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DEVELOPMENT AND IMPLEMENTATION OF THE WEB-BASED INFORMATION SYSTEM "COMMON INFORMATION SPACE FOR VIRTUAL EXCHANGE PROGRAMS"

Abstract. The increasing importance of online learning, blended learning, and virtual exchange programs in contemporary education necessitates the development of robust digital platforms. Virtual exchange programs are online platforms that help students from different countries connect and learn together. They allow students to communicate, share cultures, and develop important skills. These programs give everyone a chance to receive quality education, no matter where they live or what their background is. They also help students gain international experience, improve their professional skills, and prepare for future jobs. By doing so, virtual exchange programs support the labor market with well-trained specialists who meet high European standards.
This paper presents design and implementation of a web-based information system titled "Common Information Space for Virtual Exchange Programs". This system aims to facilitate seamless virtual exchange programs by providing a comprehensive platform for collaboration, communication, and resource sharing among students and educators globally.
By integrating online and blended learning methodologies, the system ensures that high-quality educational resources are accessible to students irrespective of their geographical location, fostering an inclusive and diverse learning environment. The blended learning approach allows for greater flexibility and personalization, catering to varied learning styles and needs. Moreover, virtual exchange programs promoted through this platform enhance cross-cultural understanding and global awareness, equipping students with the skills necessary for a globally interconnected world.
The "Common Information Space for Virtual Exchange Programs" leverages these educational

strategies to create an engaging and interactive learning ecosystem. It supports real-time communication and collaboration, significantly improving student engagement and participation. This, in turn, leads to more effective and meaningful learning outcomes.

Keywords: virtual exchange program; web information system; MOVEx project; online education.

1. INTRODUCTION

Virtual exchange programs are educational platforms that provide opportunities for communication and intercultural interaction of groups of students in order to provide high-quality educational services, create conditions for the development of professional skills, international training for each student, regardless of their origin, country of residence or abilities [1, 2], create additional opportunities for higher education, provide the labor market with highly qualified specialists with competencies that meet high EU quality standards and are relevant.

Virtual exchanges (VEs) provide students with a unique opportunity to learn and communicate with students from other countries, leading to shared knowledge acquisition and stronger teamwork, as well as the development of intercultural competencies [1, 3]. When developing a course strategy, lecturers need to consider how to deliver instruction, perform assessments, choose systems and digital platforms for learning [4], and consider successful intercultural interaction between students, regardless of the course subject [1, 5-8].

Since 2020, members of the European Commission have presented programs for the implementation of VE in university education: "Communication from the Commission on achieving the European Education Area by 2025" and "Digital Education Action Plan (21-27)", which will be part of the Erasmus program [9]. The MOVEx project is part of such programs [10].

Virtual education refers to utilizing information and communication technologies to provide educational experiences to students, overcoming the conventional constraints of time and space in their interactions with educators, classmates, and instructional resources.

This approach, often synonymous with distance education, predominantly operates online but is not restricted to students outside a traditional classroom setting. It incorporates multimedia tools to facilitate not only content delivery but also extensive interaction among learners, educators, peers, and administrative personnel in both real-time and asynchronous modes.

Figure 1 demonstrates the tendency in self-paced online education market by 2030 according to [11], highlighting the relevance of conducting research in this area.

Figure 1. Digital Self-Paced Online Education Market according to [11]

The results of the analytics showed that VE programs are widely used in European universities. Their use has become especially widespread after the COVID-19 pandemic. Today, researchers from all over the world are conducting research on VE programs, online learning platforms, and technical tools. Such programs allow students to be more culturally aware, learn from the experience of other countries, think globally, and develop their competencies and skills. Also, the use of VE programs can address the issue of sustainable development goals regarding the possibility of obtaining a quality education by any person, regardless of their place of residence and status.

2. THE THEORETICAL BACKGROUNDS

Today, many studies are being conducted in the field of VE. The objective of [12] was to explore the impact of COVID-19 on students' motivation concerning intercultural understanding and pedagogical awareness using multiple modes of analysis. The Trello platform was used as a learning environment, Zoom, Google Meet, WhatsApp, Facebook Messenger were used for communication, and digital tools such as Instagram, Wix, Google Sites, YouTube video editors, which were chosen by each team, were used to create artifacts.

Paper [13] presents the results of a study on the development of teachers' pedagogical and digital skills when using an EFL program for learning foreign languages.

The program included VE, an online course, a case study approach, data collection through observations and field notes, records of teachers' reflective activities, as well as focus groups and individual interviews with teachers.

The authors of [14] present the results of participation in the Sustainable Schoolyards program, which takes into account the UN Sustainable Development Goals and the Global Competency Framework. The program was proposed by the California Global Education Project (CGEP) to train teachers to create and implement climate justice projects. The program used VE to establish virtual connections between school classes and kindergarten groups.

Paper [15] presents the results of using the Collaborative Online International Learning

(COIL) model, which were collected using statistical data from an anonymous questionnaire and from students' reflective reports. The analysis of the use of COIL showed positive results: it increased students' intercultural awareness, provided opportunities for intercultural interaction, and promoted personal and professional development.

The authors of [16] considered the issue of intercultural competencies to increase tolerance in the global labor market. Students from the University of Valencia (Spain) and the University Center of Brasilia (Brazil) took part in the Online Intercultural Exchanges (OIE) and positively evaluated the learning outcomes. Students gained knowledge about intercultural leadership and developed intercultural competencies.

Paper [17] reviews the research of scientists from 12 higher education institutions in eight countries during the COVID-19 pandemic. The article discusses online education and the use of online platforms in emergencies.

Study [18] presents the results of a survey and interviews of college students after the introduction of VE, which was conducted in 2020. In their conclusions, the authors note the positive effect of VE implementation and the opportunity to move to virtual international education. Networks and various communities were used to transition to VE programs. At the same time, lecturers had to overcome certain technological barriers and learn creative strategies for implementing VE.

Source [19] presents the experience of virtual student mobility in the post-pandemic period using digital platforms in higher education. The Zoom platform was used for communication. The results of the implementation of the Senior-Middle (SM) 2 Scholarship Scheme, which provided an opportunity for students of the People's Republic of China to continue their studies in schools and universities in Singapore, are presented.

Article [20] presents the results of online intercultural interaction during participation in the Collaborative Online Learning Across Borders (COLAB) program for teacher training in New Zealand and the United States of America. The paper presents online learning methods that provided insight into the specifics of working with people, taking into account their cultural differences.

Paper [21] discusses issues related to programs, problems associated with imperfect technologies, and adaptations during the VE program. It is noted that Collaborative Online International Learning (COIL) is generally quite effective, making it possible to increase intercultural communication of students. However, there are still some issues that have not been sufficiently studied.

The MOVEx project participants, namely the working group of Khmelnytsky National University, analyzed the use of online education practices by European and Ukrainian educational institutions, aiming to use innovative information technologies that take into account the rapid pace of information updates and socio-economic changes in society, which require more effective two-way communication in the learning process, exchange of experience and promote interaction and cooperation.

As a result of the analysis, the main distance learning centers of Ukraine are: Khmelnytskyi National University, University of the State Fiscal Service of Ukraine, Training to Teach Online in Wartime and After (U-train) Project, National Technical University "Kharkiv Polytechnic Institute", Ukrainian Academy of Public Administration, Wisconsin International University in Ukraine, Kharkiv National University of Radio Electronics, Lviv Polytechnic, Prydniprovska State Academy of Civil Engineering and Architecture, Vinnytsia National Technical University, Igor Sikorsky Kyiv Polytechnic Institute and Sumy State University.

An urgent task today is to develop and apply educational information that will enable the use of various collaboration tools for interaction between students and teachers within the European space. To achieve this goal, universities use learning platforms with courses (massive

open online courses): Prometheus, edX, Coursera, Khan Academy, Udacity, Google Digital Garage, SoloLearn, TalTechDigital, Duolingo, Greenforest, BBC Learning English, British Council, ESL Lab, Memrise, Open Culture, Language Learning with Netflix, and others.

To organize communication and video conferencing, we use web services, applications and programs such as: Zoom, Google Classroom, BigBlueButton, Skype for business, Blackboard Collaborate Ultra, Google Meet, WhatsApp and others.

These centers, platforms and tools are convenient to use both during standard full-time education as additional tools and as the main educational environment for educational institutions whose educational program is based on a combination of classical and alternative methods, as well as for individual learning, in case of forced distance learning and even for independent self-development and self-study.

These tools help to expand access to education and create convenient conditions for studying material anywhere and anytime, increase digital awareness among students and, as a result, improve the education system based on digitalization. The choice of a particular platform may depend on user needs, educational goals, and technical capabilities.

Therefore, the implementation of VE programs is quite relevant. However, today there are still problems related to intercultural communication, a systematic pedagogical approach to the implementation of such projects, the development of goals and criteria for participation in VE programs, the introduction of effective methodologies and the choice of learning outcome assessment tools. Thus, the aim of this research is to develop a Web-based information system "Common Information Space for Virtual Exchange Programs" – a platform that will enable virtual education for students from partnering universities.

3. RESEARCH METHODS

Blended learning currently is a growing global trend [22, 23]. Blended learning, also known as hybrid learning, occupies a significant position on the spectrum between traditional in-person instruction and entirely online formats. It harnesses online tools to enhance and evolve the learning experience rather than merely adding to it. Additionally, within a blended learning framework, the teacher's role transitions from being a knowledge provider to that of a coach or mentor (Figure 2).

Blended learning models include the following models:
1. Flex Blended Learning Model
2. The 'Flipped Classroom' Blended Learning Model
3. Lab Rotation Blended Learning Model
4. Face-to-Face Blended Learning Model
5. Online Lab Blended Learning Model
6. Self-Blend Blended Learning Model
7. Online Driver Blended Learning Model
8. À La Carte Blended Learning Model

The characteristics and peculiarities of each blended learning model are presented in Table 1.

Table 1

The characteristics and peculiarities of known blended learning models

Model name	Brief description
Flex Blended Learning Model	In the Flex model, the majority of the curriculum is accessed through a digital platform. Online learning serves as the primary avenue for student education, while teachers offer in- person consultations and assistance.

|	
	Students engage in independent work, fostering the development of new concepts within a digital realm. This model offers flexibility, allowing students to access the physical campus at their convenience. Teachers in this model take on the role of mentors, providing guidance and instruction to support students throughout their learning journey.
The "Flipped Classroom" Model	At home, students are introduced to the content, followed by practice sessions at school with the support of teachers and peers. The traditional roles are reversed, with students viewing online lectures independently and then participating in collaborative discussions online. Research tasks are completed at home, while classroom time is dedicated to actively engaging with concepts. Various resources, including video lectures, recordings, podcasts, and articles, are provided to facilitate the transfer of essential knowledge from teachers to students before each class.
Face-to-Face Model	A method of instruction where students absorb course content and complete activities in person. Students and instructors benefit from physical presence and can engage on a deeper level by observing cues and body language. This allows teachers to dedicate class time to supporting students in activities that foster discussions and promote engagement, such as quizzes and other interactive games.
Lab Rotation Model	This model operates by enabling students to move through digital stations on a set schedule, necessitating physical transitions between rooms. Instead of remaining in the same classroom, learners rotate to a computer lab for online learning tasks. This approach appears to be favored in elementary settings where students can be grouped according to their proficiency levels, such as reading and math. For instance, students excelling in reading may receive direct instruction from their teachers in math before transitioning to online reading stations.
Online Lab Model	With schools encountering greater resource limitations, the online lab model emerges as a feasible solution to assist students in completing their courses, including those unavailable at their particular site. All curricula are accessed through a digital platform, but within a designated physical space, like a computer lab. While individuals oversee the lab, they are not necessarily trained teachers. Moreover, this model enables schools to provide courses even when they lack a sufficient number of teachers.
Self-Blend Model	Enables students to enhance their traditional education with online coursework. For this blended learning model to thrive, students must be highly motivated. It is perfect for those who wish to pursue additional advanced placement courses or explore subjects not included in the standard course catalog.
Online Driver Model	Unlike the face-to-face model, the online driver model has students working remotely with materials delivered through an online platform. While in-person check-ins are optional, students can usually communicate with teachers online if needed. This blended learning model is ideal for students who require more flexibility and independence in their daily schedules.
À La Carte	In the À La Carte blended learning model, students take an online course alongside their core curriculum. This allows them to select additional courses online to complement their existing coursework. Students are expected to complete assignments by specified deadlines. Communication with the instructor occurs online through email or other chat programs.
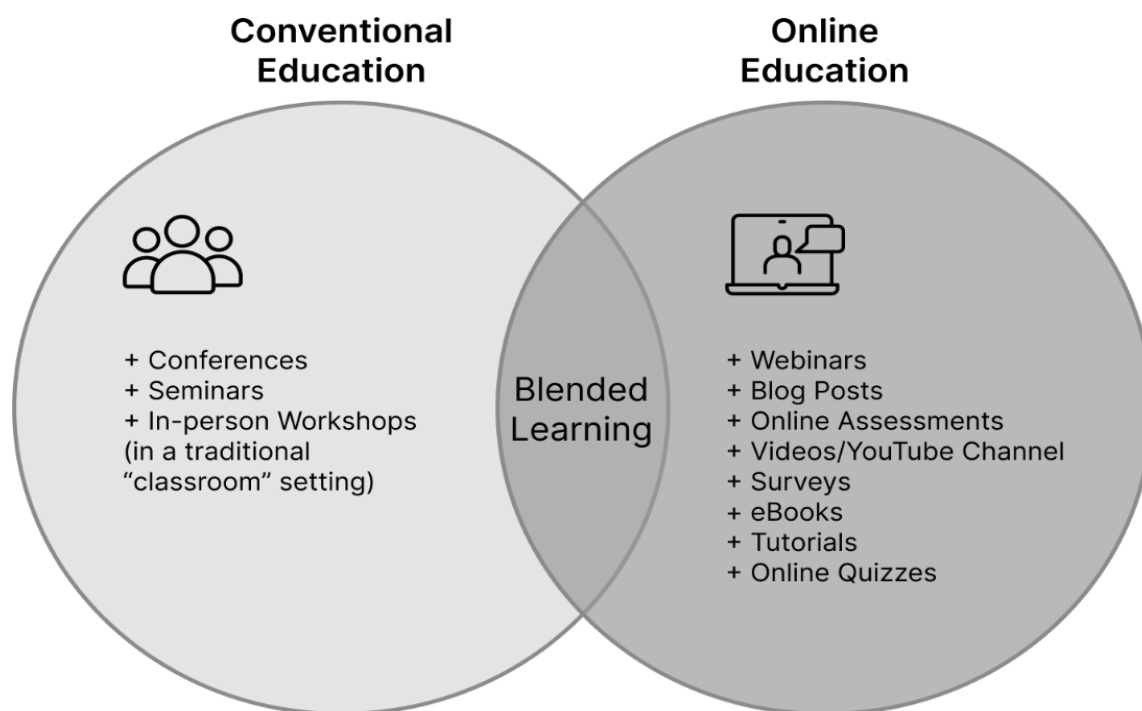
Figure 2. The concept of blended learning according to [22]

Figure 3 demonstrates the elements of virtual learning, such as Learning Management Systems (LMS), Digital learning games, Communication tools and Online learning resources and the integration of technology and highly qualified human resources.
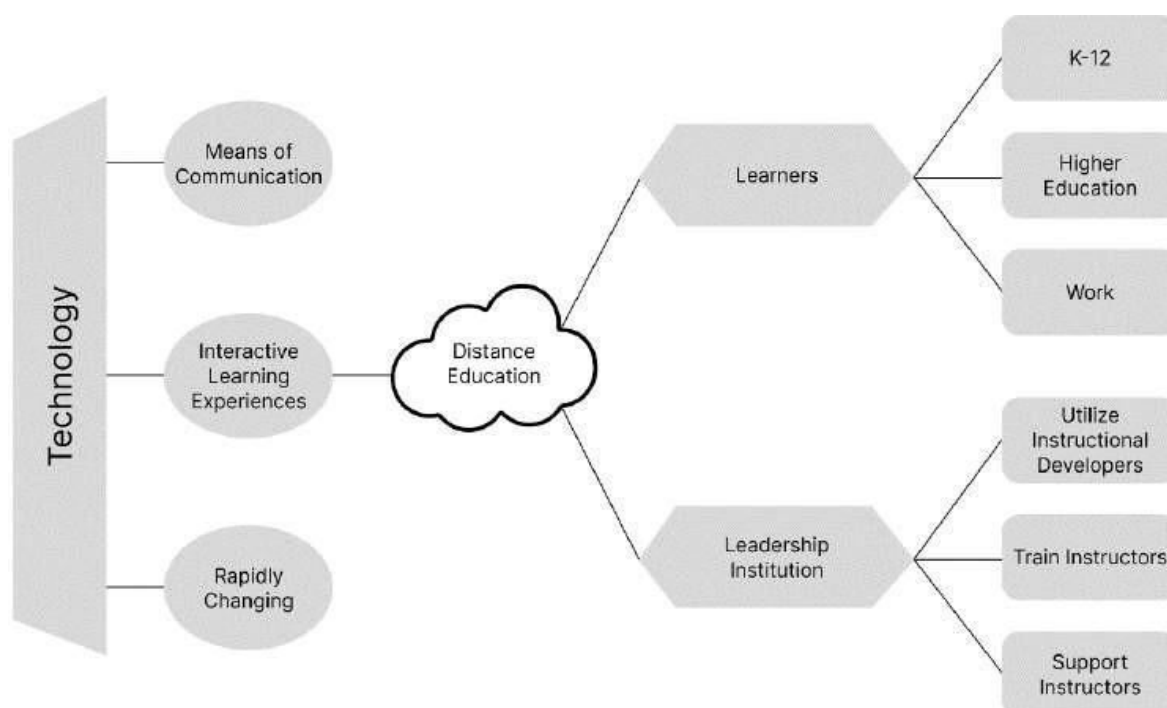

Figure 3. Elements of virtual learning

Since online learning resources are an integral part of distance and blended education, development of Web-based information system "Common Information Space for Virtual Exchange Programs" is currently a relevant task.

4. THE RESULTS AND DISCUSSION

MOVEx Web Portal "Common Information Space" (CIS) is a web-based system for management and delivery of educational content. The requirements for the CIS are:

1. User Management:
   – User registration and authentication.
   – Role-based access control (admin, instructor, student, etc.).
   – User profiles and permissions.
2. Assessment and Quizzes:
   – Tools for creating quizzes and assessments.
   – Support for various question types (multiple-choice, true/false, essays).
3. Tracking and Reporting:
   – Reporting and analytics on course passing rates.
   – Customizable reports for administrators and instructors.
4. Customization and Branding:
   – Customizable interface and branding options.
   – Theming and styling options to align with the organization's branding.
5. Security [24, 25]:
   – Data encryption for user data.
   – Role-based access controls to protect sensitive information.
6. Scalability and Performance:
   – Ability to handle a large number of users.
   – Performance optimization for quick response times.
7. User Support and Training:
   – Helpdesk or support system.
   – Training materials for administrators, instructors, and users.
8. Mobile Compatibility:
   – Responsive design for access on various devices.
9. Databases Integration:
   – Database of course introduction materials.
   – Database of students – assignees for courses.

According to the abovementioned requirements Users' categories and the role of partners in the process were described.

User

Unregistered (Guest) – registration function; Registered – authorization, view courses;

– student - view the list of courses, do preliminary enrollment (fill in the form), view the introduction material for the course, complete the quiz, receive the decision about course enrollment from administrator, receive a certificate of completion of the course, get support from the administrator, receive feedback from the administrator.

– enrollment specialist (from partner universities) – view the list of students who were selected after the completion of the quiz, validate the list of students in a loop until the group is full, get contact information of students for the appropriate course (all necessary information to register students in local education system);

– facilitator (lecturer from partner universities) – provide the system with a list of students who completed the course.

Administrator

– Manage user access and permissions

– Design user interface of the system taking into account branding

– Provide support to users

– Accept a valid list of students
– Provide feedback for students who did preliminary enrollment
– Receive the results of the quiz, completed by a student
– Create ranking of candidates for each course
– Provide students with a decision about acceptance for the course Partners

The enrollment specialist is a person responsible for providing access to the education system of each partner university.

The facilitators of the courses are lecturers of partner universities, who can provide course content for students. Table 2 displays the roles and functions of users in Web-based information system "Common Information Space for Virtual Exchange Programs"

Table 2

The roles and functions of users in Web-based information system "Common Information Space for Virtual Exchange Programs"

Role in the system			Functions
User	Unregistered (Guest)		registration
	Registered		Authorization, view courses
	Registered	Student	view the list of courses, do preliminary enrollment (fill in the form), view the introduction material for the course, complete the quiz, receive the decision about course full enrollment from administrator, receive a certificate of completion of the course, get support from the administrator, receive feedback from the administrator.
		Enrollment specialist (from partner university)	view the list of students who were selected after the completion of the quiz, validate the list of students in a loop until the group is full, get contact information of students for the appropriate course* *all necessary information to register students in local education system
		Facilitator (lecturer from partner universities	provide the system with a list of students who completed the course
Administrator			Manage user access and permissions; Design user interface of the system taking into account branding; Provide support to users; Accept a valid list of students; Provide feedback for students who did preliminary enrollment; Receive the results of the quiz, completed by a student; Create ranking of candidates for each course; Provide students with a decision about acceptance for the course.

Based on requirements and functions, a system architecture of Web-based information system "Common Information Space for Virtual Exchange Programs" has been developed. The architecture is presented in Figure 4 in the form of a chart.
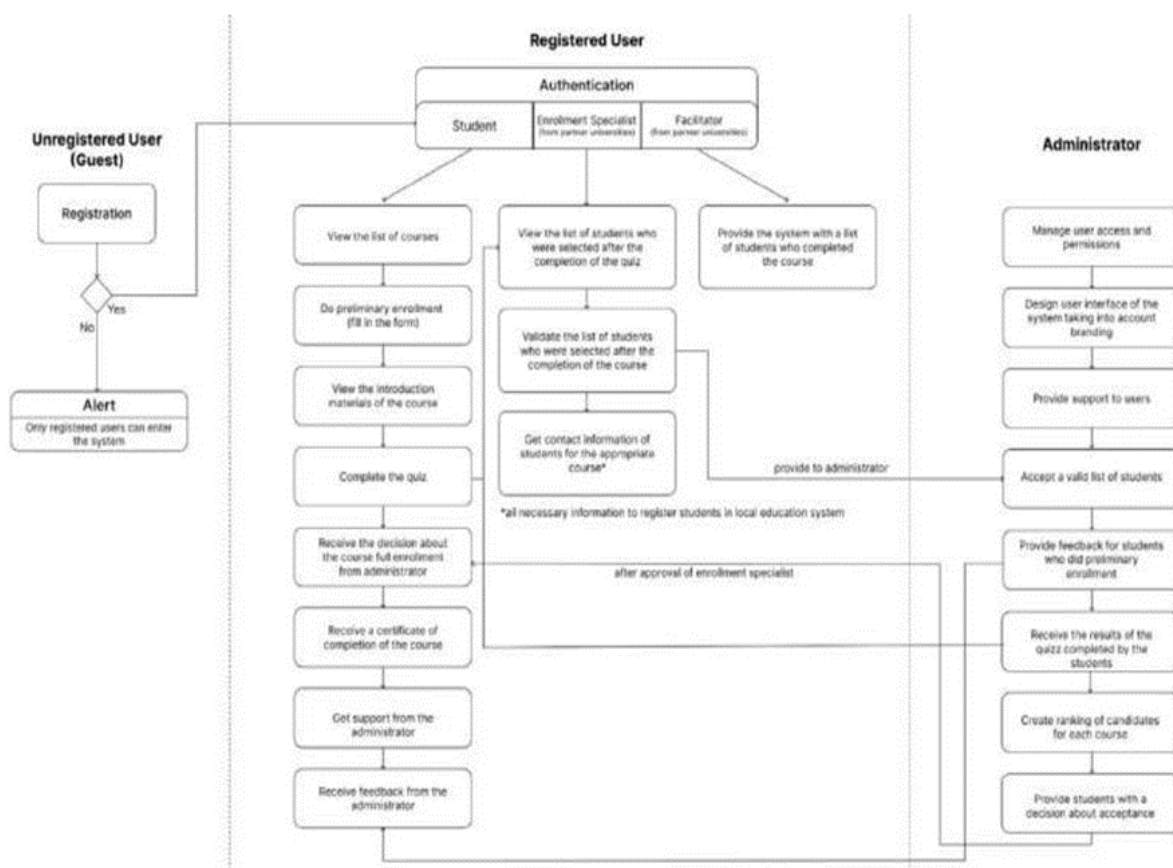
Figure 4. Architecture of the Web-based information system "Common Information Space for Virtual Exchange Programs"

For better visual and structured representations of the system's functionality a Use Case Diagram (Figure 5) has been proposed to visually depict the various user roles and their actions within the platform.
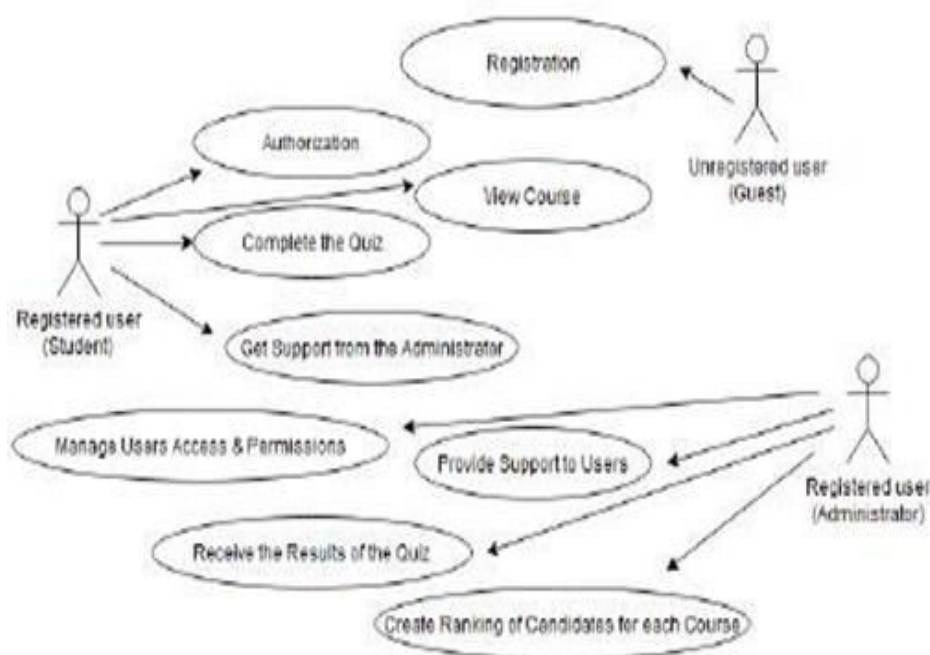

Figure 5. System's functionality (a Use Case Diagram)

5. CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

A key outcome of this study is the development of the Web-based information system "Common Information Space for Virtual Exchange Programs". The interface of the dashboard (a) and log in form (b) are displayed in Figure 6. The authors' further efforts will be directed at the development of microcredential courses for virtual mobility programs, their integration into the system and conducting experiments to assess the system's effectiveness in facilitating real virtual exchanges under the MoveX project.
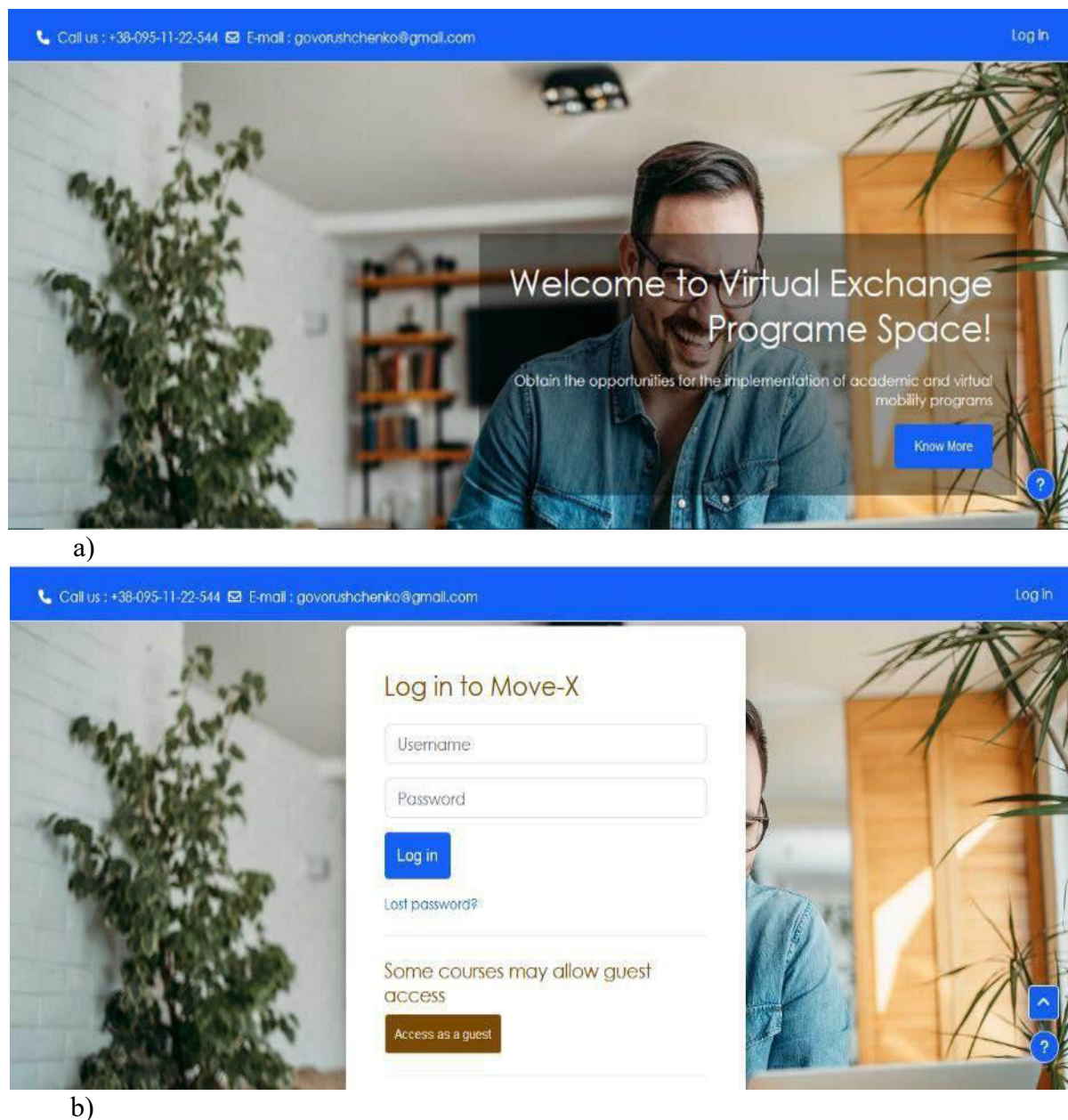

a)

b)

Figure 6. User Interface of the Web-based information system "Common Information Space for Virtual Exchange Programs"

To clarify the operation of the proposed platform and to determine the features that distinguish it from already existing platforms for distance learning and massive open online courses, a comparative analysis was conducted (see Table 3 below).

Table 3

Comparative analysis of well-known distance learning platforms and massive open

Platform or MOOC	Target Audience	Content	Specifics	Technical Features
Coursera	Students, professionals, and academic institutions.	Offers courses, specializations, certificates, and degrees in a wide range of subjects.	Partnerships with Universities Flexibility Mobile app Learning pathways	Integrated assessments: quizzes, peer-reviewed assignments, and auto-graded programming assignments. discussion forums: community- based support for learners. LMS Integration: supports integration with learning management systems for institutions. Multilingual support.
edX	Students, professionals, and lifelong learners.	Free and paid courses, MicroMasters, professional certificates, and online degrees.	Open edX platform: an open-source platform used by various universities and organizations. Focus on high-quality Education: collaborates with prestigious institutions (e.g., MIT, Harvard). Flexible learning. Accessibility.	Adaptive learning: some courses offer adaptive learning paths. Interactive components: Videos, quizzes, and labs. Mobile-friendly: Responsive design and mobile app for learning on the go. APIs: provides apis for integration with other platforms and tools.
Udemy	Professionals and general learners looking for skills development.	Over 150,000 courses in various domains, often focused on professional skills.	Instructor-driven: anyone can create and sell courses, leading to a wide variety in course quality. Frequent discounts: regular discounts and sales on courses. Lifetime access: once purchased, learners have lifetime access to the course content. Practical focus: many courses focus on practical skills, especially in technology and business.	Video-based learning: predominantly video-based content with downloadable resources. Interactive features: quizzes, coding exercises, and assignments. Course creation tools: simple tools for instructors to create and upload content. Multilingual support.
FutureLearn	Students, professionals, and academic institutions.	Short courses, micro-credentials, and online degrees.	Social learning: emphasis on discussion and interaction among learners. Partnerships with universities:	Discussion threads: embedded discussion prompts within course content. Progress tracking: tools to track learning progress. Mobile access: fully responsive platform with mobile app

			courses are developed by universities and industry leaders. Step-by-step learning: Courses are designed to be taken in small, manageable steps. Collaborative projects: some courses include group projects and peer learning.	support. Certificates: options for free participation or paid certificates and accreditation.
Google Classroom	Schools, teachers, and students.	Classroom management and communication tools for K-12 education.	Free for schools: part of google workspace for education. easy integration: seamlessly integrates with other google services like drive, docs, and gmail. assignment management: streamlines the process of assigning and grading work. real-time collaboration: supports real-time collaboration on documents and projects.	Simple interface: user-friendly for teachers and students. mobile access: fully accessible via mobile app. automatic organization: automatically organizes assignments, materials, and communications. privacy and security: built-in security features to protect student data.
MoveX Common Information Space for Virtual Exchange Programs	Partnering Educational Institutions	Platform for hosting courses created by partnering institutions	Highly customizable and free to use. Community driven: strong community support and frequent updates. scalability: can be used for small classes or large-scale implementations. plugins and extensions: wide range of plugins available to enhance functionality.	Moodle-driven modular design: courses are built using different activity modules (e.g., quizzes, forums). Role-based access: different roles for students, teachers, and administrators. Analytics and reporting: advanced tools for tracking student performance.

This study developed a web-based information system "Common Information Space for Virtual Exchange Programs". The goal of the proposed system is to provide a platform for student virtual exchange, develop international and intercultural communication, enable work

in the international groups around the world.

The integration of online and blended learning methodologies within this platform offers several advantages. It allows students to access high-quality learning materials no matter where they are, making education more inclusive and diverse. Virtual exchange programs further enrich learning by helping students understand different cultures and develop global awareness. These programs allow students to connect with peers from various backgrounds, broadening their perspectives and preparing them for a more interconnected world.

The 'Common Information Space for Virtual Exchange Programs' system draws on these ideas and aims to create an engaging and interactive learning environment. By enabling real-time communication and collaboration, it boosts student participation and engagement, leading to more effective and meaningful learning experiences.

The development of the proposed web-based information system is a significant step towards modernizing education and making it more accessible and relevant to students. It highlights the transformative potential of online learning, blended learning, and virtual exchange in providing equitable and high-quality education. The authors' future efforts will focus on further refining the system and expanding its capabilities to support a wider range of educational activities and collaborations, thereby continuing to enhance the learning experience for students around the world.

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РОЗРОБКА ТА ВПРОВАДЖЕННЯ ІНФОРМАЦІЙНОЇ ВЕБСИСТЕМИ «ЄДИНИЙ ІНФОРМАЦІЙНИЙ ПРОСТІР ДЛЯ ПРОГРАМ ВІРТУАЛЬНИХ ОБМІНІВ»

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Анотація. Зростаюче значення онлайн-навчання, змішаного навчання та програм віртуальних обмінів у сучасній освіті вимагає розробки надійних цифрових платформ. Програми віртуальних обмінів – це освітні платформи, які надають можливості для спілкування та міжкультурної взаємодії груп студентів з метою надання якісних освітніх послуг; створюють умови для розвитку професійних навичок, міжнародного стажування для кожного студента, незалежно від його походження, країни проживання чи здібностей; створюють додаткові можливості для здобуття вищої освіти; забезпечують ринок праці висококваліфікованими фахівцями з компетенціями, що відповідають високим стандартам якості ЄС та є актуальними.

У цій статті представлено розробку та впровадження інформаційної вебсистеми під назвою «Єдиний інформаційний простір для програм віртуальних обмінів». Ця система має на меті сприяти безперебійній реалізації програм віртуальних обмінів, надаючи комплексну

платформу для співпраці, спілкування та обміну ресурсами між студентами та викладачами по всьому світу.

Інтегруючи методології онлайн і змішаного навчання, система забезпечує доступність високоякісних освітніх ресурсів для студентів незалежно від їхнього географічного розташування, сприяючи створенню інклюзивного та різноманітного навчального середовища. Підхід змішаного навчання забезпечує більшу гнучкість і персоналізацію, використовуючи різні стилі навчання і задовольняючи навчальні потреби. Крім того програми віртуальних обмінів, що просуваються через цю платформу, сприяють міжкультурному розумінню і глобальній обізнаності, надаючи студентам навички, необхідні для життя в глобально взаємопов'язаному світі.

«Єдиний інформаційний простір для програм віртуальних обмінів» використовує ці освітні стратегії для створення цікавої та інтерактивної навчальної екосистеми. Він підтримує спілкування і співпрацю в режимі реального часу, значно покращуючи залучення та участь студентів. Це, своєю чергою, призводить до більш ефективних і значущих результатів навчання.

Ключові слова: програма віртуальних обмінів; веб-інформаційна система; проєкт MOVEx; онлайн-освіта.