

Ministry of Education and Science of Ukraine
Black Sea Universities Network

ODESA NATIONAL UNIVERSITY OF TECHNOLOGY

International Competition of
Student Scientific Works

BLACK SEA SCIENCE 2022 PROCEEDINGS



ODESA, ONUT 2022

Ministry of Education and Science of Ukraine

Black Sea Universities Network

Odesa National University of Technology

International Competition of Student Scientific Works

BLACK SEA SCIENCE 2022

Proceedings

Odesa, ONUT 2022

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INTRODUCTION

International Competition of Student Scientific Works “Black Sea Science” has been held annually since 2018 at the initiative of Odesa National University of Technology (formerly Odesa National Academy of Food Technologies) with the support of the Ministry of Education and Science of Ukraine. It has been supported by Black Sea Universities Network (the Association of 110 higher education institutions from 12 countries of the Black Sea Region) since 2019, and by Iseki-FOOD Association (European Integrating Food Science and Engineering Knowledge into the Food Chain Association) since 2020.

The goal of the competition is to expand international relations and attract students to research activities. It is held in the following fields:

- Food science and technologies
- Economics and administration
- Information technologies, automation and robotics
- Power engineering and energy efficiency
- Ecology and environmental protection

The jury includes both Ukrainian and foreign scientists. In the 4 years that the competition has been held, the jury included scientists from universities of 24 countries: Angola, Azerbaijan, Benin, Bulgaria, China, Czech Republic, France, Georgia, Germany, Greece, Israel, Italy, Kazakhstan, Latvia, Lithuania, Moldova, Pakistan, Poland, Romania, Serbia, Slovakia, Switzerland, Turkey, USA.

At the same time, every year the geography has expanded and the number of foreign jury members has increased: from 46 jury members representing 25 universities from 12 countries in 2018, to 73 jury members of the 46 universities from 19 countries in 2022.

More than a thousand student research papers have been submitted to the competition from both Ukrainian and foreign institutions from 25 countries: China, Poland, Mexico, USA, France, Greece, Germany, Canada, Costa Rica, Brazil, India, Pakistan, Israel, Macedonia, Lithuania, Latvia, Slovakia, Romania, Kyrgyzstan, Kazakhstan, Bulgaria, Moldova, Georgia, Turkey, Serbia.

The interest of foreign students in the competition grew every year. In 2018, the students representing 15 institutions from 7 countries have submitted 33 works. In 2021 the number of submitted works increased to 73, authored by the students of 40 institutions from 18 countries.

The competition is held in two stages. In the first stage, student research papers are reviewed by members of the jury who are experts in the relevant fields. In the second stage of the competition, the winners of the first stage have the opportunity to present their work to a wide audience in person or online.

All participants of the competition and their scientific supervisors are awarded appropriate certificates, and the scientific works of the winners are included in the electronic proceedings of the competition. Every year the competition receives a large number of positive responses from Ukrainian and foreign colleagues with the desire to participate in the coming years.

3. INFORMATION TECHNOLOGIES, AUTOMATION AND ROBOTICS

DEVELOPMENT OF SOFTWARE FOR AUTOMATION OF KNOWLEDGE TESTING

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***Abstract.** Testing is one of the most effective and common ways to control knowledge. The process of taking the test, passing it and counting the results manually is quite time-consuming and monotonous. Modern means of information technology allow you to quickly create a variety of test and thus get rid of these shortcomings. However, despite previous developments in this area, research in this area is relevant. After all, modern technology allows you to perform intelligent analysis of test results, and make passing tests convenient on different devices.*

*The **purpose** of this work is to automate the process of testing knowledge.*

*To achieve this **goal**, the **task** was to create a universal testing system that would provide an environment for both test developers and test takers. Users will be able to create and edit test tasks, take tests on various devices and analyze test results.*

*In the process of creating an automated system for testing knowledge, the following **research** was conducted: analysis of analogous software, study of technical and methodological literature on the subject, work with technical documentation.*

To implement the task, the following technologies were used: Loosely Coupled Monolith; C# programming language; to implement data storage – SQL database.

The work consists of four chapter, conclusions, list of references. The total volume of the work is twelve pages. The work contains 13 drawings, 7 used scientific sources.

***Keywords:** intelligent analysis of results, automated system, Loosely Coupled Monolith.*

I. INTRODUCTION

Today information technology has become an important part of human society. The development of the information society requires the existence of a modern education system.

The field of education, like any other, is constantly evolving. With it come new forms of learning and technology. One of the main areas of learning improvement is the development of an automated knowledge control system that allows you to effectively and quickly assess knowledge. Computer-based testing is a modern adaptive tool for testing student achievement. The development of information technology has allowed the introduction of modern computer technology in the process of monitoring and evaluating skills. Therefore, the main task is to study the process of testing knowledge and creating a modern program to automate this process.

The testing system should make it easy to create and edit the test. Based on the analysis of test results, the test creator is given the opportunity to improve the content of the test. Passing the test should be user-friendly, multi-platform and intuitive.

The C# programming language and Visual Studio 2022 development environment were chosen to implement the task. The Loosely Coupled Monolith

pattern was chosen to implement the system. The user has the opportunity to take the test both on the site and through a bot on social networking platforms such as Telegram.

II. LITERATURE ANALYSIS

Control of knowledge through testing is a topical issue today. Accordingly, there is a demand for the development of software to automate the testing process. During the development of technology in the field of software development, many products have emerged to automate the testing process.

Most software products may have similar basic functions. The systems have the functionality to create a test, as well as edit and analyze test results. Some services have authentication and storage of test results.

One of the most common services is Classroom [1]. In the service, you can leave comments on the work of schoolchildren and give grades, publish announcements, archive courses, share files from other applications, and have access to materials without an Internet connection. The teacher can monitor the process of completing assignments in real time [2].

Another popular service is Quizizz, a world-famous service that provides distance learning through the creation of tests, control and homework assignments in the format of quizzes and tests, and the organization of competitions. It has millions of users in more than 100 countries around the world. The site contains a huge number of ready-made tasks in a variety of disciplines and industries, but the teacher can create new original quizzes and publish them in their profile. It shows the completion of tasks by the class in real time and the ability of the teacher to track the results of each student, to generate a report [3].

The systems listed above provide powerful functionality to meet the needs of the testing process. But this subject area is relevant, more and more people are working online, studying online, discussing work issues. Accordingly, this subject area is competitive in the market, and consumers are ready for new ideas and functions in the field of test automation.

After analyzing the functionality of the best products on the market, a plan was developed to create your own software product that will be competitive in the market, easy and convenient to use.

Firstly, the analysis of test results allows the test owner to control the knowledge better. For example, if there are questions in the test that most people answer incorrectly, it may be a problem of objective assessment of knowledge. Therefore, it was decided to add a statistics page to the software product, which will inform the test owner about potentially incorrect questions in the test.

Another need for a large number of users is the customization of content. Therefore, the software product has an API implemented so that developers can obtain data and customize it to their liking. An API is a system that enables data transmission between one software product and another [4]. It also contains the terms of this data exchange. Therefore, users with API skills have the ability to obtain test data, test results, export them to third-party analysis services, customize test results and the test itself for themselves and their audience.

It is very important that the software product is developed in sync with current user requests, taking into account their tastes. Today, messengers are the most common

way of communicating between people. So, we can conclude that almost everyone has a messenger installed on their phone, laptop and so on.

According to the AIN.UA poll, the most popular messenger in Ukraine is Telegram. It is chosen by 50.6% of respondents for communication [5]. Telegram provides an API for creating chatbots, which are predicted to have a great future in marketing and communications. This is a specialized application that is based on the messaging platform, allowing users to interact with third-party services through a familiar chat interface. Bots are third-party applications that run inside Telegram. Users can interact with bots by sending them messages, commands and inline requests. That is, in order to receive certain information, a person does not need to leave the messenger, it is enough to send a special command, which is interpreted accordingly by the bot [6].

At the moment, Telegram has a lot of bots that provide functionality for downloading music, searching for videos, viewing weather forecasts, etc. In this regard, one of the functions of the test automation system is to manage the functionality directly from within Telegram with the help of the chatbot. Thus, the user works with a familiar interface without wasting time getting to know the site interface [7].

As a result, after analyzing the most popular analogs of the test automation system, it was concluded that the products that are intuitive for the user, easy to use and have flexible functionality have gained the greatest success.

And, accordingly, to create a competitive software product, it is necessary to provide the user with functionality that will not be inferior to successful products in this area. A nice bonus that can attract users is a chatbot that will make life easier for users who do not like to get to know a new interface.

All this functionality is aimed at improving the quality of knowledge control.

III. OBJECT, SUBJECT, AND METHODS OF RESEARCH

The subject area of this work is test automation. Today there are several traditional methods of knowledge control:

- Oral examination - checks the quality of student training, consists of questions from the teacher. The quality of testing depends on the correctness and number of questions.
- Tests - allow you to test the possibility of applying theoretical knowledge in practice. It is more accurate than an oral examination, but requires more time to prepare and conduct.
- Practical and laboratory work - tests the ability to apply knowledge to solve practical problems.

All the above methods are created and carried out exclusively in manual mode, which is not effective. Routine operations for the preparation, printing, verification of tests and the formation of the assessment take a lot of time and, in addition, there are complications for the following reasons: the number and complexity of questions, the number of tests.

Tests are prepared by teachers to control knowledge of discipline modules, for session control or for state exams. Tests are provided to students in paper format. Students receive information on the rules of the tests. Test results are evaluated by processing answers using templates, comparing answers with correct answers. Such a system does not guarantee the quality and reliability of test checking. Based on the

results of testing, protocols are formed, which are the basis for assessment of knowledge in the discipline. The student does not always have the opportunity to adjust the answer when performing tests. As a result of the analysis of existing testing processes, a decision was made to automate these processes.

The development of scientific and technological progress has made it possible to create a new, better and less time-consuming way to control knowledge - machine testing. The use of computers during testing makes it possible to improve the quality of control, reduce complexity and cost. In addition, the human factor, which can negatively affect the quality of evaluation of results, is limited as much as possible. In general, the method of testing can quickly and effectively control the knowledge of a significant number of people in a short period.

The software product involves the design of tests by the user. The system should ensure convenient creation and storage of the tests. After testing, the results should be displayed on the screen. There is also a security system that will not allow users to view and edit tests without access rights.

The target users of the software product are students and teachers. The system also provides an opportunity for users who want to test their knowledge, take tests that are in common access, see their position in the rankings.

The main modes of the program are test taking and test design.

Software features in the test taking section:

1. Registration of the user who passes the test. This is necessary in order to save the tests created by the user and store the results of the tests they have taken.
2. Navigation between test questions. Transitions between questions make taking the test more convenient. The user has the opportunity to leave a question to which they do not know the answer, and return to it later.
3. Forming the answer to the question. Choosing the answer that the user thinks is correct. The user has the opportunity to change the answer.
4. Generating test results. After passing the test, the user sees the page with the test results. The results are saved, and the registered user after login sees the history of the tests, their results and their place in the ranking.

Software functions in the test design section:

1. Creating and editing a test. In their account, the user can create a test. The created test can be edited or deleted.
2. Test planning. Assigning test status. Each test has a private or public status. A public is visible to all users of the system. Users who have been granted access by the test owner can take a private test. You can set a time frame for the private test for when it is available for passing.
3. Preliminary testing. The owner of the test can take the test to check its operability: how clear the questions are, the answers, whether they are displayed correctly, whether the user will have enough time to pass all the test questions.
4. Report. The user can see the statistics of the tests created by them. How many people passed the test, how successful the test results are.

Based on the requirements of modern users, the following functionality was created:

1. API for developers. The user can use it to configure tests or use test data in

their system.

2. Telegram chat bot. Ability to view a list of your tests, results, without leaving Telegram.

All the described functionality is aimed at meeting the needs of the user in the field of test automation.

Most other software products in this area work in such a way that the user has to register as a teacher or student. Accordingly, the teacher cannot take the test, and the student has no right to create the test.

However, our software product is aimed at synthesizing user rights. There is no role assigned to the user. Each user has the opportunity to both create tests and pass them. For example, a teacher creates a private test for students. In addition, the same user has the opportunity to take a public test, which they find interesting.

Thus, the system provides a wide range of functions to meet user requirements and lead to their satisfaction with the product.

IV. RESULTS

4.1. Overview

After analyzing the literature, defining the object, subject and methods of work, a software product with the functionality described above was developed. The system is called “Test Your Brain”.

4.2. Authorization

To control the full functionality of the system, you must log in (Fig. 1.a.). Users who do not have an account yet have the opportunity to register in the system (Fig. 1.b.).

The figure displays two side-by-side screenshots of the 'Test Your Brain' application's authorization interface. Both screens feature a dark background with white text and blue buttons. The top of each screen shows the application logo and name, 'Test Your Brain'.
 Screenshot (a) is the login form. It includes an 'Email address' input field, a 'Password' input field, a 'Forgot your password?' link, a checked 'Remember me' checkbox, and a blue 'Login' button. At the bottom, there is a link 'Don't have an account?' and a blue 'Sign up' button.
 Screenshot (b) is the sign-up form. It includes an 'Email address' input field, a 'Password' input field, an 'Enter password again' input field, and a 'Your nickname' input field. At the bottom, there is a blue 'Sign up' button.

Fig. 1. Authorization:

a – login form, b – sign up form

After registration, the system user has the opportunity to specify additional information on the account page - name, surname, country. It is also possible to add an avatar, change the nickname and password (Fig. 2.).

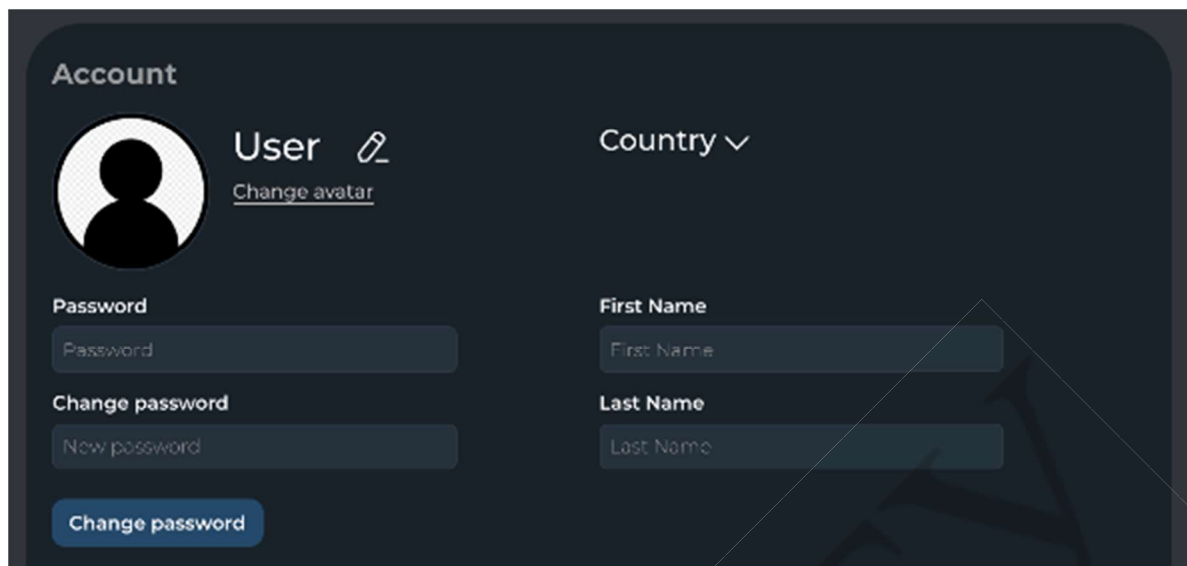


Fig. 2. Account page

This data will be useful for users for whom it is important to see information about those taking the test.

4.3. Navigation bar

After logging into the system, the user has the opportunity to use the full features of the system through the navigation bar (Fig. 3.).

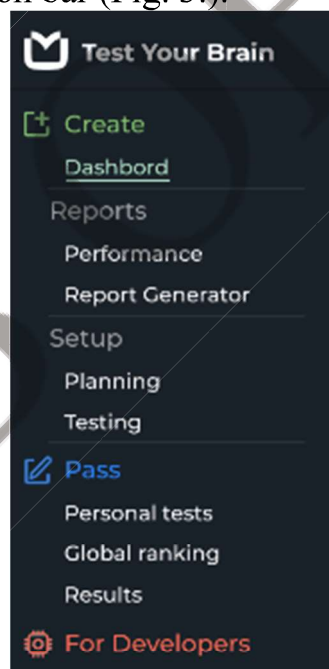


Fig. 3. Navigation bar

The panel is divided into three sections.

1. Test creation section. Through this dashboard tab you can create a test, edit and delete the test, see a list of created tests. The reports unit provides data on the results of users who have passed the test. The setup unit manages the status of the test, plans the time of the test, previews the test to test the convenience of passing.

2. Test taking section. The personal tests tab shows information about the tests the user was given access to. The results tab contains information about the results of the passed tests, and the global ranking tab shows information about the most accomplished users by the number and quality of tests passed.

3. Section for developers contains API for developers to customize tests.

4.4. Dashboard tab

The tab is used to view and manage the data of the created tests (Fig. 4.).

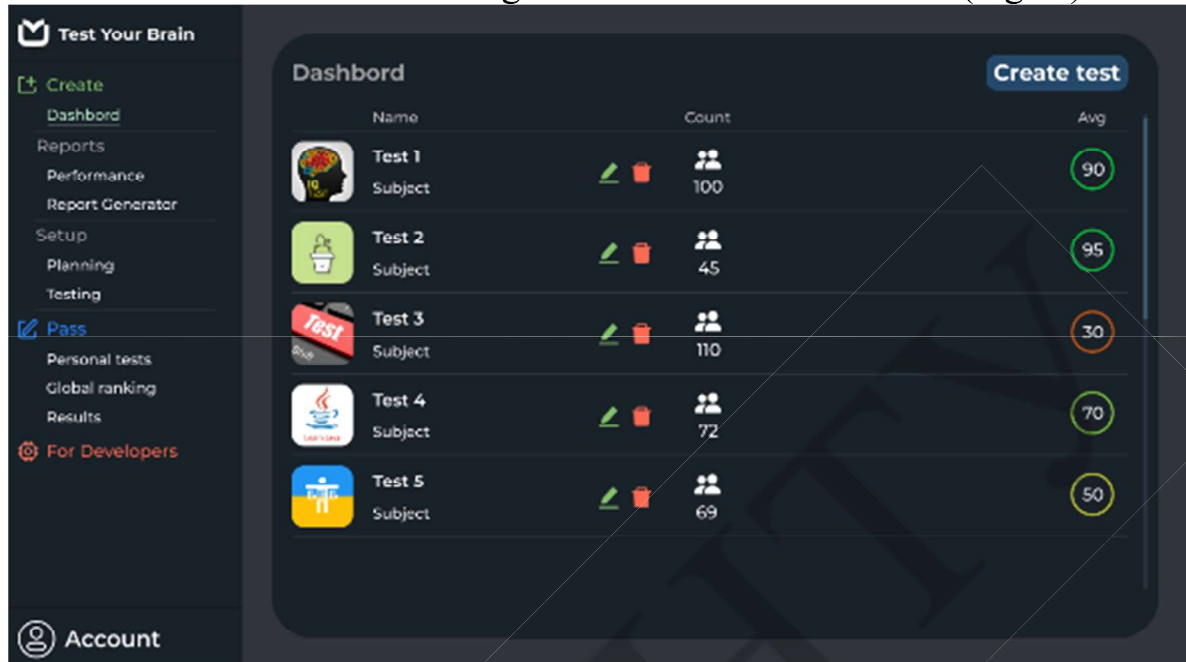


Fig. 4. Dashboard

Through the dashboard the tests are managed: the tests can be created edited or deleted. This page provides tabular information on the number of people who took the test and the average score of those who took the test.

4.5. Create test page

Creating and editing the test is performed through the following page (Fig. 5.).

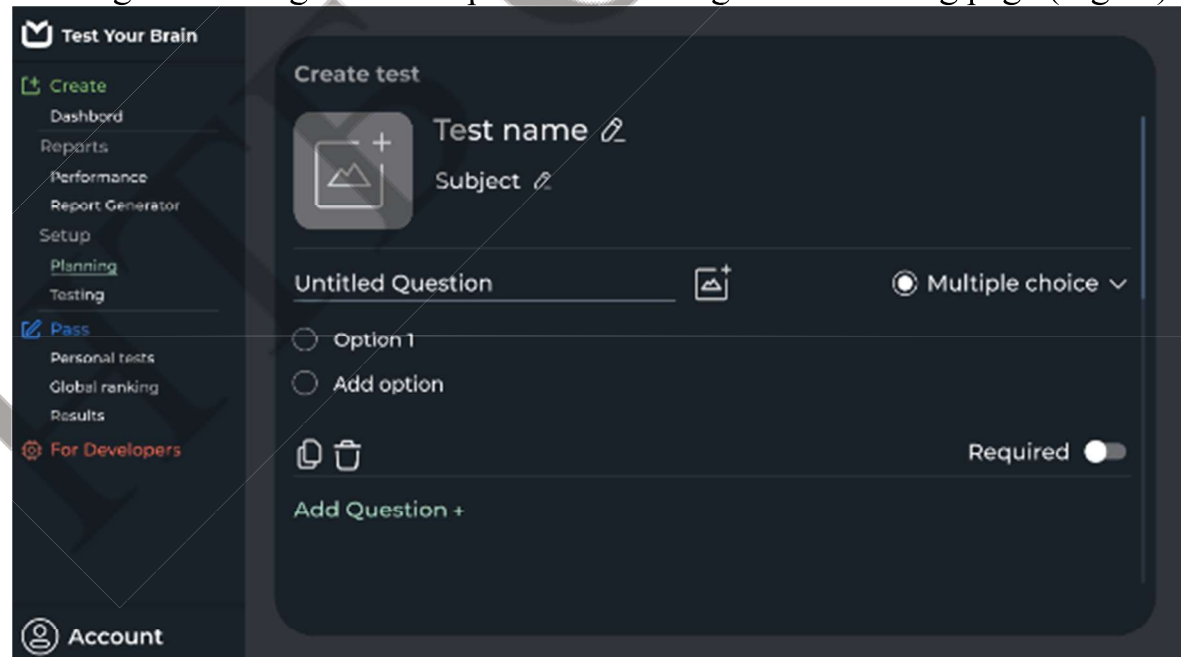


Fig. 5. Create test page

The test has the following properties: title, subject, icon, and list of questions. Each question has its own properties. It can be mandatory or not, have one or more correct answers. This page provides functionality for creating and editing test questions and information.

4.6. Reports section

This tab allows you to view the statistics of the results of those who passed the test graphically (Fig. 6.).



Fig. 6. Performance

An analysis of the effectiveness of the created tests is conducted through the reports section. It is possible to filter by time, view information on a specific test, and the tests overall, view the number of users who passed the test broken down by day, see the average score for the tests and compare them with each other.

4.7. Setup section

This section provides functionality for editing the test status and preview of the test.

The planning tab looks as follows (Fig. 7.).

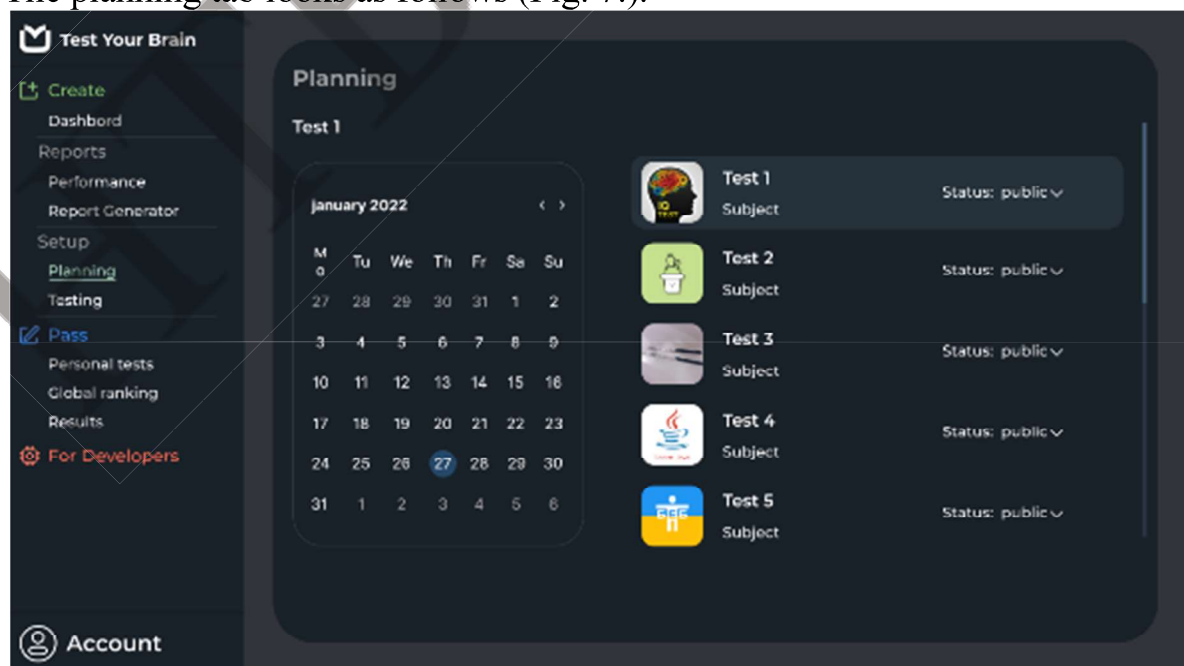


Fig. 7. Planning page

This tab presents a list of tests with their status: public or private. A public test

is visible to all users, a private one - only to those who have been granted access. Each test is assigned a time frame for when the test is available.

The test tab is designed to check the quality of the test by passing it (Fig. 8.).

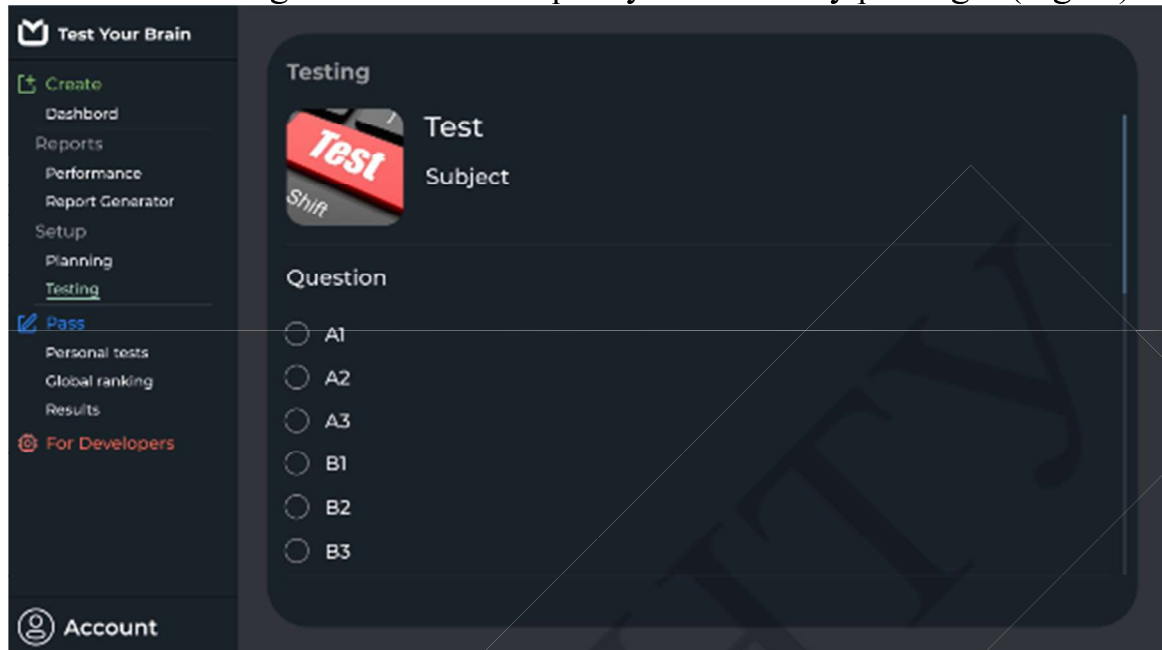


Fig. 8. Testing page

A test page is identical to the passing page, but without saving the test results. The user answers the questions, choosing the options that they consider correct, after confirming the answers, the test result is formed.

4.8. Personal tests page

This page shows a list of tests that are available for the user to pass (Fig. 9.).

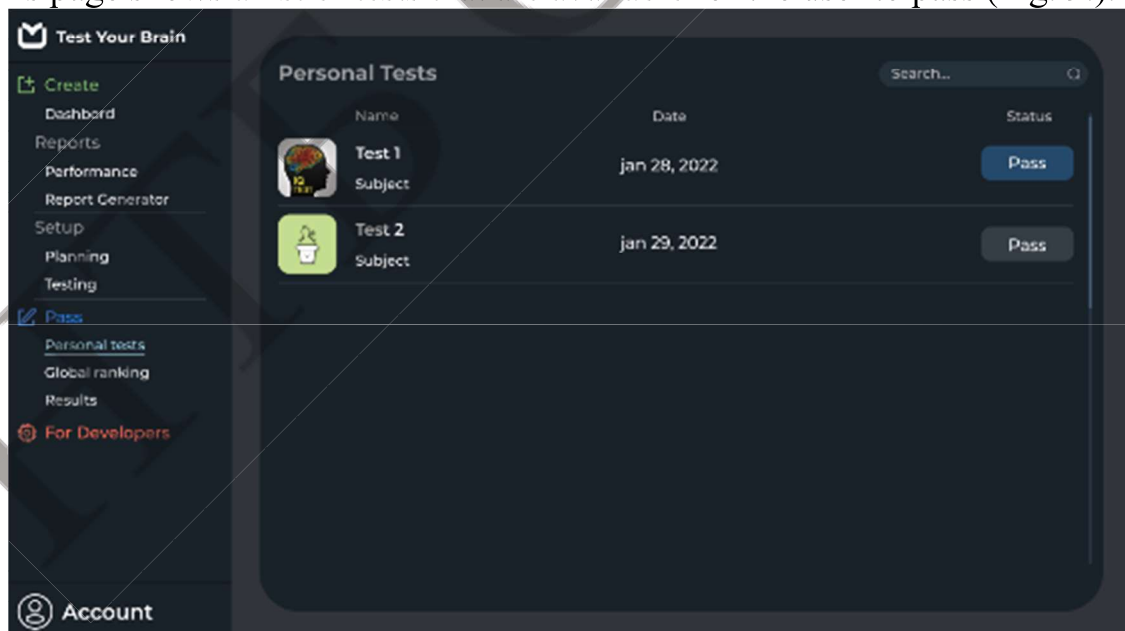


Fig. 9. Personal tests page

The user sees a list of tests that they will be able to pass later, and tests that are already available for passing.

4.9. Results page

The results page provides the user with information about the tests they have passed (Fig. 10.).

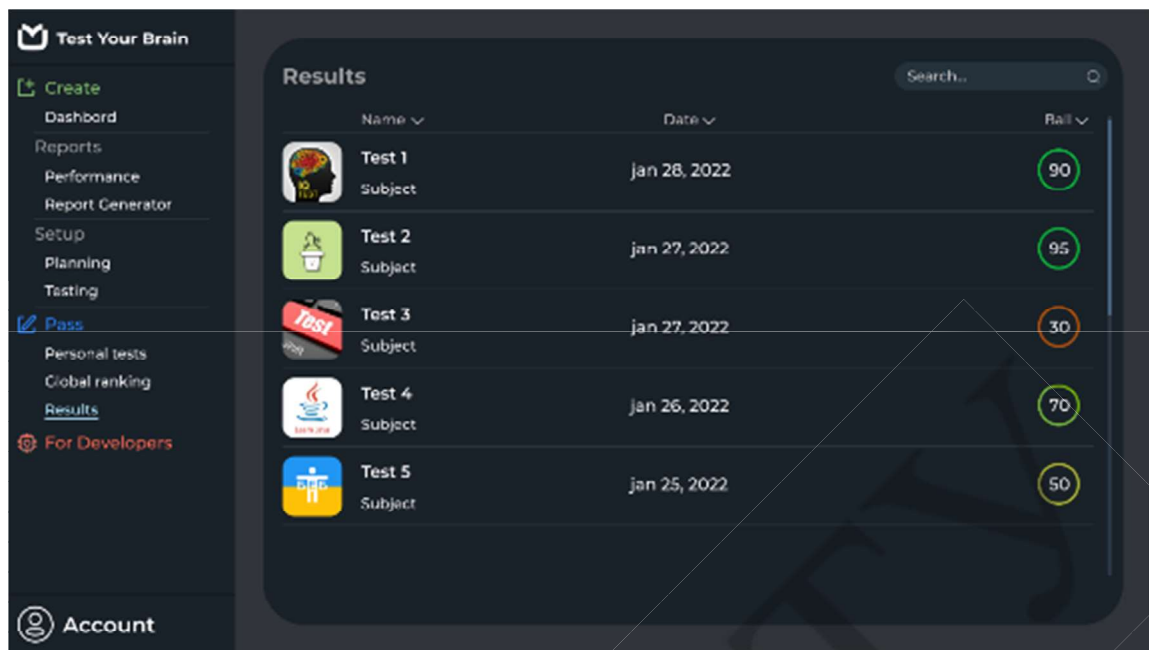


Fig. 10. Results page

This page contains information about the passing date and the percentage of correct answers to each test. It is possible to sort data by name, date, and score.

4.10. Global ranking page

This page shows information about the most successful users of the system, and shows a list of the most popular tests.

The Top Tests panel shows information about the tests that have been taken the most times and the average percentage of correct answers from users who have taken the test (Fig. 11.).

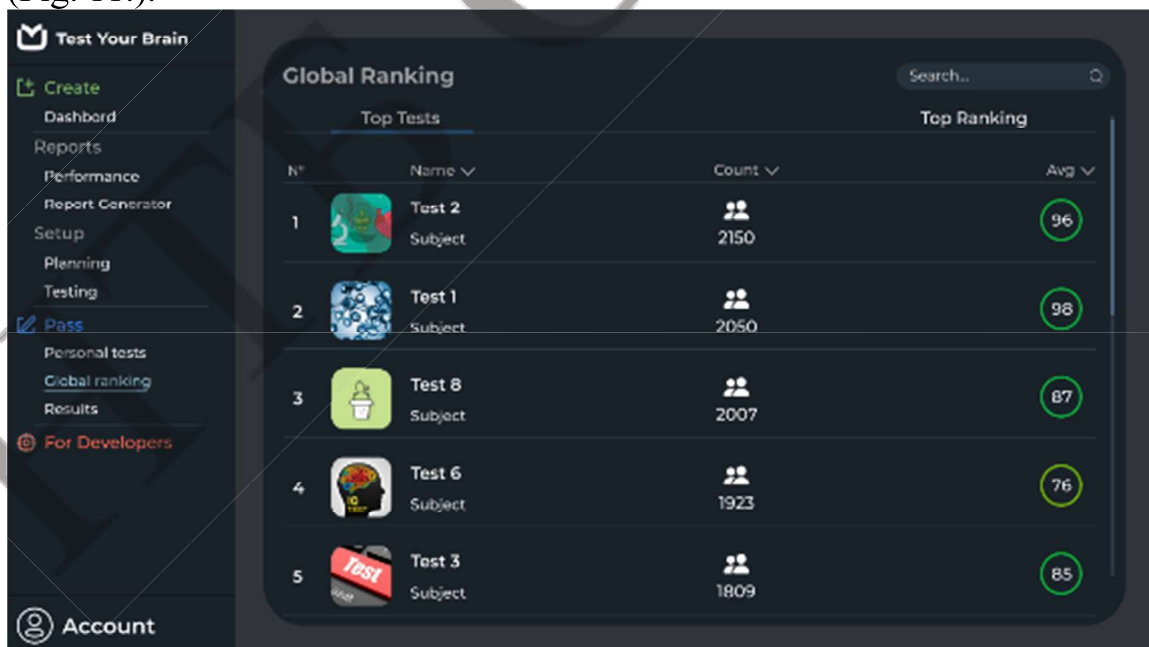


Fig. 11. Top tests panel

The Top Ranking panel shows information about the users who passed the most tests and who passed the tests with the maximum percentage of correct answers (Fig. 12.).

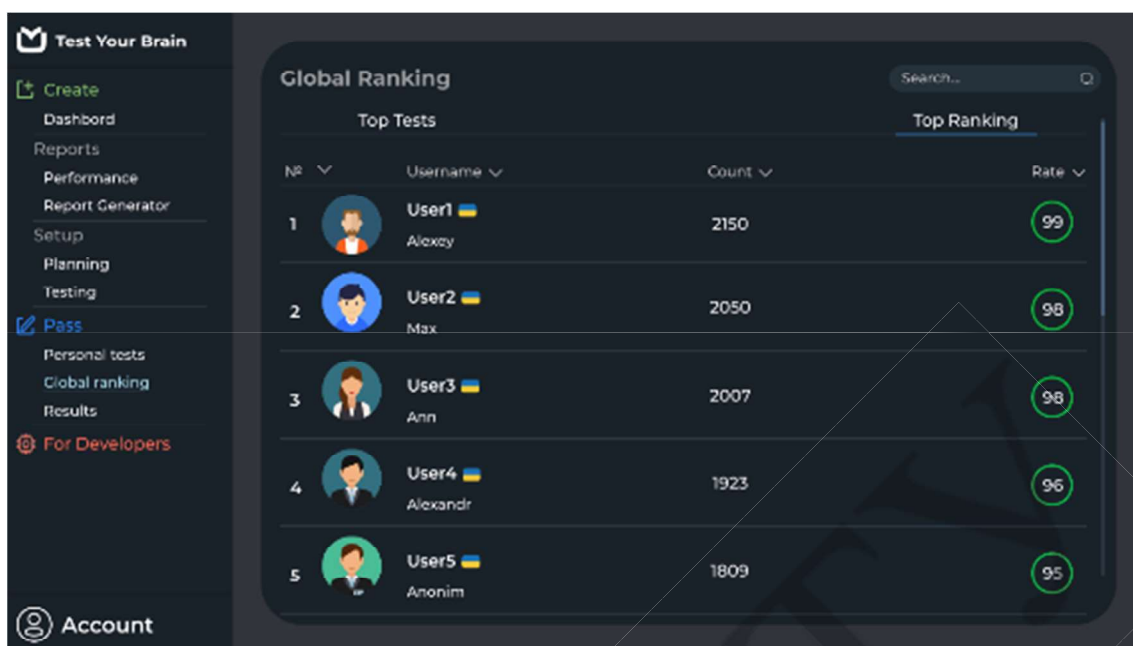


Fig. 12. Top ranking panel

Data can be sorted by number of tests, or by average score. Thus, it is possible to view your place in the global ranking of users, and to see how popular the tests created by a user are among others.

4.11. Telegram bot

The telegram bot looks as follows (Fig. 13.).

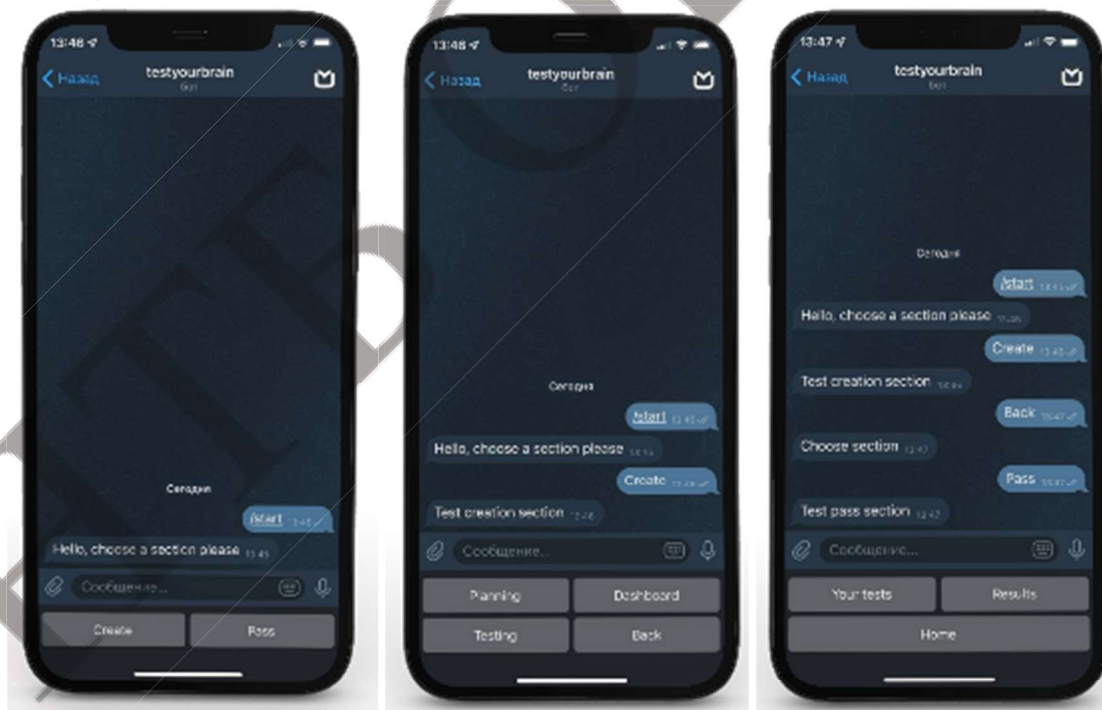


Fig. 13. The telegram bot:

a – start bot, b – test creation section, c – test pass section

The interface of the bot is intuitive and repeats the functionality of the site.

V. CONCLUSIONS

The field of education, like any other, is constantly evolving. An automated knowledge control system has been developed that allows for efficient and fast assessment of knowledge.

Computer testing has the following capabilities:

- creating a test with questions;
- editing the test;
- saving the test;
- viewing statistics of created tests;
- passing the test;
- viewing the results;
- viewing the leaderboard.

The software product provides greater accuracy and speed in the process of conducting and designing tests than in manual testing. The test design process is universal and the user can compose individual questions in tests, quickly edit test questions, view the list of leaders, take public tests that they like or private tests that are made available to them.

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