Roman Kvyetnyy, Oleh Bisikalo, Yevhen Palamarchuk, Olena Kovalenko

Methodology for developing an educational electronic information environment

JetIQ VNTU

Main Speaker: Olena Kovalenko

Methodology: essence and substance; methods of strategic planning and implementation; environmental life cycle.

Methodology for developing of an educational electronic information environment: features, established methods, and implementations.

Higher Education Institutions.

Distance learning platforms.

Corporate platforms.

Microlearning via short courses and social media.

Electronic space as a web-oriented learning system. A system established through various electronic devices, hardware, and software for managing information and knowledge within a specialized environment.

Strategy for the Development of the Educational Electronic Information Environment

Development Strategy and Digitalization Strategy.

Fragmentation of digitalization tasks.

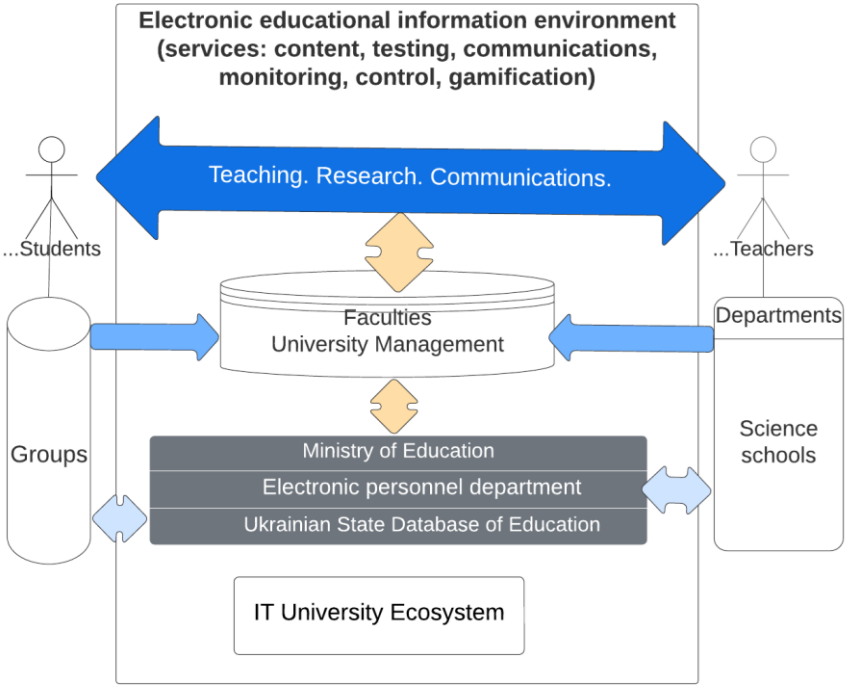
Systemic development strategy based on sociotechnical parameters.

Principles for creating an educational electronic information environment as an ecosystem:

- Single-entry data principle: input once, use multiple times.
- Process optimization over automation: analyze and optimize or replace existing processes with digital-native workflows rather than simply automating them.
- Agent-based and microservice interaction: single process owner per microservice; defined communication protocols; interaction between software modules, process owners, and participants.
- Core information preservation and redundancy.

IT University Ecosystem and its Participants

- students
- teachers
- administration
- services
- state management institutions
- commercial management boards



The mathematical model of the educational electronic information environment can be presented as a specific type of proprietary model of the electronic information environment, structured as a set of circuits.

$$OEIS = \langle z_p, z_f, z(r_1 ... r_2), [\![z_k, z]\!]_m \rangle,$$

where z_p is the monitoring and performance control circuit; z_f represents the functional circuits for operational activity; $z\{r_1 ... r_n\}$ denotes the activity implementation scenario circuits; z_m is the motivational circuit; and z_k is the communication and interaction circuit.

A composite set of agent sets (users or software modules), electronic static and dynamic resources, and communications.

$$Z=\langle A,ER,B\rangle,$$

where A is the set of agents (software modules and users); ER is the set of electronic resources; and B is the set of interactions between agents. The interaction B{ij} with defined vectors describes the nature of information interaction between agents Ai and Aj (j, i = {1, N}, j = M).

The mirror concept is based on the definitions of information theory and its classification according to perception, presentation, processes, and the reflection of information by an agent.

$$Jspr=Rk\ (Jp\ )\ Jpr=Rka\ (Mspr\ )\ Mpr,$$

where J{spr} is perception information; Jp is presentation information; J{pr} is process information; M{spr} denotes measurement indicators of perception; M{pr} denotes measurement indicators of processes; Rk is the relative content density of electronic resources; and R{ka} is the relative perception (reflection) of information by an agent.

The informational perception vector can be represented as a Gaussian integral, encompassing the information flow vector over the area of the environment.

$$J_{spr}=\oint S[\![R_k\ OdS]\!]=\oint S[\![O_{spr}\ dS]\!],$$

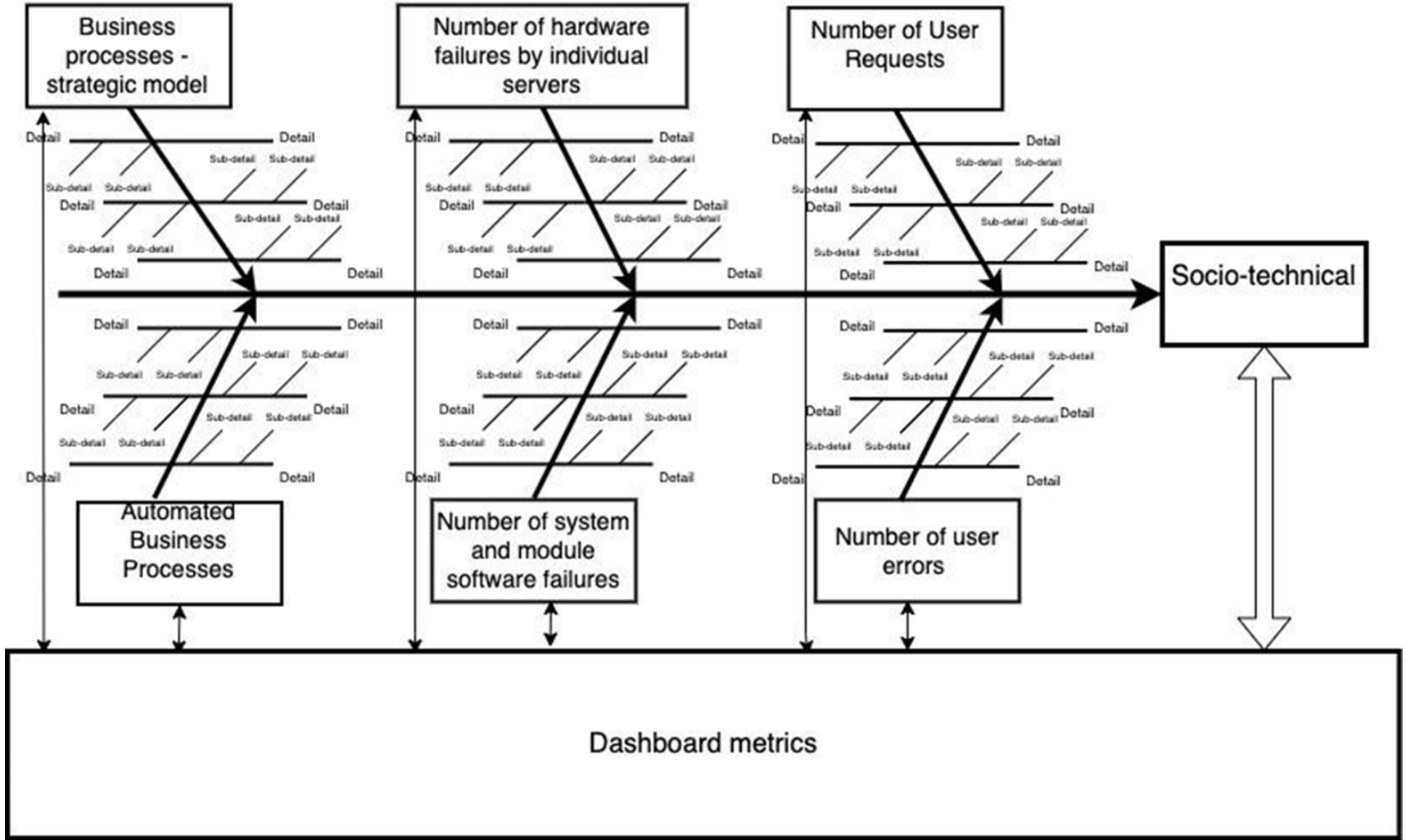
where O{spr} = R_k O is the reflection intensity vector; O{spr} is the coverage vector of educational and managerial activities and their reflection for user perception.

A novel methodology for developing an educational electronic information environment is introduced. This methodology encompasses concepts and methods, models of agent interaction within the educational information ecosystem, and educational, managerial, and supporting processes. The approach enhances the quality of the design and implementation of educational electronic information environments and reduces the time required to adapt implementation methods to the specific requirements of individual educational institutions and corporate training programs.

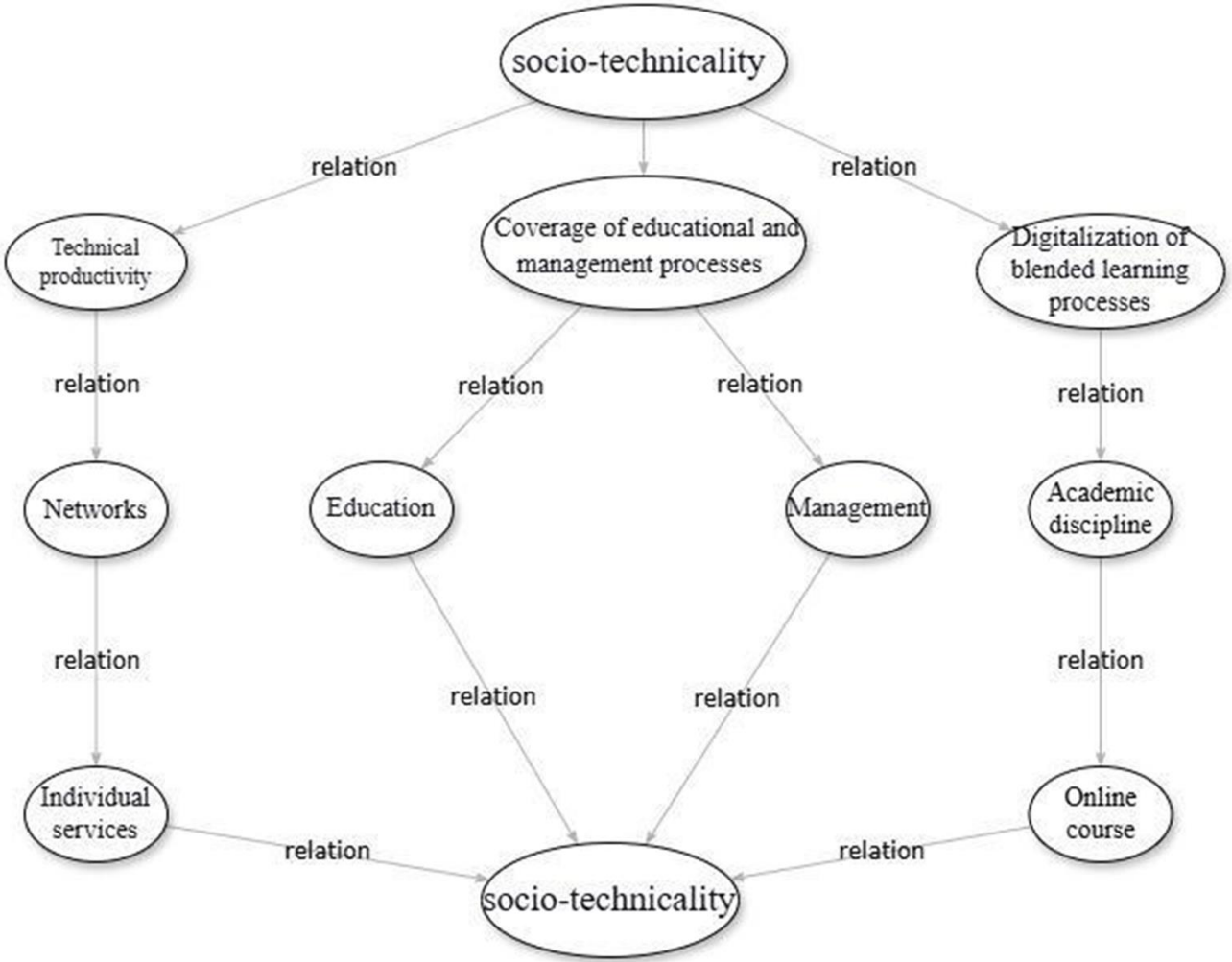
A project management technology for implementing an educational electronic information environment is proposed. This technology enables the identification of requirements for individual modules, verification of agent interactions, assessment of error risks in specific processes, and evaluation of the socio-technical level of the educational information ecosystem. These features collectively reduce the time required to implement new modules and changes within the educational electronic information environment.

A visual collaboration library is proposed that, unlike existing solutions, employs specialized visual elements to reduce facilitation time and to define requirements for developing an educational electronic information environment. This library also enables rapid visual modeling of educational, management, and support processes.

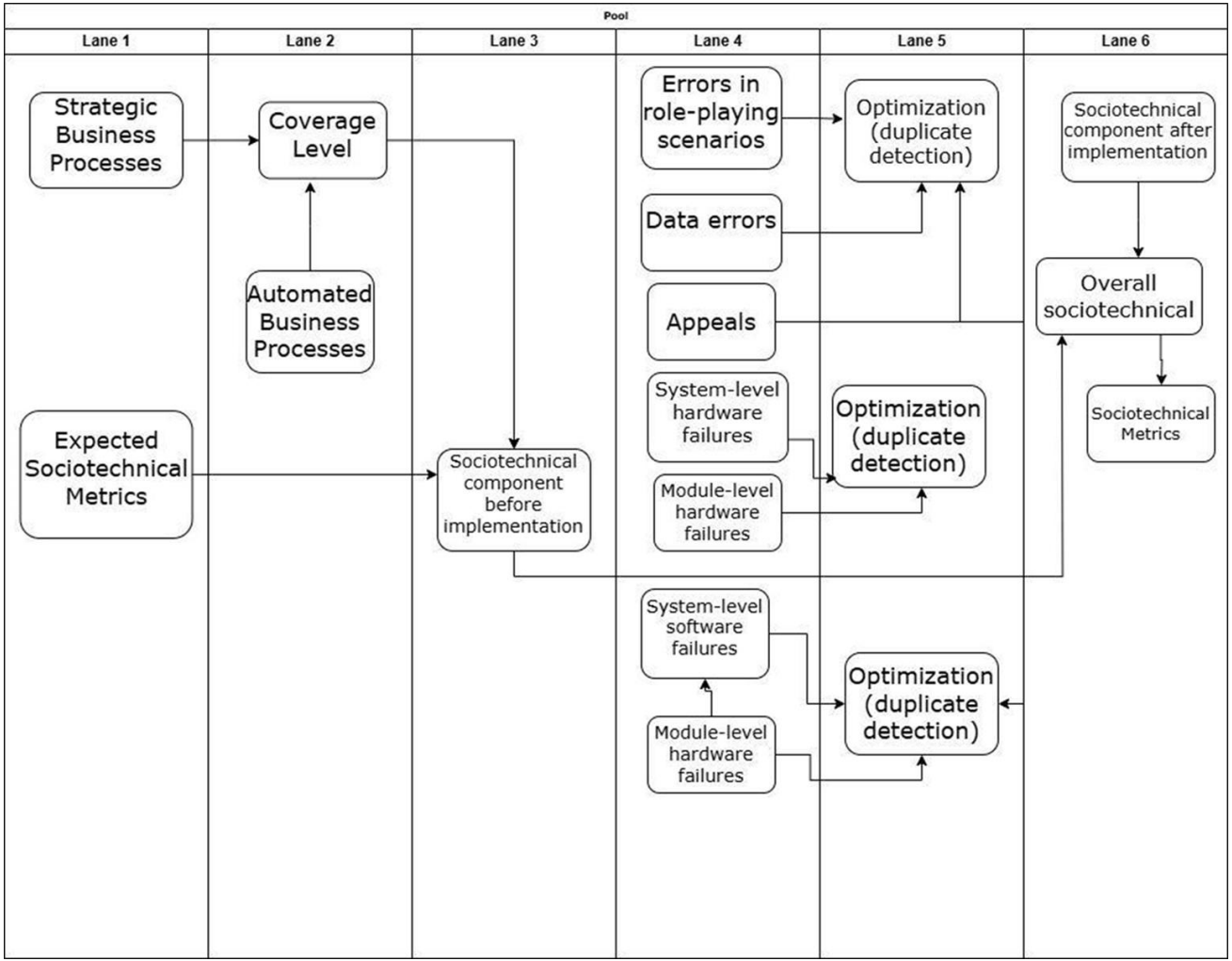
The theory of information reflection for educational electronic information environments has been refined by clarifying post-processing information reflection processes, considering the characteristics of educational, managerial, and auxiliary processes. This refinement enables assessment of the socio-technical level of the information ecosystem at the strategic level and formalizes information flows within individual modules and agent interactions at the contour level. Consequently, input and output information can be structured in accordance with specified requirements and international standards for educational software, facilitating the optimization of the learning space based on defined criteria.


Business processes - strategic model
Number of hardware failures by individual servers
Number of User Requests
Socio-technical
Automated Business Processes
Number of system and module software failures
Number of user errors
Dashboard metrics

Process groups	LMS	
	SEL	JetIQ
1. Functional educational processes	5.75	8
2. Electronic Dean's Office	7	9
3. Reporting	4	8
4. General communications	5	5
5. Integration with external resources	4	6
6. Document management	7	3
7. Emotional circuit	1	3
8. Brand presentation	3	4
9. Mobile applications	2	4
Total	38.75	51



Socio-Technical Ecosystem Mapping Diagram of the "Electronic University"

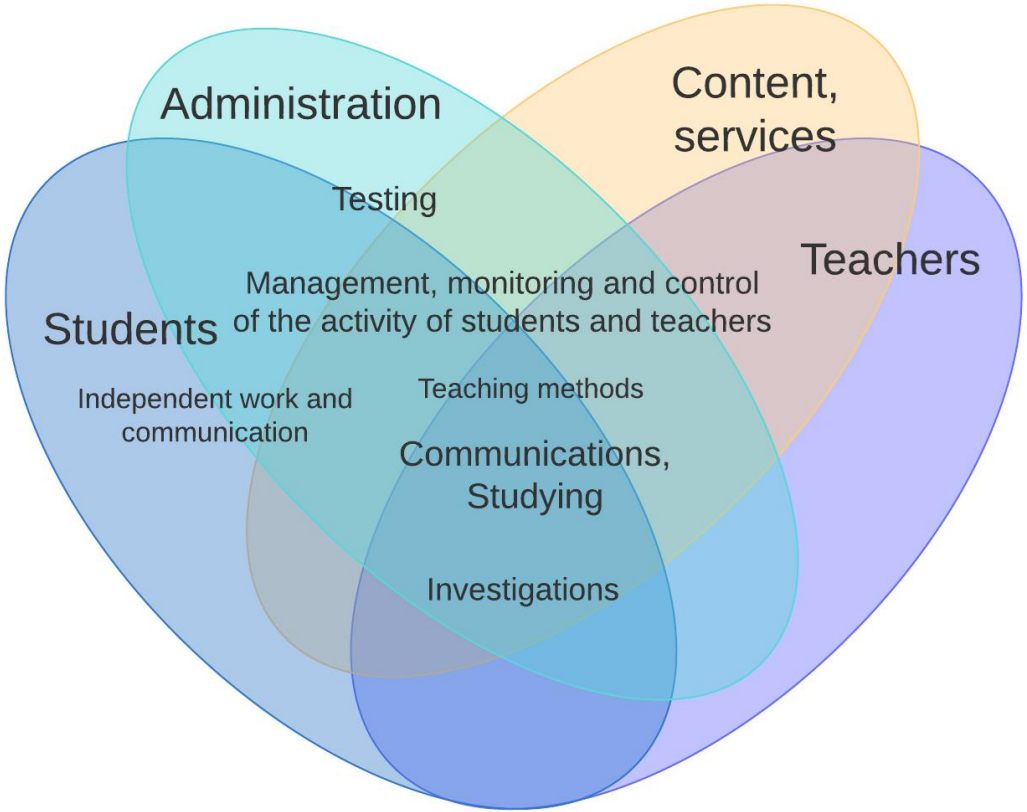


Transition from the existing model to the proposed model

The structural model of the educational electronic information environment has been enhanced to incorporate functional, communication, and motivational-emotional contours within a unified system, distinguishing it from existing models. This approach enables the separation of specific functions, reduces the prominence of the functional contour, and optimizes communication and motivational-emotional processes in accordance with specified criteria.

JetIQ contours

- functional
- emotional and motivational
- meaningful (content)

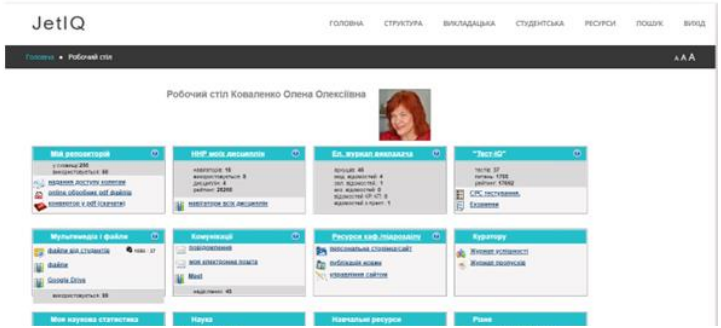


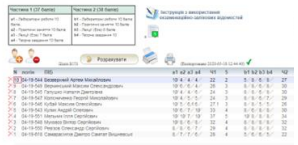
Contours and formats of interaction in the JetIQ university ecosystem

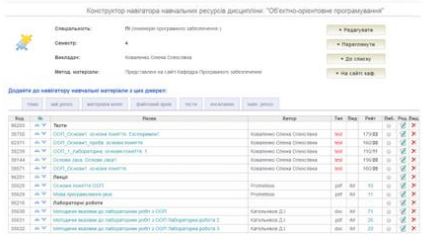
Contour/ Format	Traditional	Mixed	Distance	Quarantine/ war	Session
Institutional	All processes comply with the Law on Higher Education, the Statute and Regulations on the educational process, distance and mixed learning		Special orders and regulations to strengthen the distance learning formaty		Electronic dean's office. Integration systems with the database of the Ministry of Education.
Educational	Implementation of the curriculum		Application of special services		Processes of final control of knowledge
Support of methodical and scientific activity	Traditional communications	Traditional and online communications	Online communications	Providing free access	A built-in system for evaluating educational and scientific activities
Technical support	Process automation		Strengthening the work of technical service centers		Emphasis on security
Emotional	Elements of self-management, self-learning, gamification, introduction of original teaching methods		**Emotional, methodological and technical support**		
Training and coaching	Information technologies and pedagogical skills				

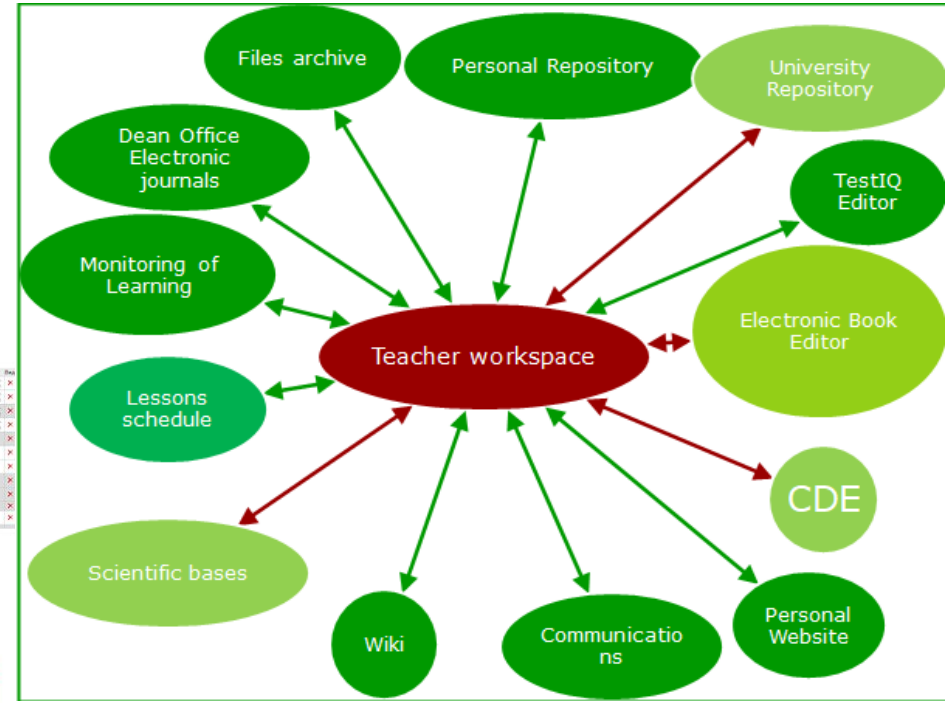
Levels of Management and Use		**What**	**How**	**Where**	**Who**	**Why**	**Motivation**	***Models***
Heads of the institution and the project "Electronic University"	Head	Educational Plans and Objects	Educational and management processes	Internal network, external public portal; territorial placement	Key departments and individuals	According to the curricula and timetables of the departments	Target benchmarks of the educational development strategy	**Scope, context**
	Scheduler	Conceptual Data Model	Educational and Management Process Model	Logistics Information Scheme Схема	Target Users		Information Mirrors of the	**Model "Electronic University"**
Users	Student	Electronic resources communications, presentations monitoring of results of activity	Through personal electronic cabinet; public portal;	Internal network external public portal	Specialist Administrators with a certain level of access and capabilities in the system		Convenient, accessible, fast, modern.	**Real Electronic University**
	Teacher							
	Specialist							
	Methodist							
	Administrator							
	Dispatcher							
	Leader							

Components of teacher workspace.









The model for developing an educational electronic information environment for microlearning has been enhanced using the modules "Electronic book" and "Navigator of academic disciplines." Unlike existing models, it incorporates SMART elements that improve communication and motivational-emotional contours by increasing the number of short motivating messages for independent student work, utilizing test tasks, and automating the evaluation of student work results, thereby reducing teacher workload.

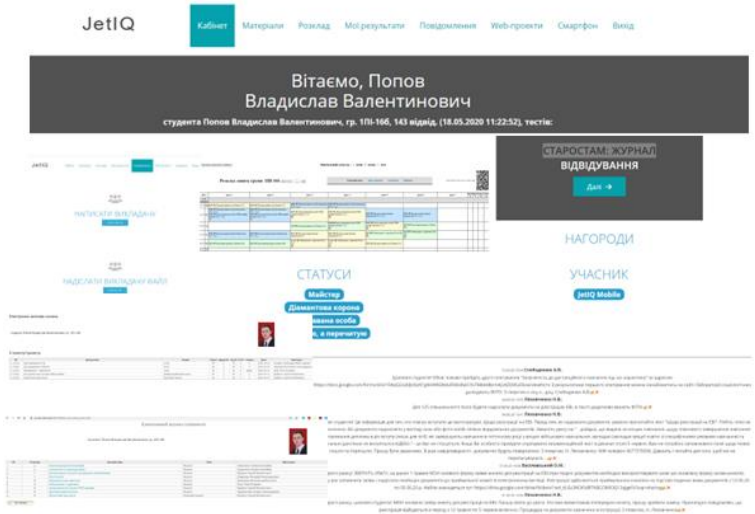
$K_{elbook} = \{K_{fteach}$ (Learnin$_{strteach}$; Cr; Content; Plan$_m$; L$_{sms}$; Tests, Val; Tasks;Exterlinks); K_{fst} (Learnin$_{strst}$; Read$_{st}$; Not$_{st}$; Tasks $_{St}$; Tests$_{st}$; SMS$_{st}$; Forum$_{st}$);K_{fSM}(Track$_{St}$;Auto-SMS,Gam);K_{fSI}(Integer$_{navigator}$;Integer$_{testresults}$;Integer$_{communication\ teacher}$; Integer$_{sms}$; Integer$_{sendfile}$; Integer$_{forum}$); $K_{fSecurity}$ }

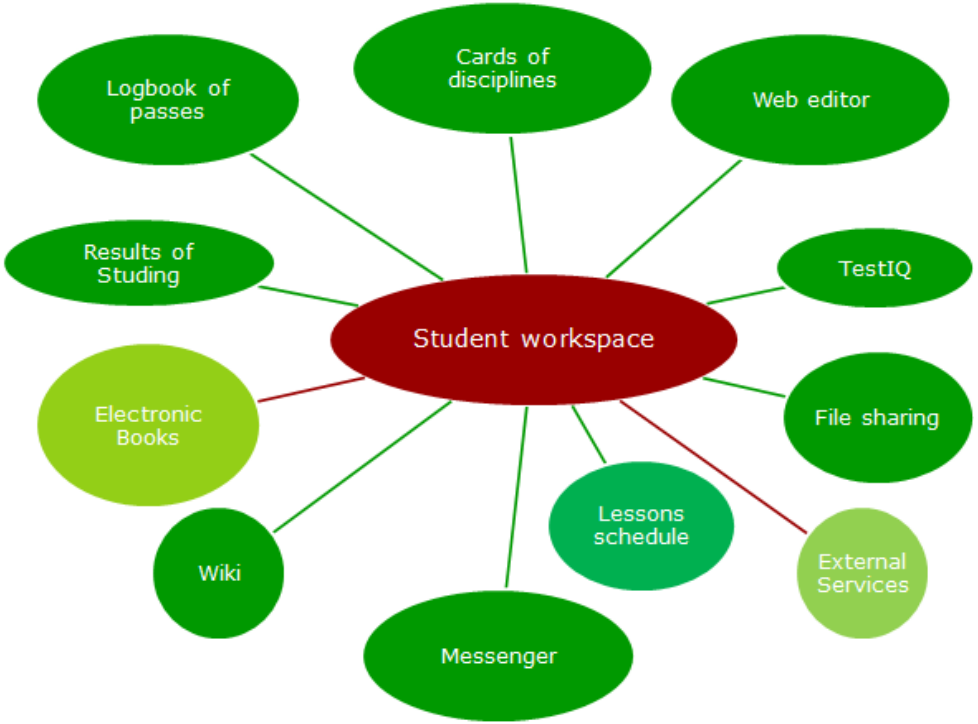
- **Instructor's functional actions** K_{fteach} (functions for studying instructions on how to work with the "Electronic Book" module Learn $_{instr\ teach}$; creation Cr; populating Content; management action plan $Plan_m$; message library for the student action monitoring system L_{sms}; embedded tests with assessment evaluation Tests, Val; assignments Tasks; list of external links Exterlinks);
- **Student's functional actions** K_{fst} (functions for studying instructions on how to work with the "Electronic Book" module Learn $_{instr\ st}$; reading electronic resources Read $_{st}$; bookmarks and notes Not $_{st}$; completing assignments Tasks $_{St}$; taking embedded tests Tests $_{st}$; generating messages SMS_{st}; and navigating to the discussion forum Forum $_{st}$);
- **Monitoring system functions** K_{fSM}(tracking student actions $Track_{St}$; generating automated messages Auto-SMS; connection with the gamification system Gam);
- **Integration system functions** K_{fSI}} for integrating the electronic book with other modules of the JetIQ VNTU information ecosystem (integration with the discipline navigator $Integer_{navigator}$; generating test result reports; capabilities for semi-automatic entry of grades into the electronic journal Integer $_{test\ results}$; connection with the instructor notification system Integer $_{communication\ teacher}$; sending files $_{Integer\ sms}$; Integer $_{sendfile}$; Integer $_{forum}$)

The **security contour** is supported by the JetIQ VNTU information ecosystem login system $K_{f\ Security}$ and the instructor's own tools for granting access to electronic learning resources to specific groups of students, as well as the use of protection tools for various electronic resource formats.

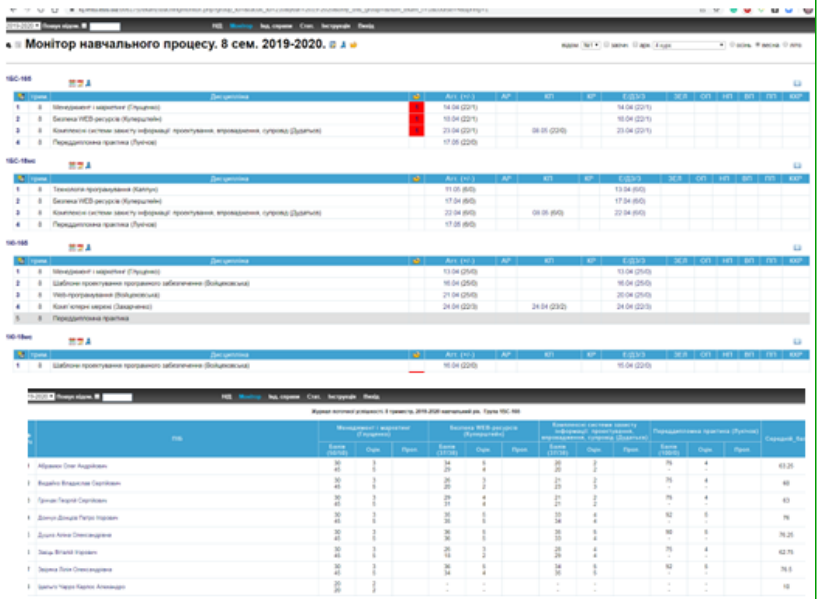
Student workspace.

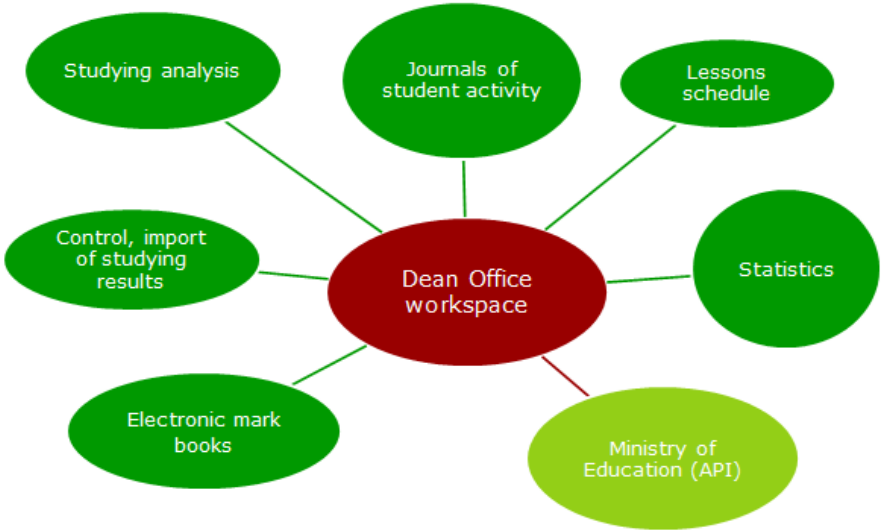
Components of student workspace



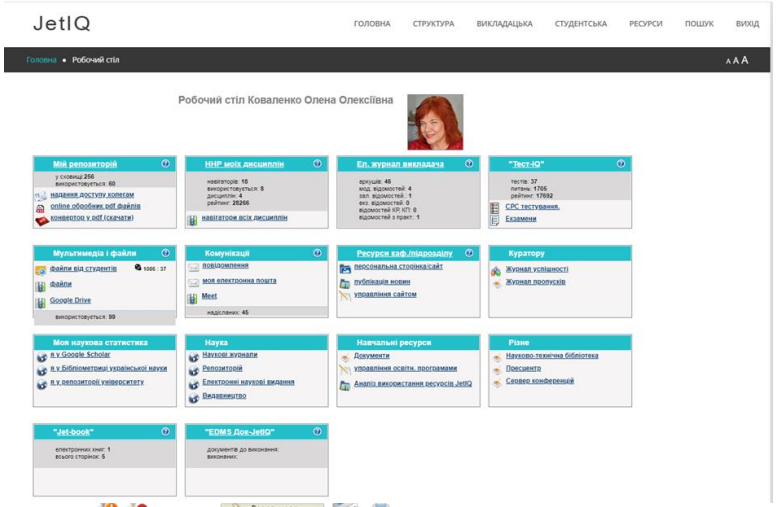


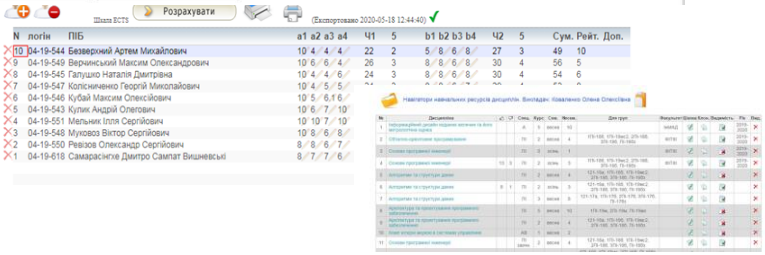
Components of Dean Office workspace.

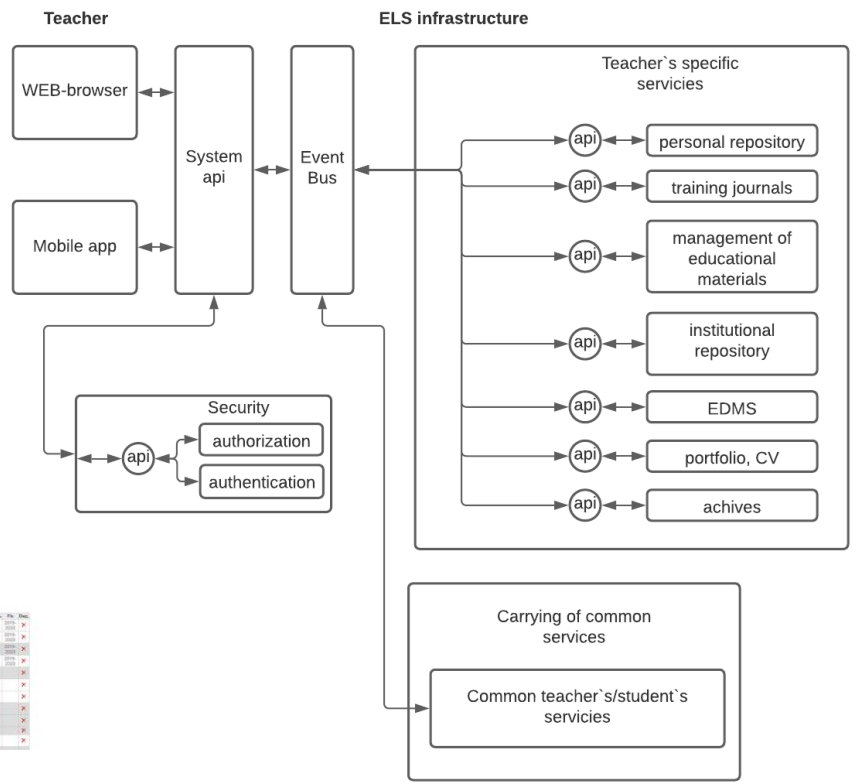




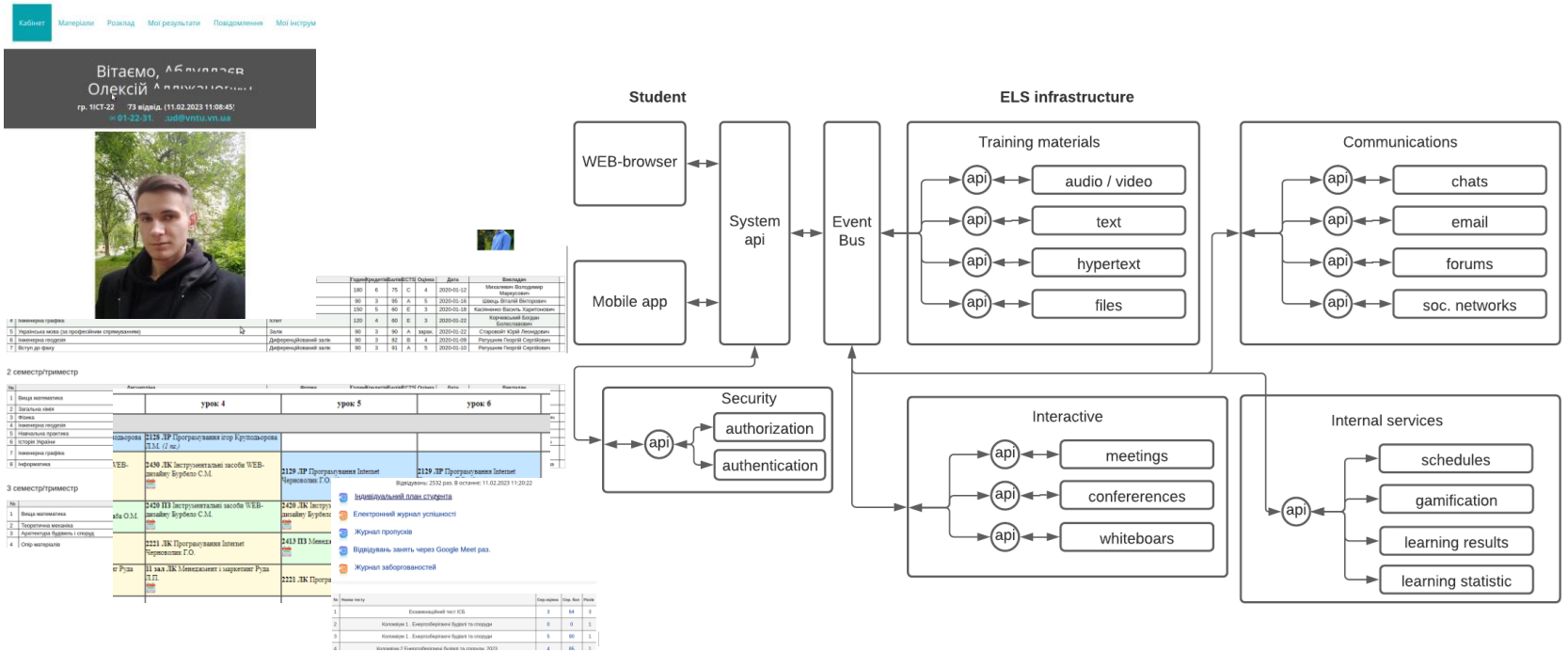
Microservice architecture of teachers workspace.



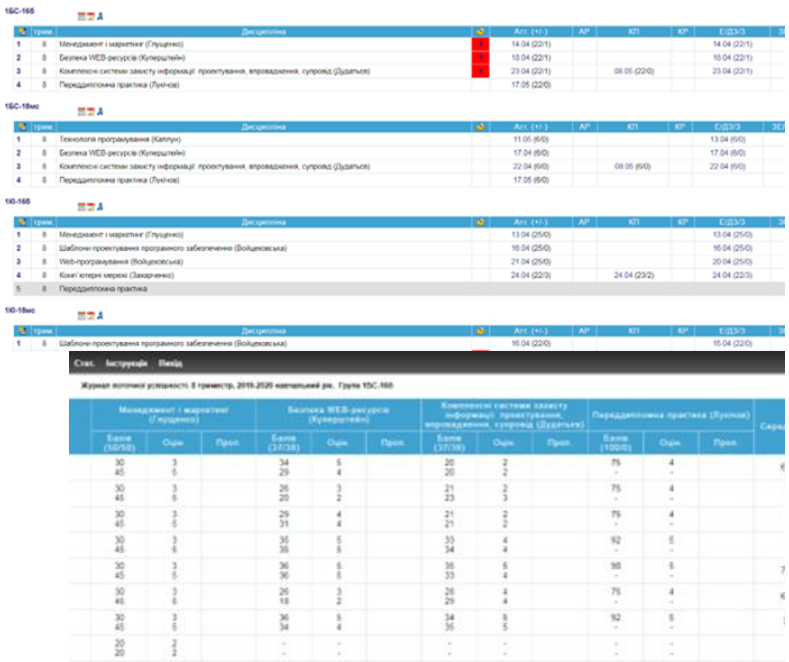


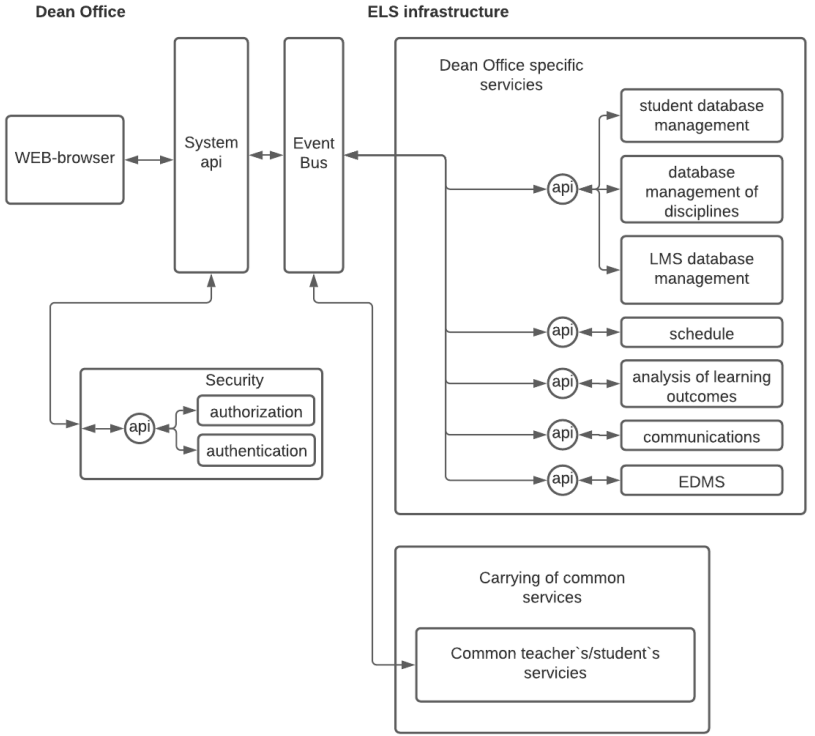


Microservice architecture of student workspace.



Microservice architecture of dean office workspace.





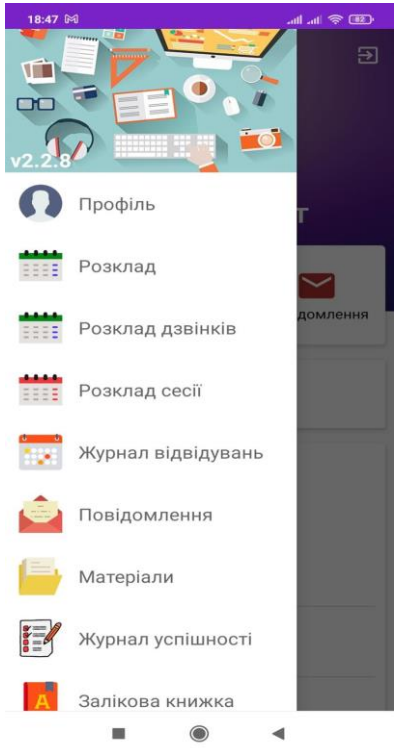
Flexibility, scalability, cloud technologies

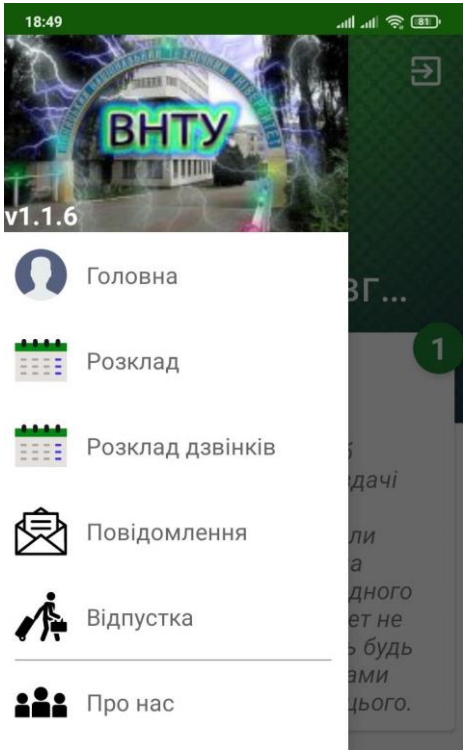
Mobile applications:

- JetIQ Student
- JetIQ Teacher

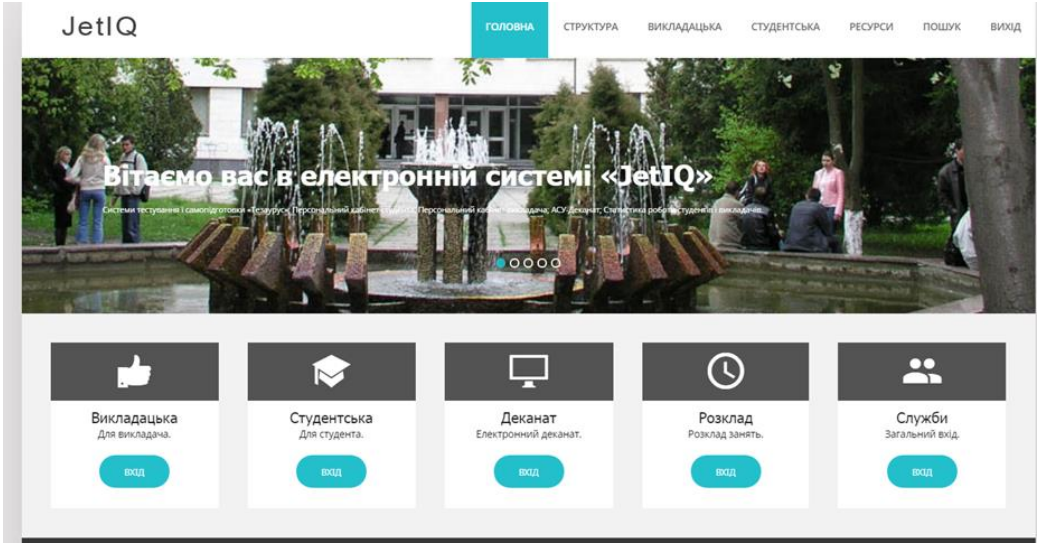
Cloud technologies:

- Google Workspace for Education
- Microsoft 365





Basic statistical data of JetIQ (VNTU, 2026)



Users:
- Students: 5943 [16153]
- Student groups: 543 [2137]
- Teachers/employees: [1804]
- Resources:
- Navigators of educational resources: 5703
- Electronic tests (TestIQ): 5885
- Educational materials: 30691
- Scientific publications: 38342
- Documents: 5240

Dean Office:
- Examination lists: 60730
- Grades: 600838
- Electronic class schedule:
- Lessons: 60494
- Classrooms: 467
- Faculties: 9
- Mobile applications (users):
- JetIQ Student: 6121
- JetIQ Teacher: 210

The model for development an educational electronic information environment for clients has been improved, in contrast to educational spaces in CRM systems. This adaptation of the contour model of training is designed to enhance client loyalty.

The general methodology is applicable to any educational institution and can be further adapted to meet specific needs. Additionally, methods for developing open educational courses are proposed, including microlearning and mobile application development. The methodology facilitates the identification of correspondences among pedagogical theories, methodologies, and technologies to create an educational electronic information environment based on a multi-agent information ecosystem. This approach enables the parallel adaptation of technologies during implementation.

The proposed concepts and models can be utilized to enhance JetIQ, Sokrat, SEL, and other existing platforms for learning and institutional management. Furthermore, they can be applied to the development of educational electronic spaces for educational institutions, corporations, and individual distance learning courses, as well as for training clients, software users, development teams, and other stakeholders.

Addresses and contacts

Vinnytsia National Technical University, Khmelnitsky av., 95, Vinnytsia, 21021, Ukraine.

https://jetiq.vntu.edu.ua

jetiq@vntu.edu.ua