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Models and methods of online training at Uzhgorod National University

IGOR POVKHAN, ANDREY LEGEZA, OKSANA MULESA, ELENA MELNYK, YURIY BILAK. **Models and methods of online training at Uzhgorod National University.** *The paper shows the features of organizing online learning at Uzhgorod National University, presents the technology for creating an online course using the distance learning information platform. Modern education is characterized by a steady trend of transition to digitalization and personification of learning. Modernization of education is currently associated with the introduction of adaptive, practice-oriented and flexible educational programs. At the same time, existing platforms for creating e-learning courses do not yet have the ability to intellectualize the learning process, flexibly adapt the content of*

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education to the individual needs of students, do not contain convenient intelligent tools to support developers of online courses, automate routine operations for structuring educational content. Approaches to the development of e-learning courses are studied, stages of development and requirements for e-learning courses are highlighted, a structural and content model of the e-learning course and a model of data collected in the e-learning process are developed. Based on the developed models, intelligent methods for creating e-learning courses, an algorithm for structuring e-learning course materials, an algorithm for hierarchical classification of training course materials by thematic blocks, and an algorithm for primary ranking of training course elements by complexity and significance are proposed. The organization of an online course and a brief description of the implementation of an online course based on an e-learning system are presented. The presented paper reflects the results of the development and implementation of an online course based on the e-learning methodology. The article presents the development of an intelligent training course using data mining mechanisms. Efficient intelligent data processing algorithms underlie the development of adaptive online learning technologies implemented in educational processes. The basic principles of synthesizing a system for evaluating the quality of online courses are developed.

Keywords: *online learning, online course, online course development, distance learning, educational platforms, Moodle.*

1. Introduction

At the current level of IT technology development, educators in educational institutions significantly rely on ready-made or self-developed electronic course materials when presenting new content. It is worth noting that such an approach to delivering material allows each participant in the process to acquire a set of basic knowledge and skills using network and client-server technologies. The fundamental requirement for organizing such interaction between elements of the educational process is access to the institution's network. A defining characteristic of online learning is its global accessibility, content relevance, and rapid feedback between participants in the process [1-3].

Academic mobility is one of the important directions in the development of modern education both in Ukraine and abroad, and it is a necessary condition for integrating educational organizations into

the global educational space. Virtual academic mobility involves the formation of learning trajectories using online courses created by various educational organizations or developed based on new information technologies by individual specialists (outside educational institutions), holders of specific competencies, groups of people, and non-educational organizations. The individualization of educational trajectories allows students to gain additional motivation for learning, expand the horizons of educational opportunities, and acquire unique professional competencies.

It is evident that such a system of organizing the educational process allows for a transformation in the very nature of obtaining education. The general architectural scheme of the educational online process (based on the IEEE P1484.1 standard) at Uzhhorod National University is presented in (Fig. 1). Each participant in online learning can now study anytime and anywhere, which in turn allows for both the expansion of the circle of participants in the process and the provision of a high level of inclusivity in education [2].

Given all of the above, there arises an urgent task of organizing an effective and inclusive learning process based on electronic educational courses, which should meet the set of requirements from educators regarding both the theoretical and practical parts of a discipline. From the student's side, there is a need for unlimited and global content accessibility and an effective feedback mechanism with the educator [4-6].

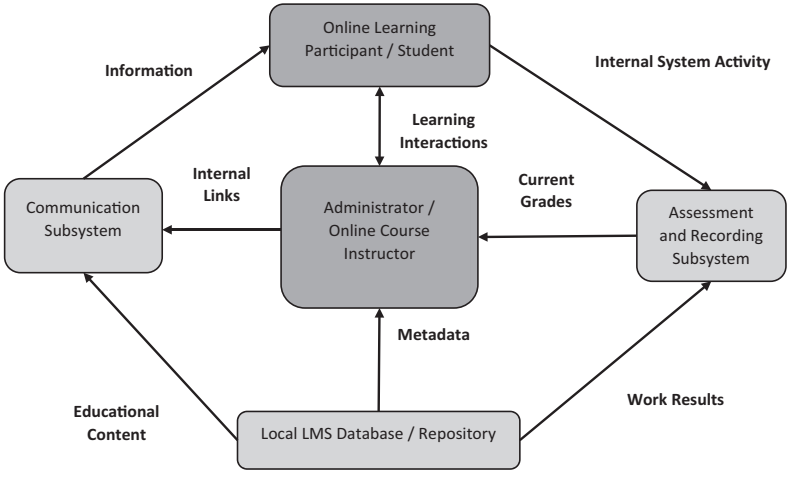

Figure 1. General Architectural Scheme of the Educational Online Process at Uzhhorod National University

In recent years, leading universities around the world and in Ukraine have begun to introduce distance education into their structures as an equivalent form of education, creating hundreds of courses for training specialists in various fields. Currently, some of the most popular international online learning platforms used worldwide are "Coursera" and "Udemy." In Ukraine, among higher education institutions, a significant portion utilizes the "Moodle" system for managing educational electronic courses [7].

In Ukraine, as well as worldwide, there is a transition to electronic means of distance learning in all spheres of education. Significant drivers in this direction have been the global pandemic and the military aggression on Ukrainian territory in 2022. This has created the opportunity to master parts of educational programs using a vast array of electronic educational resources that vary in technology, type, and format. This, in turn, allows students to build their own educational trajectories necessary for future or current professional activities or for implementing specific projects. The process of removing barriers that hinder the development of virtual academic mobility (based on online courses) and creating conditions for the active involvement of a wide range of educational organizations, business structures, IT clusters, and other participants in the online education market are fundamental goals of the overall development strategy of Uzhhorod National University.

2. Literature revew

The presented work is based on the use of effective research methodologies, content analysis, and a comprehensive review of documents in the Scopus and WoS databases. Content analysis tools were used to analyze written and other sources on the Internet. The primary focus was on the methods and approaches to designing and implementing an online learning course. The search engine research was conducted using the keywords "online learning," and the obtained documents were analyzed using content analysis.

Modern education is characterized by a steady trend of transition to digitalization and personification of learning. In [1,2], the central task of organizing online learning within an educational organization based on open LMS systems is considered. In [3], a general model for organizing distance learning within the framework of the open access concept of the Learme platform is presented. The works are devoted to the problems of efficiency and adaptability of organizing online courses in the educational environment [4,5]. The main unresolved problem here remains the low

versatility of this approach. An important task that becomes at the stage of designing an online learning model remains the problem of choosing an LMS platform that is suitable for the organization conditions [6]. A partial solution to this problem is the development and design of modern hybrid LMS platforms based on artificial intelligence. This problem is closely related to the task of simple and efficient processing/collection/analysis of statistical data (data mining) in the process of online learning [7]. The stage of choosing an LMS platform is related to the needs of the educational organization, support for the system of relevant educational standards [8-12]. An important direction in the development of modern e-education platforms is the use of distributed (cloud) technologies for accessing educational content [13]. The fundamental disadvantage of this approach is the high requirements for the quality and distribution of information infrastructure within the educational organization.

3. General concept of Online Learning

In the first stage, it is important to establish that for the effective implementation of online learning, all elements of the distance learning system (both the information system itself and the electronic educational courses) must comply with all educational standards. Therefore, a fundamental requirement for the online learning system at Uzhhorod National University is its openness, transparency, high quality of electronic courses, and broad inclusivity in education [2].

The basic step-by-step scheme for building an online course at the Faculty of Information Technology at Uzhhorod National University within the LMS platform (Learme) is as follows – (see Fig. 2).

A Learning Management System (LMS platform) is an information system built on a client-server architecture, which allows for the creation of educational content in electronic form and the organization of multi-level distance learning (facilitating the learning process in any format).

The main directions of work with LMS platforms include the following:

Primary development and marketing of online courses (educational content of various types) for any interested users;

Simple tools and a foundation for organizing the educational process in an educational institution in online mode;

Flexible process of organizing learning and improving the qualifications of LMS platform users.

The general concept of an LMS is not limited to a local database and client-server architecture (such as cloud services of various levels).

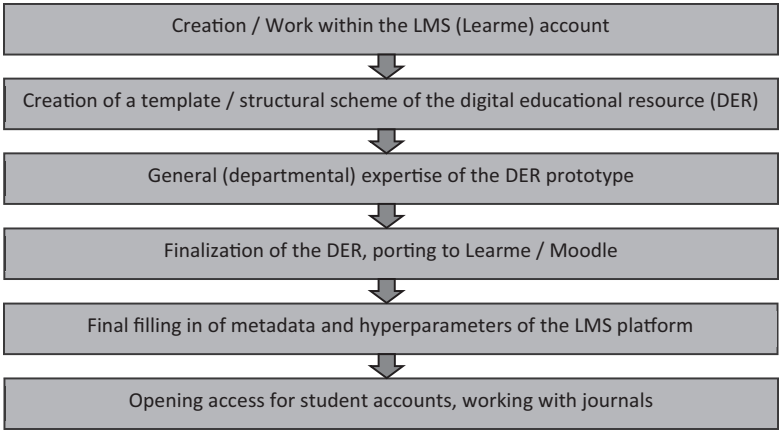

Figure 2. General Scheme for Creating DER/Content within the LMS (Learme)

An LMS platform is primarily an information system for managing educational content and learning processes and conceptually approaches systems like WorkFlow.

All existing LMS platforms provide the following basic functions for managing educational content within the educational process:

- **Creation and storage of various types and formats of educational content** within the platform's educational space;
- **Automation, centralization, and distributed access to educational content** within the educational process;
- **Complete automation of the process of managing groups of participants** in the educational process;
- **Providing the broadest range of participants** in the educational process;
- **Automation of functions for checking the knowledge and skills** of educational process participants;
- **Provision of a knowledge base functionality** within the LMS platform;
- **Provision of tools for analyzing the success** of educational process participants, tracking progress;
- **Provision of functionality for creating and issuing certificates** upon completion of learning.

It should be noted that all modern online learning (distance education) platforms support the following basic international educational standards:

- **Sharable Content Object Reference Model (SCORM);**
- **AICC HACP standard for Online Learning platforms;**
- **Simple import of IMS Common Cartridge packages directly into Moodle.**

The IMS toolkit allows the implementation of a set of online services in a network based on IP. The technology enables the creation of a homogeneous environment for providing multimedia services over a standard IP network. The general scheme of the learning process procedure within IMS is presented in (Fig. 3);

- **Learning Tools Interoperability (LTI)** – an open standard introduced by the IMS (Global Learning Consortium). This specification allows for the simple integration of an online (cloud) service into the LMS using various tools (API).

In the next phase, it is important to analyze and select the basic technology (tools) for organizing online learning. The simplest way to organize online learning is to create and launch online courses based on ready-made information platforms. One of the most popular platforms is the "Moodle" system. Moodle is a virtual distributed platform designed for creating and distributing interactive learning content.

The "Moodle" platform is an open-source web application (distributed under the GNU GPL license). This approach to organizing Moodle's architecture allows for the creation of custom online learning portals and their quick adaptation to the needs of both instructors and students.

Moodle developers have adopted the following e-learning standards:

- **SCORM** (Sharable Content Object Reference Model)
- **WCAG** (Web Content Accessibility Guidelines)
- **Experience API** (also known as xAPI or Tin Can API)
- **AICC** (Aviation Industry CBT Committee)
- **IEEE LOM** (Learning Object Metadata)

The SCORM standard was introduced to standardize all learning files (educational content) for LMS systems (Learning Management Systems). A SCORM course is an archive (usually in ZIP format) that contains the course files and XML markup with its structure (header and content block). This standard allows the inclusion of presentations, texts, videos, audio, and more in the archive, which can then be opened in any SCORM-compliant LMS. Currently, LMS systems are mostly presented as SaaS (Software as a Service) cloud solutions, in addition to local implementations. SCORM courses are supported by services like iSpring, Moodle, and Learme [9-12]. With the development of SaaS services that allow for creating online

courses directly in a browser, the focus on SCORM has started to shift. For example, the GetCourse platform does not support SCORM because it has its own editor for creating courses and other content.

The main goal of WCAG is to provide online platform developers with the ability to create and test interfaces and content that will be accessible to people with disabilities, as well as to everyone else. WCAG is the basic standard for digital content accessibility, including for LMS systems [11-15].

Experience API and xAPI represent a general standard for distance learning platforms. This API allows distance learning platforms to establish a data exchange protocol between themselves based on a simple tracking and recording scheme of learning activities of all types. In general, different types of data about the learning process are stored in a special Learning Record Store (LRS). An abstract LRS database can be part of a larger database or function independently, which allows for a high level of data abstraction.

The main advantages and improvements compared to SCORM include:

- **Full functionality for working with educational content in offline mode**. This mechanism is implemented based on temporarily storing the work session in the LRS.
- **Enhanced security mechanisms** for both content and work sessions (supports the OAuth open authorization protocol).
- **A set of powerful static data collection capabilities** (compared to SCORM).
- **xAPI does not have a strict database dependency** (using LRS mechanisms, content can be uploaded to a website, blog, or social networks).
- **xAPI allows for consideration of various types of learning activities within online learning**, which are absent in SCORM.

The AICC standard regulates general instructions for developing, delivering, and preliminarily evaluating Computer-Based Training (CBT) and Web-Based Training (WBT), as well as various types of learning and control technologies (including distance learning). This standard is currently used for a wide range of distance learning technologies and has significant distribution and support at the level of all modern online learning platforms and educational content development.

The open IEEE LOM standard provides tools for describing learning objects (of various types and structures). Within this standard, the attributes of a learning object include the following basic characteristics:

object type, object author, object owner, distribution and access conditions, format, and methodological attributes such as learning or interaction schemes and rules.

A key feature of the Moodle platform is the ability to automate the task evaluation process (based on a test system), tools for monitoring and consolidating material learned, with real-time feedback from the instructor [16, 17]. The general architectural scheme of the LMS "Moodle" at Uzhhorod National University is presented in (Fig. 4).

As of now, the total number of users of this online learning platform exceeds fifty million worldwide, with hundreds of thousands of professional instructors teaching and learning in over sixty languages. The total number of courses in the Moodle systems worldwide was about two hundred thousand courses in 2023. Another popular online learning platform (for creating online courses) is the Learme platform. The main advantage of this system is its open and simple interface, which is accessible both for those who want to create a course and for those who want to take courses. This online platform allows access to both paid and free courses.

The quality and versatility of electronic learning implementation can be ensured by using specialized software for developing electronic educational materials and courses. This software enables the creation of learning material packages that are largely independent of the specific LMS being used. Therefore, such content can be transferred from one

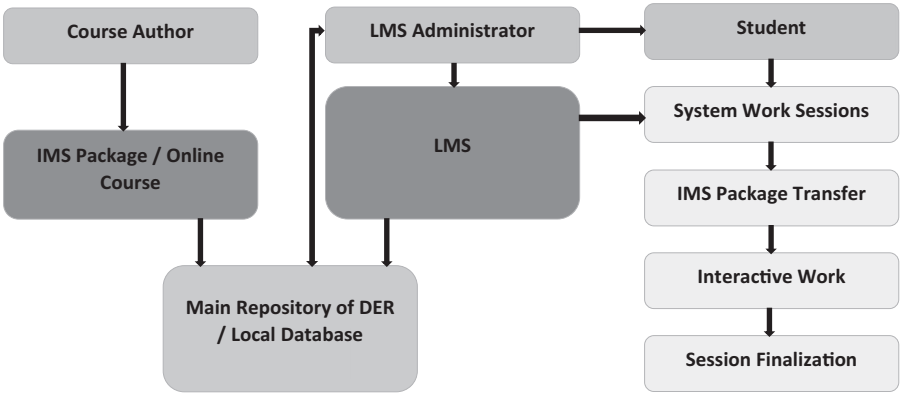

Figure 3. General Architectural Scheme of the LMS "Moodle" at Uzhhorod National University

LMS to another and distributed in various ways, including through sales. There are several common formats for educational materials (learning content), but the most popular in recent years has been the SCORM format. It allows for the creation of a hierarchical structure of learning content and tracking student interaction with the material to obtain a comprehensive report on their work.

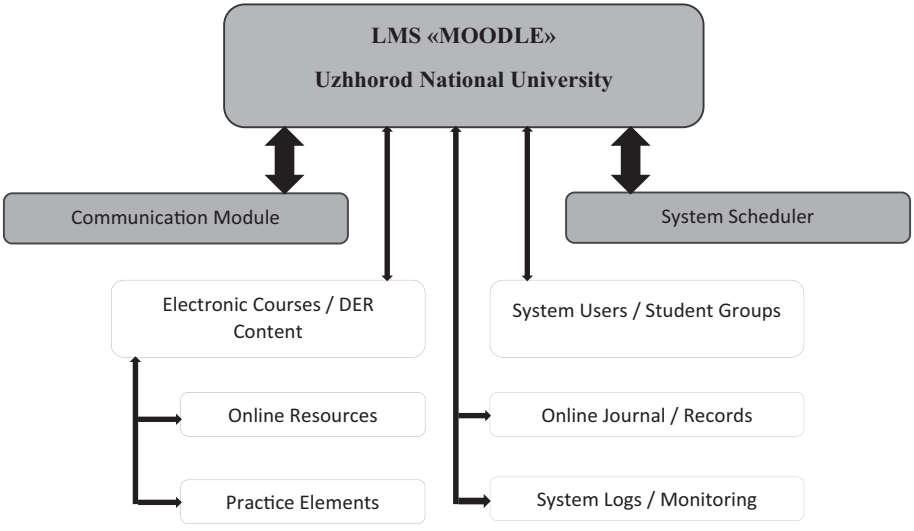

Figure 4. General Architectural Scheme of the LMS "Moodle" at Uzhhorod National University

The general scheme of the online course development cycle is presented in **Figure 5**. Let's analyze the stages of implementing the "Basics of Programming – Basic Level" online course. In the first stage, well-known tools for developing and implementing online courses, such as Articulate Storyline and iSpring, were analyzed. The development of the "Basics of Programming – Basic Level" online course was carried out using the Learme online course platform and the Articulate Storyline software. The overall structure of the course, its content modules, content filling, detailed description of each session, and registration were implemented on the Learme platform. The course content, test assignments for ongoing assessment, and examples were implemented in the Articulate Storyline software.

The **Articulate Storyline** tool provides content development for interactive courses. The Storyline interface is familiar to all users of

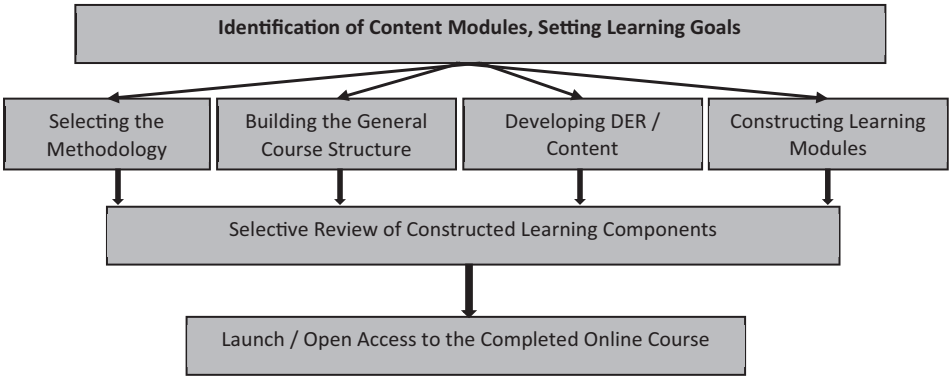

Figure 5. General Architectural Scheme of the LMS "Moodle" at Uzhhorod National University

modern office programs because its menu is presented as a ribbon with tabs. The program allows language packs to be uploaded as plugins. Additionally, the educational materials, courses, and entire disciplines developed with its help (including their navigation elements) can be localized in any language, including Ukrainian. A key feature of Storyline is that media objects (text, images) are not placed directly on a slide but on an additional container (layer). Each slide can contain any number of layers, which are essentially different states of the slide, and the state change can occur based on certain student actions. For example, when a question is answered correctly, an additional element, such as a general visualization of the answer, appears on the slide. Such course object responses to actions are configured using special software triggers.

It is worth noting that Storyline can be used to create simulators, software simulations. A special recorder built into the system provides a demonstration of working with software. It can record what happens on the screen or in a selected area with the ability to capture audio in various formats simultaneously. In step-by-step mode, each system operator's action is automatically accompanied by comments. It is possible to create not only demonstration content of different levels but also content where the user must perform the necessary actions as a task or test. The Storyline system includes an effective tool that allows online course developers to record the screen while working with the program. It also offers features for preliminary software modeling, basic video content editing functions, support for mobile devices, Flash, HTML5, multilingual support, and auto-translation support.

An extremely important advantage is that a course developed in Articulate can be published in all popular educational material formats such as SCORM, TinCan, AICC, HTML5, Word, on any information carrier. It is also possible to import a finished course into the "cloud" environment of Articulate Online or any other platform. This tool enables the simple and effective import of a finished course into the "Moodle" platform. The course player has flexible settings: the course format and content can be changed, resources, additional files or links, a glossary of terms, and notes can be added.

It should be noted that the "Moodle" platform allows not only the placement of materials but also their creation directly within the system. However, such an approach is not always productive. Creating educational content in "Moodle" is particularly advantageous for tasks that do not require automated assessment, such as seminars, response tables, forums, in cases of fixed courses (or several courses). Although "Moodle" has a powerful testing module, a finished test, like other locally created elements, cannot be transferred to another LMS (an issue with the effective export of finished courses). Therefore, when creating interactive, illustrative content, sets of tests, variable questionnaires, or simulators—any material that includes multimedia and logical automation—it makes sense to use a special tool in the form of separate software that allows doing this simply, quickly, attractively, and, most importantly, universally.

For example, content can be developed in PowerPoint using the iSpring Suite plugin, which transforms PowerPoint from a presentation creation tool into a means for creating professional educational content. Educational materials can be created as sets of web pages, groups of slides, videos, and standalone educational courses. There is an option to work with content in different formats and efficiently export finished materials. This means that the content (course) can be developed, then exported to a convenient format, and republished in another format if needed.

At the final stage, to demonstrate the flexibility and multiplatform capabilities of the Learme platform, the course was imported into the "Moodle" system.

During the registration stage, the student registers in the Learme system and selects the online course "Fundamentals of Programming – Basic Level." In **Figure 6**, the course "Fundamentals of Programming – Basic Level" is shown. One of the goals of this work is to develop the online course "Fundamentals of Programming – Basic Level." In the first stage, the standards in the field of distance learning, as well as the methods and

tools necessary for creating educational content, were analyzed.

During the development stage of the online course, the following requirements were set for content preparation:

- **Primary focus on practical tasks.** The defining characteristic of the "Fundamentals of Programming – Basic Level" course is its practical component.
- **All learned educational content is based on and connected to the students' existing knowledge from previous disciplines.** This approach allows combining the existing knowledge base with new content and building a base of associative connections.
- **High variability of educational content within the online course.** The "Fundamentals of Programming – Basic Level" online course uses various levels of communication to deliver educational content. This helps students quickly and effectively assimilate educational information and seamlessly switch from one type of content to another within the course.
- **Significant emphasis on independent application of acquired knowledge.** During the course, students independently solve sets of examples as well as control test assignments.

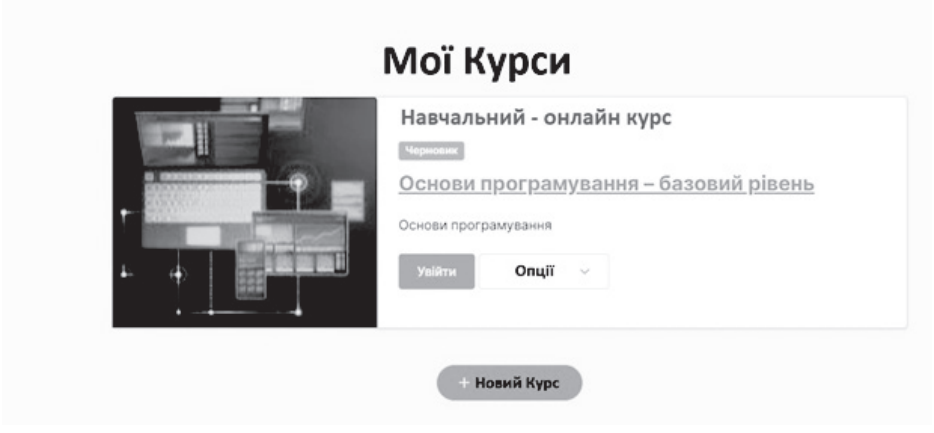

Figure 6. General Interface for Selecting an Online Course in the Learme System

The Learme system allows for the creation of various types of sessions, which include both self-check assignments and different types of homework. The instructor has extensive opportunities to communicate

with online course participants via chat or using audio and video comments (**Figure 7**). A key advantage of this system is the functional website technical support service, which assists developers in resolving issues that arise during the platform's operation. This service also allows for the expansion and improvement of already existing functions, sections, and parts of the platform when necessary.

From the student's perspective, significant advantages include ease of use, portability, and multi-variability of access to the platform. This means that students have the ability to work with prepared content in the form of an online course, anytime and anywhere. All that is needed is an Internet connection and a device on which the learning process will take place.

The effectiveness of two-way communication between the instructor and the student creates an atmosphere of trust and inclusivity in the learning process, as well as provides tools for diverse assessment of the effectiveness of learning content absorption. The ability to build a student rating allows tracking the progress of each participant in the learning process. The instructor of the online course has the option to enable or disable comments as needed, enable audio/video comments, chat, feedback, and grades for each learning block separately.

The Learme platform allows for the creation of various types of online courses (different types of learning content) for both individual learning and corporate training and has the following advantages:

Availability of a simplified, free version;

Simple and easy launch and navigation on the platform;

Extensive opportunities for individual customization of the learning process and the ability to create an individual learning plan;

Availability of a mobile app, which significantly increases the audience reach and simplifies connection to the learning process;

The ability to organize both free and commercial courses in the corporate sector;

The possibility of organizing online courses in chatbots. This tool allows replacing the instructor and actively interacting with the student in an automated mode.

However, the Learme platform also has some disadvantages:

The basic (free) version lacks the ability to market educational courses.

The basic (free) version does not include its own webinar room (it only integrates with YouTube streaming). Overall, the video streaming capabilities are quite limited.

There is no simple and effective search system for open (non-commercial) educational content (online courses, educational materials, ready-made test blocks) directly on the Learme platform.

Access to ready-made online courses and learning content, in general, is only possible by following an invitation link. The overall content access scheme is based on accounts and invitation links. This organization of the learning process has certain drawbacks related to restrictions on accessing necessary content and the inability to conduct a preliminary assessment of the online courses presented in the system. Clearly, such restrictions negatively impact the search and indexing of all educational content on the platform as a whole.

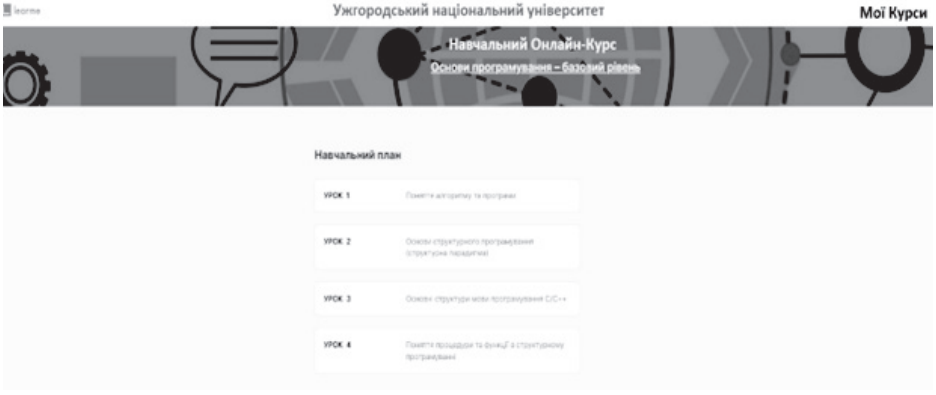

Figure 7. Selecting a Lesson in the Online Course within the Learme System

The developed online course "Fundamentals of Programming – Basic Level" can be exported to other platforms in accordance with standards such as SCORM 1.2, SCORM 2004, AICC, and TinCanAPI. When creating the online course, the SCORM standard was used as the foundation, being the most widely adopted and supported on other online learning platforms (with a focus on the "Moodle" platform).

The "Fundamentals of Programming – Basic Level" online course has a simple three-level structure, an introduction, and a knowledge assessment block. The overall architectural scheme of the course is presented in **Figure 8**. The first part of the course describes the basic concepts of algorithmic programming, the main paradigms, and approaches in program construction. The first block consists of five lessons, which cover general

concepts of structured programming, key programming constructs, the concept of algorithms and data types, the structure of program code for high-level programming languages (C/C++), and the features of code compilation and translation.

The second block of the course covers the main language constructs and structures of C/C++ without the introduction of classes (OOP programming paradigm). This part of the course is divided into four lessons and is necessary for a comprehensive understanding of the structured-procedural programming paradigm.

The third part of the online course "Fundamentals of Programming – Basic Level" is dedicated to basic concepts of the OOP approach with a focus on C++/Java programming languages. This section consists of seven lessons that cover the fundamentals of the object-oriented approach, the concept of classes, and the notion of object code. The main goal is to demonstrate the power and advantages of the OOP approach compared to classical structured programming based on C++/Java.

It is worth noting that the course structure includes a knowledge assessment block, where students can test their acquired knowledge by completing a set of self-check assignments in the form of tests (based on simple binary invariants). Various types of assessment tasks are allowed, including terminology as well as tasks with supplementary content.

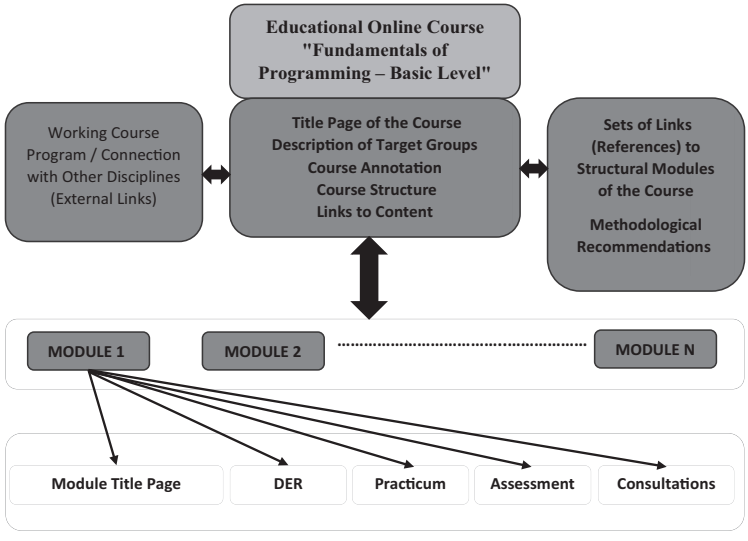

Figure 8. General Architectural Scheme of the Course "Fundamentals of Programming – Basic Level" in LMS Learme.

The Learme platform tools allow access to online courses through a simple internal search system (the course administrator can also add students to groups). This can be done in two ways. The first way involves a simple procedure of adding a participant to the learning process through the appropriate fields in the group form. The second method is based on the ability to import a group of students into the system as a list. In this procedure, the platform administrator (instructor) needs to fill out a form according to a specific template (course name, list of students, contact addresses, etc.). Based on this, personal accounts for the participants in the learning process will be created in the system (based on their user accounts). During the preliminary identification phase, the student can select their online course (from a list formed by the platform administrator or instructor) and begin the learning process in a convenient format.

The Learme system administrator (instructor) has effective tools for managing student groups and online courses (sets of filters and basic tools) and also has the ability to collect and conduct preliminary analysis of statistical data on the learning process. It should be noted that all operations with student groups and courses are carried out based on the user account mechanism and the client-server architecture of the Learme platform.

4. General model for assessing the quality of Online Courses

The comprehensive model of the online course quality assessment system within the local LMS is represented by a set of regulations, criteria, principles, methods, informational services, and other components that regulate and provide informational support for the procedures for assessing the quality of online courses with the participation of educational organization representatives, specialists, and experts [17].

The goal of the online course quality assessment system is to enhance students' academic mobility using online courses by creating conditions that promote increased trust in online education among all participants in the educational process, free access to the educational system of high-quality online courses, development of healthy competition in the online learning market, and continuous improvement in the quality of online courses.

The online course quality assessment scheme addresses the following basic tasks:

Ensuring multi-level communication between educational structures (and beyond) when creating/using online courses. A high level of communication within an educational organization can be achieved by

providing the most complete and reliable information about the online course and its quality, including the procedure for assessing the quality of the online course and information about the experts who conducted the assessment. It is clear that the level of communication organization is determined by both the overall rating of the educational organization and the popularity and mass appeal of the platform hosting the online course.

Effective mechanism for involving platforms currently operating in the informal education market into the formal education system. Simple and understandable rules for such platforms to enter the formal education market should be established, enhancing trust in online courses and the accompanying information provided by the platforms, with the prospect of crediting learning outcomes in formal education programs. This mechanism should be based on a set of minimum requirements for the content provided by online learning platforms and online course authors.

Creating effective mechanisms for competitive environments in the online education market and continuous motivation for developers to improve the quality of online courses. This can be achieved by collecting student evaluations, building online course ratings that form overlapping competencies. For courses with low ratings, one way to quickly implement improvements could be enhancing the online course according to best practices and obtaining accreditation from independent organizations (not only educational but also business structures). Another tool influencing the choice of an online course could be the presence or absence of internal regulations for quality control and assessment of the educational process in general, and online education in particular, within an educational institution.

Creating effective tools for current control (modules, credit exams) within the educational organization. In this case, the educational institution retains autonomy in deciding on credits/exams, taking into account the authoritative opinions of other educational organizations (employer associations) regarding the compliance of the learning outcomes of the online course with educational standards and labor market needs. The collection of such information about the online course should be carried out with minimal additional costs for online course developers, meaning that all possible data sources about the online course and its quality should be utilized.

The overall architectural model of the online course quality assessment system developed at Uzhhorod National University, which addresses these tasks, is presented in **Figure 9**.

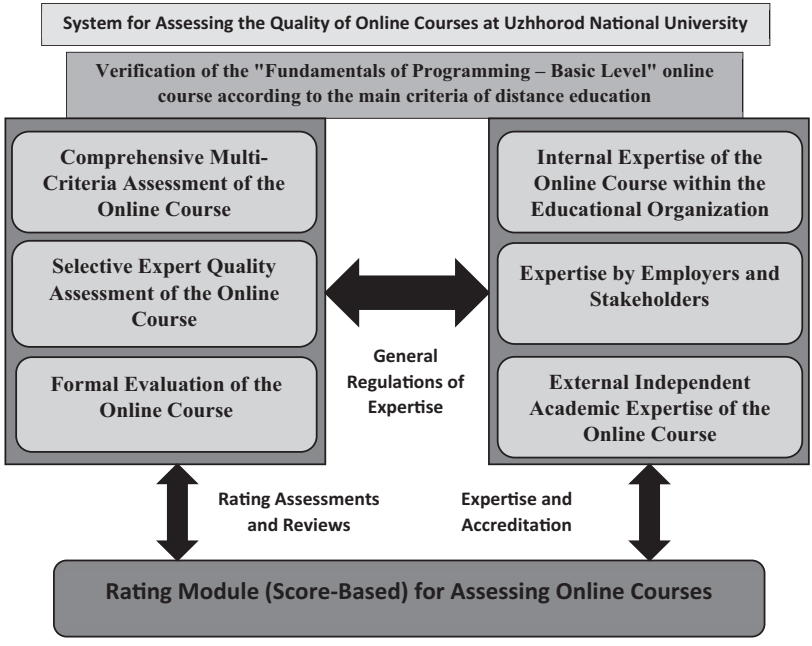

Figure 9. Architectural Model of the System for Assessing the Quality of Developed Online Courses at Uzhhorod National University.

The overall model of a working quality assessment system for online courses includes the implementation of the following basic functions:

- **Comprehensive Departmental (Multi-Criteria) Evaluation of the Online Course:** This is conducted to approve online courses for inclusion in the educational process (porting to the LMS).
- **Selective Expert Quality Evaluation of the Online Course:** Performed after the online course is launched on the LMS platform.
- **Formal Evaluation of the Online Course:** Conducted to verify the course's compliance with the requirements of the educational process.

The formal assessment of an online course is carried out based on formal criteria, mostly through automated tools, in the following areas:

- **Initial Examination of the Structure and Components of the Online Course.**
- **General Examination of the Online Course for Compliance with Legislative Requirements and the Educational Process Standards of the Institution.**

- **Comprehensive Verification of the Functionality of the Content Modules of the Online Course.**
- **Assessment of Integrity and Connections with Other Disciplines in the Online Course.**

A comprehensive evaluation of the developed online course is conducted according to the following scheme:

General Evaluation by Educational Institutions:

Based on the re-crediting of credits/exams for the online course as part of the main educational programs.

- **General Evaluation by Internal and External Academic-Methodical Associations.**
- **Variable Independent External Academic Evaluation of the Online Course.**
- **Comprehensive Review by Employers, the Business Community, and Commercial Educational Institutions.**
- **Comprehensive Independent Assessment of Compliance with Best Practices and Standards (Licensing and Accreditation Requirements).**

Continuous evaluation of the online course is conducted in the following areas:

- **Overall User Ratings (Reviews and Scores).**
- **External Evaluation of the Online Course Based on User Behavior (Actions and Results), Supported by a Statistical Processing/ Collection Module.**

The main initiators and participants in the online course quality assessment scheme include:

Primary Expert Executor: The head of the expert council, who initiates and leads the evaluation process, recruits experts, and is responsible for the procedure and outcomes. The group of experts may include educational institutions, internal methodological commissions, stakeholder groups, and independent evaluation organizations.

Main Organizer of the Evaluation: A participant in the evaluation process who forms the group of executors and distributes tasks among them according to the evaluation rules. The organizer may be an external participant (commercial and non-commercial organizations) or an internal one (departmental).

All obtained evaluations of online courses are stored in the quality assessment information system of Uzhhorod National University in the form of structured data:

- Information about all types of evaluations and scores that the online course has undergone is stored.
- Values and sets of obtained ratings for each type of evaluation, as well as other sets of evaluation parameters, are stored.

The quality assessment information system for online courses also implements an effective mechanism for sorting and filtering collected expert information (statistics module).

5. Conclusion

Students can access the learning content (online course) through their account, where they can listen to the theoretical block of the course and move on to the knowledge assessment block based on tests. The entire course is developed within the Articulate Storyline system.

All completed sessions are recorded in the system, allowing students to move to the next stage. After completing the entire course, students are offered tasks and tests to verify the knowledge gained during the learning process. Upon successful completion of the course and knowledge check, the student will receive an appropriate electronic certificate.

The developed online course "Fundamentals of Programming – Basic Level" can be used for teaching this discipline in other educational institutions. The design and implementation results of the online course can also serve as a template for creating similar online courses with a similar structure.

The main principles for synthesizing a quality assessment system for online courses have been developed. The procedures and criteria of the quality assessment information system developed at Uzhhorod National University ensure:

- Initial testing of methods for developing and evaluating online courses that correspond to more than 10 fields of higher education knowledge.
- Development and implementation of protocols for conducting quality evaluations of online courses by educational organizations, employers, internal and external academic-methodical associations, and independent experts on more than 150 online courses.
- Promotion and popularization of distance education and the quality assessment system for online courses with the involvement of a wide range of higher education institutions.
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Abstracts

ІГОР ПОВХАН, АНДРІЙ ЛЕГЕЗА, ОКСАНА МУЛЕСА, ОЛЕНА МЕЛЬНИК, ЮРІЙ БІЛАК. **Моделі та методи онлайн-навчання в Ужгородському національному університеті.** *В роботі показані особливості організації онлайн навчання в Ужгородському національному університеті, представлена технологія для створення онлайн-курсу за допомогою інформаційної платформи дистанційного навчання. Сучасна освіта характеризується стійкою тенденцією переходу до цифровізації та персоніфікації навчання. Модернізація освіти в даний час пов'язана з впровадженням адаптивних, практико-орієнтованих і гнучких освітніх програм. У той же час, існуючі платформи для створення електронних навчальних курсів, поки не мають можливостей для інтелектуалізації процесу навчання, гнучкої адаптації змісту освіти під індивідуальні потреби учнів, не містять зручних інтелектуальних інструментів для підтримки розробників онлайн-курсів, автоматизації рутинних операцій зі структурування освітнього контенту. Вивчено підходи до розробки електронних навчальних курсів, виділено етапи розробки та вимоги до електронних навчальних курсів, розроблено структурно-змістовну модель електронного навчального курсу і модель даних, що збираються в процесі електронного навчання. На основі розроблених моделей запропоновано інтелектуальні методи створення електронних навчальних курсів, алгоритм структурування матеріалів електронного навчального курсу, алгоритм ієрархічної класифікації матеріалів навчального курсу за тематичними блоками, алгоритм первинного ранжування елементів навчального курсу за складністю та значимістю. Представлена організація онлайн-курсу, короткий опис впровадження онлайн-курсу на основі системи електронного навчання. В представленій роботі відображені результати розробка та реалізація онлайн курсу на основі методології електронного навчання. Представлена розробка інтелектуального навчального курсу з використанням механізмів інтелектуального аналізу даних. Ефективні інтелектуальні алгоритми обробки даних лежать в основі розробки адаптивної технології онлайн-навчан-*

ня впроваджені в навчальні процеси. Розроблені основні принципи синтезу системи оцінки якості онлайн-курсів.
Ключові слова: *онлайн-навчання, онлайн-курс, розробка онлайн-курсу, дистанційне навчання, освітні платформи, Moodle.*

IGOR POVKHAN, ANDRIJ LEGEZA, OKSANA MULESA, OLENA MELNYK, YURIJ BILAK. **Modele i metody nauczania zdalnego na Użhorodzkim Uniwersytecie Narodowym.** *W artykule przedstawiono specyfikę organizacji nauczania zdalnego na Użhorodzkim Uniwersytecie Narodowym oraz technologię tworzenia kursów online przy wykorzystaniu informacyjnej platformy kształcenia zdalnego. Współczesna edukacja charakteryzuje się wyraźną tendencją do cyfryzacji i personalizacji procesu dydaktycznego. Modernizacja systemu kształcenia w danym okresie wiąże się z wdrażaniem adaptacyjnych, praktyczno-zorientowanych i elastycznych programów edukacyjnych. Jednocześnie istniejące platformy do tworzenia kursów e-learningowych nie zapewniają jeszcze wystarczających możliwości w zakresie inteligentnego wspierania procesu dydaktycznego, elastycznej adaptacji treści edukacyjnych do indywidualnych potrzeb studentów ani wygodnych inteligentnych narzędzi umożliwiających wsparcie twórców kursów online oraz automatyzację rutynowych operacji związanych ze strukturyzacją treści edukacyjnych. Zbadano podejścia do projektowania kursów e-learningowych, określono etapy ich tworzenia oraz wymagania stawiane tego rodzaju kursom; opracowano strukturalno-treściowy model e-kursu oraz model danych gromadzonych w procesie kształcenia zdalnego. Na podstawie opracowanych modeli zaproponowano inteligentne metody tworzenia kursów e-learningowych, w tym algorytm strukturyzacji materiałów kursu, algorytm hierarchicznej klasyfikacji treści według bloków tematycznych oraz algorytm początkowego rangowania elementów kursu pod względem stopnia trudności i istotności. Przedstawiono organizację e-kursu oraz krótki opis jego wdrożenia na podstawie systemu e-learningowego. W niniejszym artykule odzwierciedlono wyniki opracowania i implementacji e-kursu na podstawie metodologii e-learningu. Zaprezentowano stworzenie inteligentnego kursu dydaktycznego z wykorzystaniem mechanizmów inteligentnej analizy danych. Efektywne inteligentne algorytmy przetwarzania danych stanowią podstawę opracowania adaptacyjnej technologii nauczania zdalnego, wdrażanej w procesy dydaktyczne. Opracowano podstawowe zasady syntezy systemu oceny jakości kursów e-learningowych.*
Słowa kluczowe: *nauczanie zdalne, kurs e-learningowy, opracowanie kursów online, nauka online, platformy edukacyjne, Moodle.*