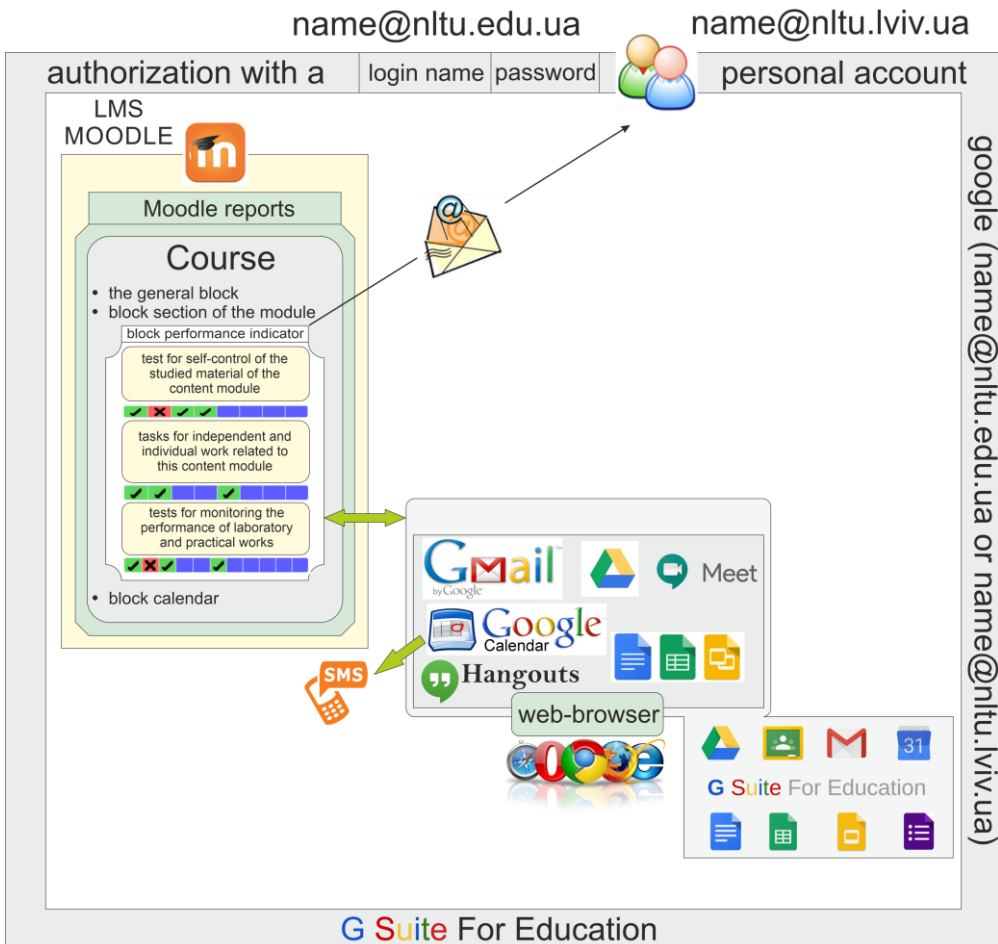


Figure 6. A didactic model that shows the relationships in the process of independent and individual work of students.

The application of the proposed didactic model is based on the block "Progress Bar" displayed on the main ETC page. This block displays a linear scale divided into rectangles. One rectangle corresponds to one task. If the task is completed on time, the rectangle turns green. A red rectangle signals to the student that the task deadline is over. If the student selects the rectangle with the mouse, he will get a description of the task. By clicking on the rectangle, the student will go to the task. The "Progress Bar" block contributes to knowledge about the progress in the study of the course. This block allows the teacher to quickly assess the course learning progress of an individual student.

In this block, teachers provide the student with a list of specific tasks for self-study, which are expected to be performed, according to the course work programme. The "Progress Bar" block is not available in the standard version of Moodle version 2.9, so it must be installed. This is important because the developers of this module have provided the possibility to view a list of students with a linear scale of their independent work progress.

One of the convenient functions in this module is that both group and individual messages can be sent by e-mail. To do this, we must select the checkbox of the relevant students and enter the text of the message before sending. By using this function, the teacher can review the maps of independent work, and have the opportunity to timely inform students about the planned deadlines. Moving the cursor, teacher or student can view additional information related to a specific task.

Conclusions

In this paper, the didactic model of the ETCs, as developed by the authors, and the main approaches to its creation in the Moodle LMS are described. This model used during the development of ETCs of blended learning and during the introduction of distance learning at UNFU. As a result of applying this model, we integrated 80-90% of ETC data into the Moodle LMS by using a package of cloud services "G Suite for Education". This didactic model of ETCs was successfully tested at the Department of Information Technologies of UNFU.

The lack of standards in Ukraine regulating the creation of ETC means that each educational institution is supposed to develop its own regulations and guidelines. As a result, educational communications between higher education institutions of Ukraine and the exchange of ETCs has become more complicated. Under these conditions, it is important to standardize ETCs within universities from the first stage of the distance learning implementation.

In addition, a hybrid model of communications in a cloud environment, see Figure 2, has been developed. After testing and identifying its shortcomings, this model was improved. Figure 4 shows the improved hybrid model, which shows the relations

between information and communication technologies that are the basis of the created VLE of UNFU. This model improves the coordination of the use of personnel and material resources in the process of implementing distance learning at UNFU. This model ensured a successful and quick transition from face-to-face to distance learning across the university at the beginning of the Covid-19 pandemic.

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