References

1. Zetter, K. (2014). Countdown to Zero Day: Stuxnet and the Launch of the World's First Digital Weapon. Crown Publishing Group.
2. United Nations. (2021). "Report on Developments in the Field of Information and Telecommunications in the Context of International Security."
3. European Union. (2018). General Data Protection Regulation (GDPR).

INTELLIGENT SYSTEM FOR AUTOMATED ASSESSMENT OF TEST TASKS SETS CONFORMITY TO SEMANTIC STRUCTURE OF EDUCATIONAL MATERIALS

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In the field of intelligent information technologies, the development of effective tools for assessing knowledge and skills has become increasingly important. Traditional evaluation methods, such as written exams or oral assessments, often lack sufficient flexibility, involve subjective judgment, and require considerable time [1]. In this regard, web-based platforms for knowledge and skills testing present a modern solution by automating the evaluation process, offering user-friendly interfaces, and ensuring objective assessments [2]. These platforms significantly enhance the processes of learning and professional development while enabling more precise and fair evaluations of professional competencies [3].

Web-based platforms not only streamline the assessment process but also offer opportunities for interactive learning. They allow users to take tests at convenient times, receive immediate feedback, and obtain recommendations for improving their knowledge. Such platforms can be tailored to different levels of complexity and cover various subject areas, making them versatile tools for students, professionals, and anyone aiming to advance their skills [4].

A key advantage of these platforms is their accessibility and inclusivity. They can be accessed from anywhere and at any time, which is especially valuable in the era of global digitalization and distance education. This ensures that individuals worldwide can benefit from high-quality assessments, contributing to the overall enhancement of qualifications within the field of information technologies.

Consequently, the creation and deployment of web platforms for knowledge and skills assessment represent a crucial advancement in vocational education and

professional development. These platforms ensure high-quality training, objective evaluations, and broad accessibility to educational resources for a diverse audience.

The objective of this work is to design an intelligent system for evaluating knowledge levels and analyzing the alignment of test content with educational materials in the form of a web platform. This system aims to provide an effective tool for assessing users' knowledge and skills in the IT domain [5]. Additionally, the platform will serve as a resource for self-assessment and learning, enabling users to evaluate their knowledge, track their progress, and analyze the relevance of tests to educational materials [6].

The aim of work is to develop an intelligent system for testing level of knowledge and analyzing the representativeness of tests in the form of a web platform, which provides the possibility of effective assessment of users' knowledge and skills in the field of information technologies. The platform should become a tool for self-testing and learning, which will allow users to check their knowledge, track progress in learning and analyze the representativeness of tests to educational materials.

An intelligent system designed for the automated assessment of test task conformity to the semantic structure has been developed based on this method. The framework (Figure 1) provides a clearer understanding of the system's operation, presenting optimal steps sequence for effective task execution in structured manner.

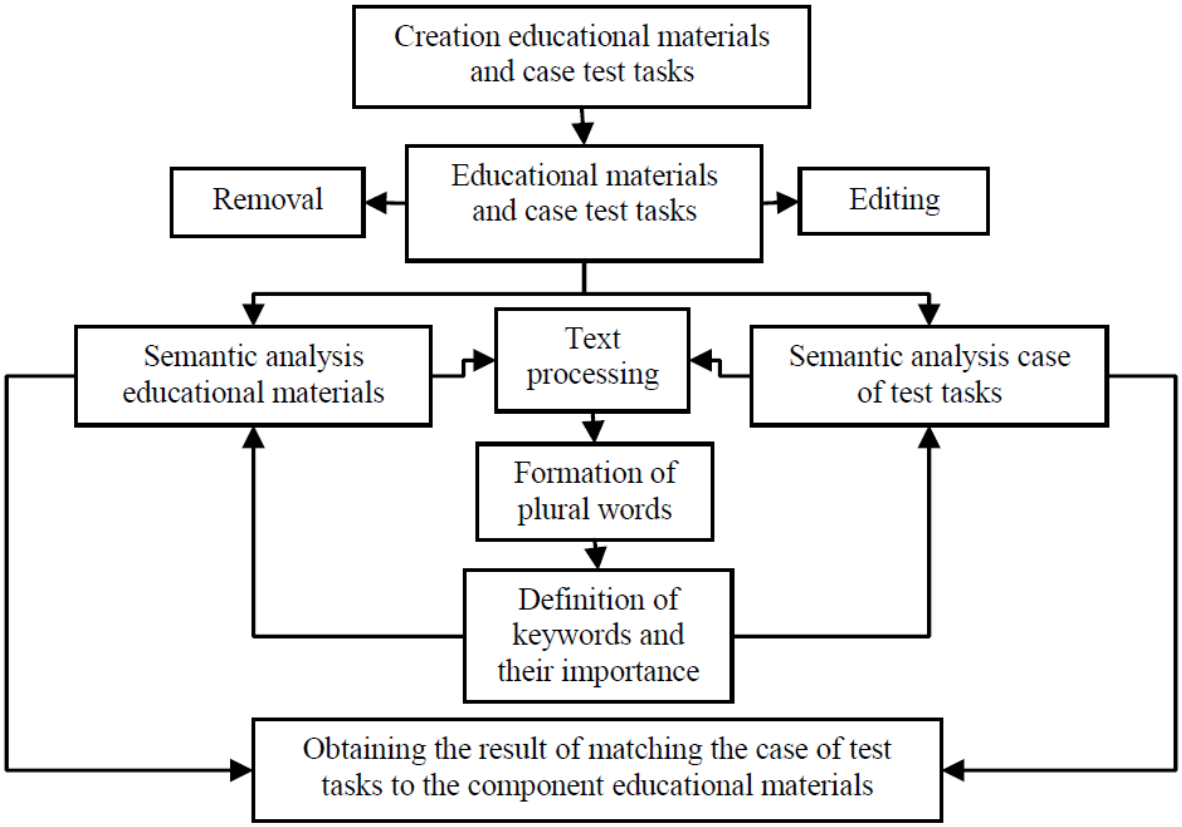

Figure 1. Generalized scheme of functionality of intelligent system for testing the level of knowledge and analyzing the representativeness of tests

The described workflow demonstrates that the initial step in using the application involves inputting data, which includes creating educational materials and

corresponding test tasks. After these elements are generated, users can access functionalities such as editing, deleting, or conducting a semantic analysis. The "semantic analysis" feature involves several stages: text lemmatization (removing punctuation, converting text to lowercase, and eliminating stop words), forming a set of words (segmenting the text into individual words), and identifying key terms along with their significance. Finally, users can obtain results, specifically an evaluation of how well the test tasks correspond to semantic structure of the educational materials.

To visually depict the structure of this software application, a schematic representation of the intelligent system for automated evaluation of test tasks' alignment with the semantic structure of educational materials has been created (Figure 2). The diagram highlights that the user interaction subsystem enables adding, editing, and removing educational materials and related test tasks, with all changes saved in associated files. The data preprocessing subsystem prepares stored data for subsequent semantic analysis [7, 8]. The semantic analysis subsystem then processes this preprocessed data to automatically generate keywords, assess their importance, evaluate the correspondence between test tasks and the semantic content of educational materials, and display the final results.

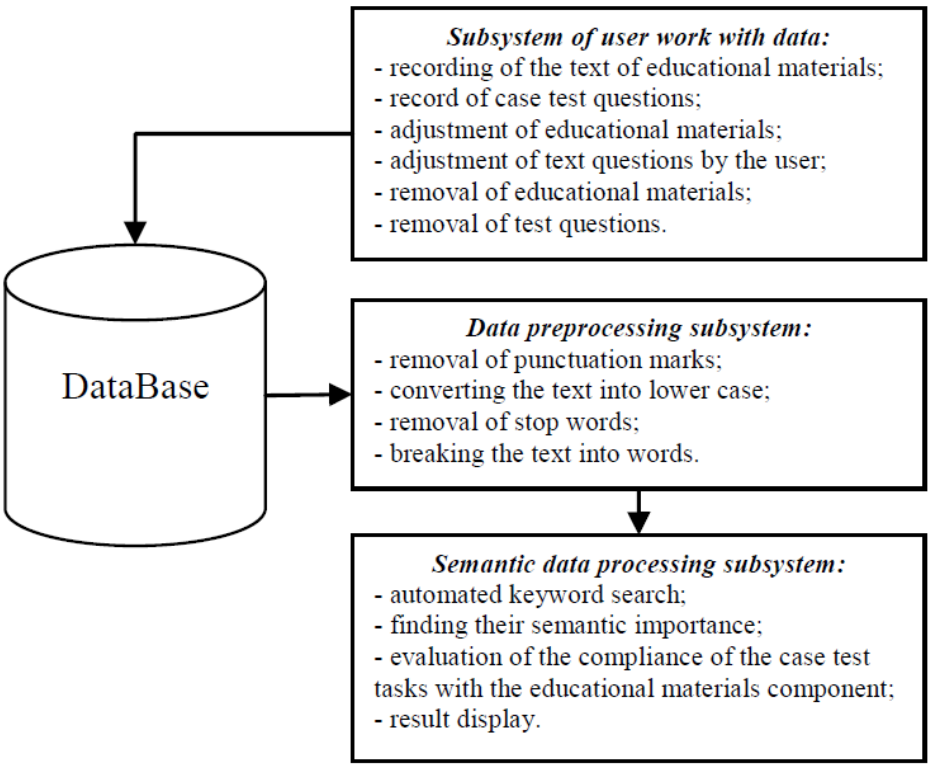

Figure 2. Scheme of intelligent system for testing the level of knowledge and analyzing the representativeness of tests

Figure 3 shows datalogical model of database for testing information technology knowledge and skills, demonstrating the database structure, its tables, and the relationships between them [9, 10]. The database contains the following tables: «users», «type_users», «courses», «testing_in_cours», «results», «passed_tests», «testing», «answers_to_questions», «answer», «type_answer», «question», «question_test».

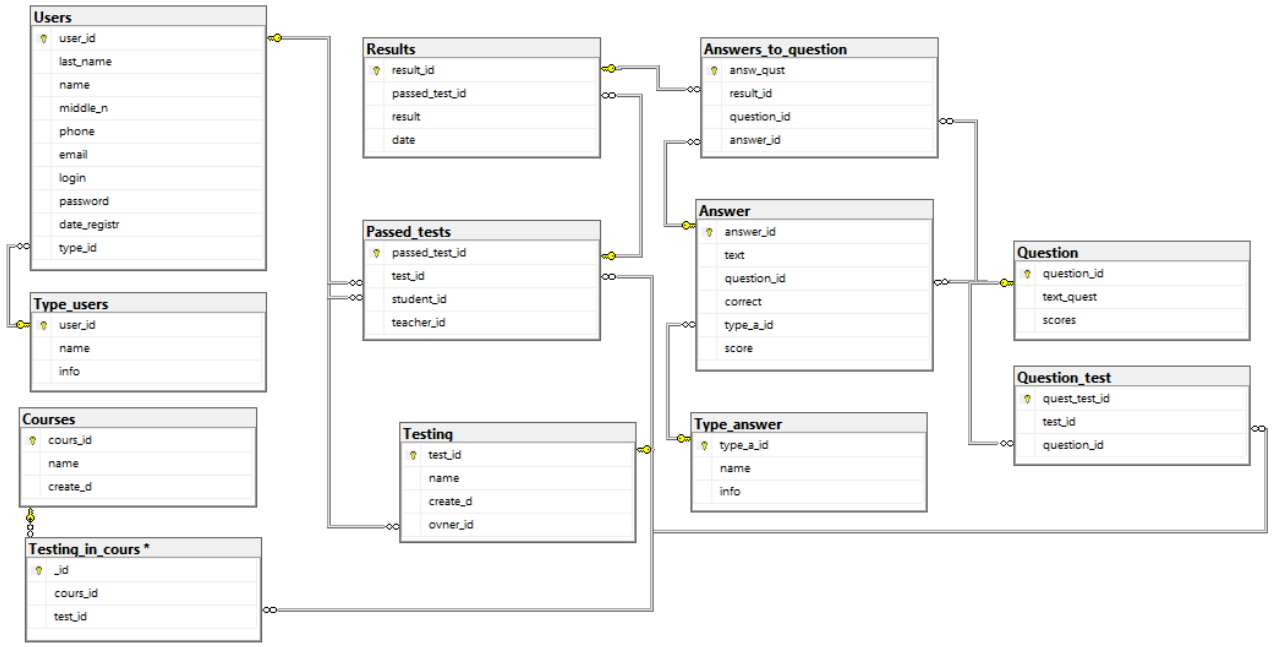

Figure 3. Database datalogic model for intelligent system for testing the level of knowledge and analyzing the representativeness of tests

According to MVC design pattern, the system consists of three interdependent components: models, views, and controllers. Accordingly, in the project of intelligent system for testing the level of knowledge and analyzing the representativeness of tests, corresponding files were created for each of these components [11]. The interaction scheme of these components is shown in Figure 4.

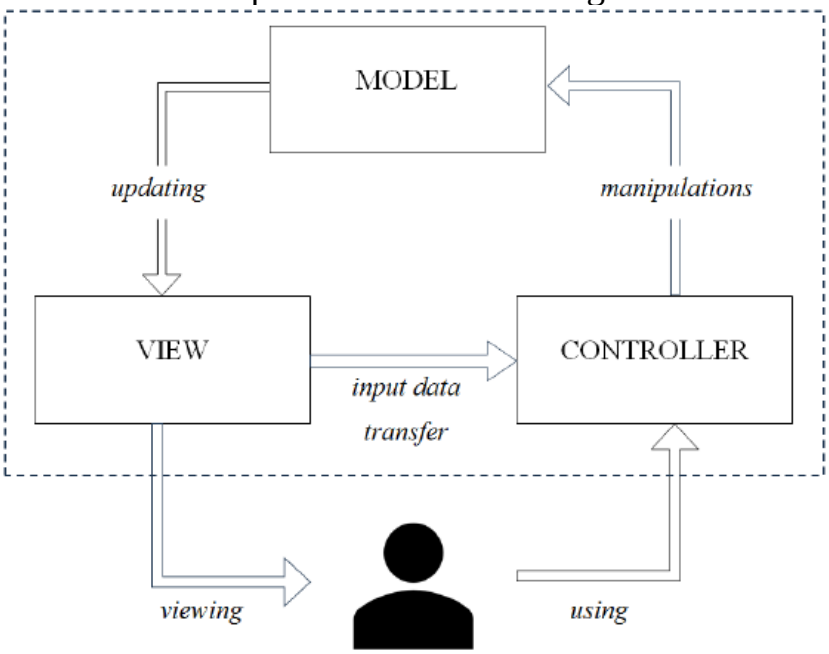

Figure 4. Component interaction diagram of intelligent system for testing the level of knowledge and analyzing the representativeness of tests

The web project structure is built using the MVC architectural pattern and the Laravel framework. Therefore, migrations were used to create the database tables, which are located in the database directory.

The resources directory is used to store project templates and pages. All route definitions for the information system are located in the web.php file in the routes directory, where there are also other files for defining system routes.

The Http directory contains all the logic for processing requests coming to the application, including controllers, mediators, and form requests. In the developed application, the Http/Controllers directory contains the following controllers:

– HomeController: handles general requests related to the platform's main page, including displaying site information and navigation;

– CategoryController: is responsible for managing test categories and their correct display;

– TestController: handles requests related to tests, allows you to display specific tests of a certain category, create new tests, and edit them;

– QuestionController: is responsible for managing test questions, including adding, editing, deleting, and viewing questions;

– ResultController: handles queries related to test results, including viewing user results, saving, and analyzing results.

Also, using Laravel-UI, controllers are connected that provide basic authentication and user management functions, such as login, registration, password reset, and email confirmation.

In Laravel, the main components responsible for interacting with the database and implementing business logic are models. Models represent database tables and provide a convenient way to access data, including creating, reading, updating, and deleting records. Accordingly, 12 models were created, each of which corresponds to one table in the database, and the model attributes correspond to table columns.

So, the intelligent system for testing knowledge level and analyzing test representativeness of tests was designed and practically implemented in the form of a web platform, which provides the possibility of effective assessment of users' knowledge and skills. The generalized scheme, database datalogic model and component interaction diagram of intelligent system for testing the level of knowledge and analyzing the representativeness of tests were designed. Practical use of the developed platform as tool for self-testing and learning is proposed, which will allow users to check their knowledge, track progress in learning and analyze the representativeness of tests to educational materials.

References

1. Mazurets O., Barmak O., Krak I., Molchanova M., Sobko O. Information Technology for Adaptive Semantic Testing of Knowledge Level of Educational Materials. Conference Paper. Proceedings of the 11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications, IDAACS 2021, 2021, vol. 1, pp. 160–165.

2. Wang H., Xu Y., Yang C., Shi C., Li X., Guo N., Liu Z. Knowledge-adaptive contrastive learning for recommendation. Proceedings of the sixteenth ACM international conference on web search and data mining. 2023. pp. 535-543.

3. Barmak O., Krak I., Mazurets O., Pavlov S., Smolarz A., Wojcik W. Research of efficiency of information technology for creation of semantic structure of

educational materials. Advances in Intelligent Systems and Computing, 2020, vol. 1020, pp. 554–569.
4. Barmak O., Mazurets O., Krak I., Kulias A. Method for automated test tasks creation for educational materials. CEUR Workshop Proceedings, 2020, vol. 2711, pp. 309–320.
5. Krak Y., Barmak O., Mazurets O. The practice implementation of the information technology for automated definition of semantic terms sets in the content of educational materials. CEUR Workshop Proceedings, 2018, vol. 2139, pp. 245–254. https://pp.isofts.kiev.ua/index.php/ojs1/article/download/288/282 Q4
6. Mazurets O., Barmak O., Krak I., Manziuk E., Bahrii R. Method for Adaptive Semantic Testing of Educational Materials Level of Knowledge. Book Chapter. Lecture Notes on Data Engineering and Communications Technologies. 2022. Vol. 77. pp. 491–506.
7. Mazurets O., Sobko O., Klimenko V., Kozenko Y. Relation Datalogic Model for Determining the Diagnosis Based on Intellectual NLP-analysis of Symptom Description. Proceedings of XV International Scientific and Practical Conference «Innovative Development: Synthesis of Scientific Approaches in Various Fields of Research». March 20-22, 2024. Tallinn, Estonia. 2024. Pp. 61-66. U
8. Zhuk D., Mazurets O., Sobko O., Klimenko V. Datalogic Model for Determining the Clients Compatibility Based on Questionnaires Data Analysis by Artificial Intelligence Means. Innovative Solutions in Science: Balancing Theory and Practice. Proceedings of the 1st International scientific and practical conference. October 28-30, 2024. San Francisco, USA. 2024. Pp. 80-85.
9. Mazurets O., Molchanova M., Klimenko V., Klopotivskyi D. Datalogic Model for Image Recognition by Convolutional Neural Network Using Cloud Services. Proceedings of XXII International Scientific and Practical Conference «Modern Scientific Research: Theoretical and Practical Aspects». May 8-10, 2024. Oslo, Norway. 2024. Pp. 64-68.
10. Mazurets O.V. Datalogic Projecting for Applied Adaptive Semantic Testing. Heritage of European Science. International collective monograph. Monographic series «European Science». Karlsruhe, Germany. Book 27. Part 3. Chapter 8. 2024. P.147-156.
11. Hardysh D., Klimenko V., Mazurets O. Intelligent System for Automated Assessment of Test Tasks Sets Conformity to Semantic Structure of Educational Materials. Proceedings of the XV International Scientific and Practical Conference. «Distance learning: problems, ways of development and the latest technologies». December 25-27, 2023. Munich, Germany. Pp. 276-282.