# INNOVATIVE TECHNOLOGIES IN ETHICAL EXPERTISE: ARCHITECTURE AND FUNCTIONAL CAPABILITIES OF THE SYSTEM

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## Purpose/Objective

The article aims to develop an intelligent system for ethical expertise in research, enhancing training quality, automating ethical reviews, and improving evaluation transparency through AI-driven learning and assessments.

## Abstract

This article presents the development of the intelligent system "Ethical Expertise for Researchers", aimed at automating researcher training and ethical review. The system integrates adaptive learning, speech synthesis, avatars, and expert evaluation. Key modules include video lecture generation, testing, a course builder, and content moderation. Built on a microservice architecture, it ensures scalability and personalization. Innovative technologies such as AI-based testing and automatic video creation enhance learning efficiency and transparency. The platform is designed for national and international use, offering a flexible tool for researcher education and certification

## Introduction

The rapid development of artificial intelligence, the swift growth of scientific research volumes, and the globalization of the academic environment are setting new demands for the ethical responsibility of researchers. In the context of digitalization and open access to data, the risk of violating ethical norms is increasing, including issues of confidentiality, participant consent, and integrity in the use of AI. International standards of research ethics are becoming a benchmark for national educational systems as well, which requires clear mechanisms for independent assessment and support of research activities.

In response to these challenges, the concept of the intelligent system "Ethical Expertise for Researchers" was developed, aimed at ensuring high-quality training of researchers and providing a transparent, objective ethical evaluation of their

work. The system is designed to offer convenient access to educational materials, create a transparent expert review process, and improve the objectivity of knowledge assessment. A key feature is the use of automated mechanisms for analysis and evaluation. One of the core aspects is the adaptability of the educational process, allowing it to dynamically adjust to the user's knowledge level and needs.

Ethical expertise of research work requires analyzing texts in terms of compliance with ethical standards. The methods of Bekmanova et al. (2024) for analyzing Kazakh political discourse confirm the importance of developing intelligent systems capable of conducting comprehensive assessments of textual content. The application of such methods can be useful for the automated detection of ethical violations in scientific publications and for assessing the degree of argumentation in research materials.

## Analysis of Existing Platforms

During the system design process, existing educational platforms such as Udemy (2025), Coursera (2025), and Microsoft Learn (2025) were analyzed. The study revealed that effective learning requires flexible tools for course creation, knowledge assessment, and educational content adaptation. However, most platforms lack mechanisms for automatic video lecture generation and expert evaluation, which makes the proposed system unique.

Additionally, existing educational program management systems were examined, and key requirements for the new system were identified.

Modern scientific research in this field was also reviewed, particularly the works of Ukenova et al. (2025). Ukenova et al. (2025), published in *Sensors*, explores the enhancement of learning systems through the use of avatars by transitioning from basic language compatibility to emotion-based interactions. Including these articles in the analysis of existing solutions helps justify the chosen methodology and architectural decisions of our system.

## Application of Digital Technologies in the Educational System

Digital transformation plays a crucial role in modernizing educational processes and implementing innovative solutions. As demonstrated by Bekmanova et al. (2024), the digitalization of education facilitates the shift from traditional learning models to interactive and adaptive formats. This work analyzes key concepts of digital transformation in higher education, including the use of artificial intelligence, digital platforms, and automated learning management systems.

The integration of digital solutions into the "Ethical Review for Researchers" system enhances the efficiency of educational programs through the automated generation of video lectures, personalized learning pathways, and expert evaluation of results. The incorporation of adaptive algorithms and intelligent data analysis ensures flexibility and a personalized approach to researcher training.

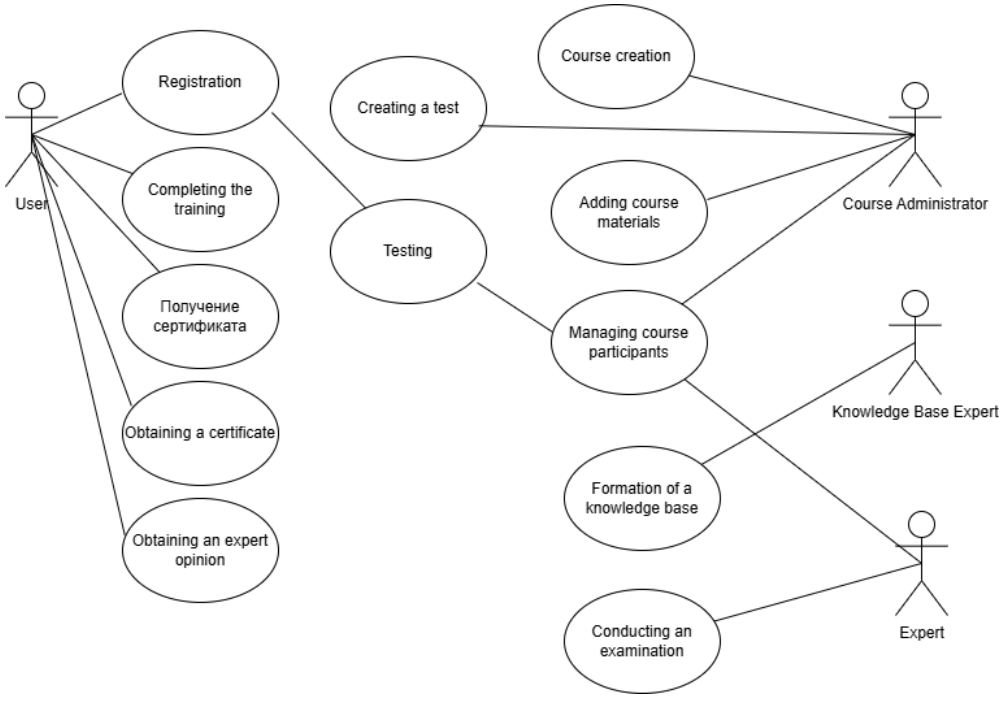
The learning process is structured in a modular format, where each course includes mandatory and optional lectures. To complete a course, the user must pass a test that includes both multiple-choice questions and open-ended assignments assessed by experts.

## System Diagram Development

To describe the structure of the system and the relationships between its components, UML diagrams were developed. Initial meetings with users were held to identify both functional and non-functional requirements. Based on the collected data, a Use Case Diagram was created (see Figure 1), illustrating how actors (users or external systems) interact with the system and what functional capabilities it provides.

**Figure 1**

*Use Case Diagram of the Intelligent System "Ethical Review for Researchers"*

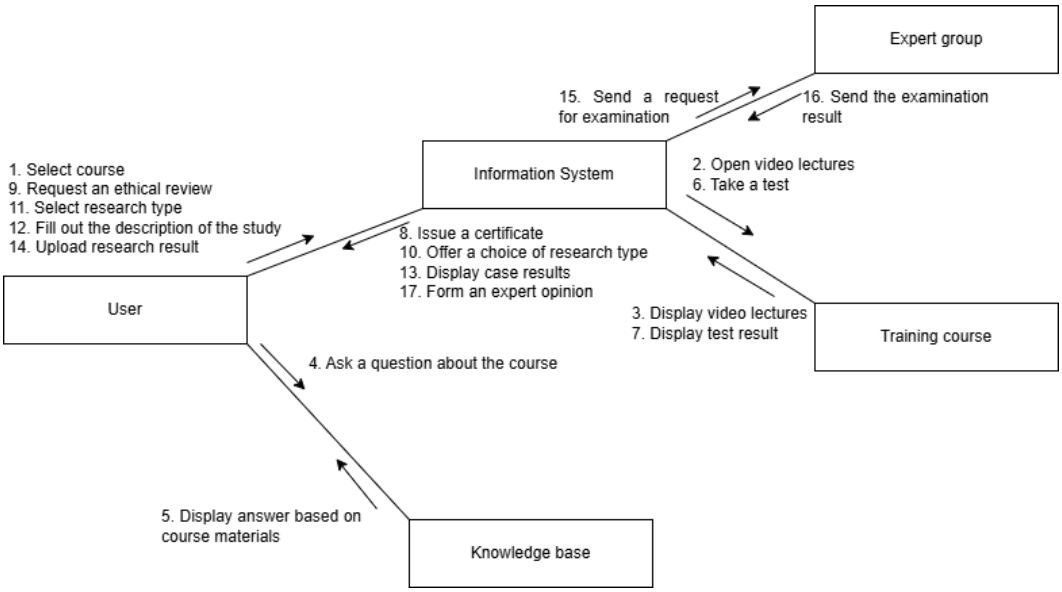



A communication diagram (see Figure 2) was also developed to illustrate the interaction among system components. While similar to a sequence diagram, the

communication diagram emphasizes the logical relationships among events rather than their temporal sequence. Interactions among objects are organized using call numbers, providing a clear representation of how information is processed and data is transferred between the system's modules.

**Figure 2**

*Communication Diagram of the Intelligent System "Ethical Expertise for Researchers"*




## Main Functional Modules of the System

The system includes the following key components:

1. Video Lecture Generation: automatic text processing, speech synthesis, and avatar animation.
2. Flexible Testing System: the ability to personalize tests and assess knowledge.
3. Course Builder: creation of educational programs with various performance evaluation options.
4. Expert Evaluation: the capability to conduct ethical reviews using objective criteria.
5. Content Moderation: quality control of uploaded lectures and user rights management

## Video Lecture Generation Technologies

One of the key components of the system is the automatic generation of video lectures. This process includes:

- Converting textual content into video format.
- Speech synthesis for voice-over of the materials.
- Use of animated avatars that convey facial expressions and gestures.
- The ability to manually edit videos before publication.

Neural network-based speech synthesis and gesture generation based on text analysis are used to create the videos. This enables rapid creation of educational content without the need for complex editing.

## Knowledge Assessment Algorithms

The system includes several methods for evaluating knowledge:

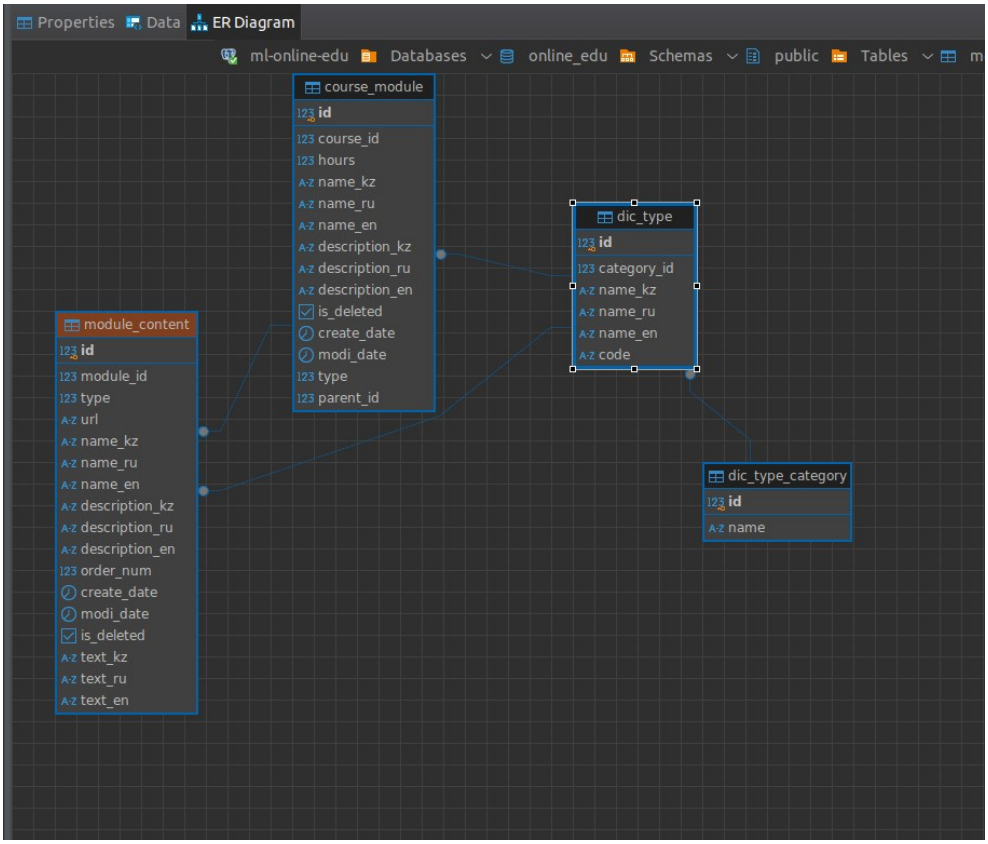
1. Automated Testing: The system randomly generates tests, checking key aspects of the material.
2. Expert Evaluation: Complex tasks with open-ended answers are assessed by experts, who can provide feedback.
3. Hybrid Model: A combination of automated analysis and expert opinion to ensure objectivity.

## System Architecture

The system is built on a microservice architecture using Docker Swarm for container management (see Figure 3). This ensures scalability, fault tolerance, and ease of integrating new services. The database is designed with normalization in mind to ensure high performance. Data is structured to enable fast retrieval of information and efficient storage of metadata related to educational programs. A data caching system is implemented to speed up the operation of the interfaces.

**Figure 3**

*Microservice System Architecture*




## Implementation and Integration

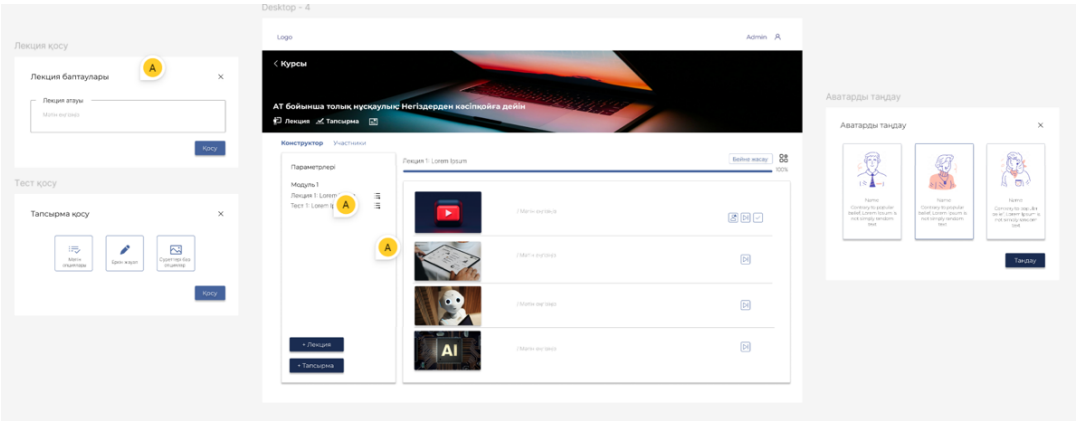
REST APIs were developed for managing courses, lectures, and users. The frontend is implemented using the Vue Composition API and WebStorm. To facilitate working with educational content, technologies like vue3-draggable-resizable are used. Additionally, integration with user management and security systems has been ensured, enabling the configuration of access levels and the personalization of content for different user groups.

## Automatic Generation of Video Lectures

One of the innovative features of the system is the creation of video lectures based on text materials. This is achieved through speech synthesis, animation overlay, and the option for manual video editing. The user can upload materials, choose an avatar, and adjust the animation. The generation occurs automatically, after which an editor is available for making changes (see Figure 4).

**Figure 4**

*Prototype of the Automatic Video Lecture Generation Interface*

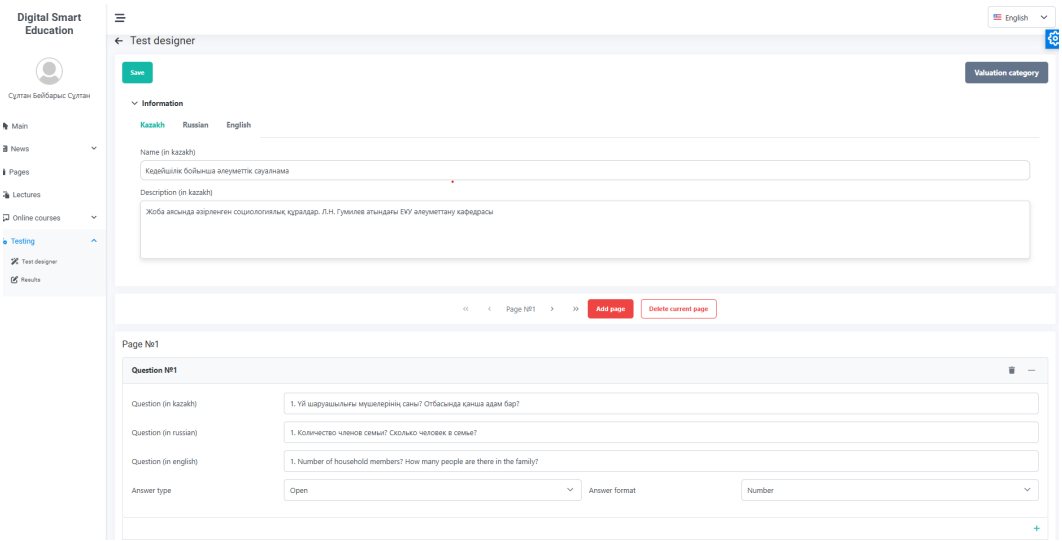



## Assessment of Knowledge and Issuance of Certificates

The system supports two learning formats: completing individual courses and a full educational program with a final exam. Customizable assessment criteria are used to conduct objective expert evaluations (see Figure 5). The final exam is generated dynamically, with randomly selected questions covering all key topics of the program. Upon completion of the program, certificates are issued, confirming successful completion of the course.

**Figure 5**

*Question Editing Interface*



## Conclusion

The developed system represents an innovative tool for automating learning and expert evaluation of research works. The integration of modern data processing technologies, automatic video lecture creation, and microservice architecture enables the creation of a flexible and effective platform. Future work will focus on further adapting the system to meet the needs of researchers and enhancing the level of personalization in the educational process. It is expected that the implementation of this system will significantly simplify the process of ethical review and increase the transparency of research evaluation. In the long term, the system may become a universal platform for training and certifying researchers at an international level. This research is funded by the Committee of Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant №. BR21882302 Kazakhstan's society in the context of digital transformation: prospects and risks).

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