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ІНТЕРАКТИВНА НАВЧАЛЬНА ПЛАТФОРМА З ЕЛЕМЕНТАМИ ГЕЙМІФІКАЦІЇ
INTERACTIVE LEARNING PLATFORM WITH GAMIFICATION ELEMENTS

Author: [1]Danylo Orlovskyi
Advisor: [2]Valentyna Yuskovych-Zhukovska
Приватний вищий навчальний заклад "Міжнародний економіко-гуманітарний університет імені академіка Степана Дем'янчука", м.Рівне, Україна
Private Higher Education Establishment "Academician Stepan Demianchuk International University of Economics and Humanities" Rivne, Ukraine
ORCID:[1] https://orcid.org/0009-0008-8432-899X, [2] https://orcid.org/ 0000-0002-4236-1467
E-mail: [1]libarimik@gmail.com, [2]valivanivna@i.ua

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Анотація. *В сучасному світі основним засобом розповсюдження освітньої та іншої інформації являється Інтернет, в результаті цього у цифровому просторі невпинно зростає попит на онлайн-навчання. Розвиток сучасних інформаційних технологій в Україні створює умови для розробки новітніх онлайн-курсів та потужних освітніх платформ. Головним елементом для онлайн-навчання є якісна та ефективна навчальна платформа. Перенесення навчальних курсів з реального світу у віртуальний потребує спеціалізованих платформ та сервісів, які дозволяють структурувати навчальний контент та змінюють формат подачі навчального матеріалу. На основі аналізу існуючих освітніх платформ було виявлено, що серед учнів є попит на використання ігрових технологій під час занять, які за результатами наукових досліджень збагачують освітній процес. Тому розробка навчальної платформи з елементами гейміфікації є актуальною. Продемонстровано інтерактивну навчальну платформу з елементами гейміфікації та штучного інтелекту. Ця платформа сприятиме розвитку електронного навчання, проведенню онлайн-занять викладачами для учнів на новому рівні.*

Abstract. *In the modern world, the main source of learning and other information is the Internet, as a result of which the demand for online education is constantly growing in the digital space. The development of modern information technologies in Ukraine creates conditions for the development of online courses and powerful learning platforms. The main element of online learning is a high-quality and effective learning platform. The transfer of learning courses from the real world to the virtual one requires specialized platforms and services that allow the structuring of learning content and changing the format of the presentation of learning material. Based on the analysis of existing learning platforms, it was found that among students there is a demand for the use of game technologies during lessons, which, according to the results of scientific research, enrich the learning process. Therefore, the development of a learning platform with elements of gamification is relevant. An interactive learning platform with elements of gamification and artificial intelligence was demonstrated. This platform will contribute to the development of e-learning, conducting online classes by teachers for students at a new level.*

Ключові слова: *освітня платформа, онлайн-курси, інформаційні технології, гейміфікація, програмне забезпечення, штучний інтелект.*

Keywords: *learning platform, online learning, information technology, gamification, software, artificial intelligence.*

1. Introduction

Today, a topical topic is digital education, which cannot exist without an important component - a learning platform. In 2022, Ukraine joined the Digital Europe Program, which provides, in particular, the introduction of digitization in the field of education [1]. The Action digital project has been launched. Digital education, which provides free access to knowledge on digital literacy [2].

Learning.ua is the largest online learning platform for children in Ukraine. This site is a virtual learning institution that effectively complements school education [3].

The modern platform "All-Ukrainian School Online" is intended for remote and mixed learning of students in grades 5-11 [4]. The scientific and learning platform of "Minor Academy of Sciences" contains professional online courses for

teachers on how to make classes interactive and exciting [5].

The Moodle online platform has a wide set of functionalities, a content management system (CMS), a learning management system (LMS) and a virtual learning environment (VLE) [6].

The Top 10 free online platforms for effective teacher-student interaction include the following interactive learning platforms, listed in Table 1 [7].

Table 1. Top 10 free interactive online platforms

№	Name of the online platform	Description of online platform
1.	Google Classroom	Learning in the virtual space, evaluated and commented by the teacher, each class has a separate folder on Google Drive, mobile applications of the service are available for Android and iOS.
2.	Trello	Teamwork of schoolchildren and a teacher to develop a joint project, in which each participant is assigned his responsibilities.
3.	Zoom	Conducting webinars, meetings and conferences, participants can show their screen, video and audio of the conference is saved in the cloud storage and on the PC in MP4 and M4A formats.
4.	LearningApps	Creation of interactive tasks using templates: tests, quizzes, puzzles, crosswords. The database contains learning and methodological materials from 32 disciplines, which facilitates the process of content creation.
5.	Edmodo	Online service for convenient exchange of information between students and the teacher, for creating various tasks. Electronic learning space - for deepening knowledge, for preparation for the Olympiad, examinations, school projects.
6.	Canva	Designed for creating diverse and high-quality visual content in the form of comics, logos, presentations, infographics, meme generators, etc.
7.	iMindMap	Creation of mind maps. Content is downloaded in the following formats: SVG, PDF, 3D images, zip file, web pages, working modes: brainstorming, capturing ideas and thoughts.
8.	Classtime	A web service for conducting instant tests that can be taken during an online lesson or given as homework.
9.	Survio	Online service for conducting questionnaires among students and their parents, the results are displayed on charts and graphs.
10.	Plickers	A mobile application for instant answers to tests in the format of choosing the correct answer or answering "yes/no". Completed tasks are displayed on the projector in real time, the teacher checks the cards with students' answers according to their QR code

In addition to the platform with learning online content, massive platforms with open online courses and with open access via the Internet have gained popularity, such as:

- Coursera,
- Prometheus,
- Udemy,
- EdX,
- Duolingo,
- Udacity,
- Khan Academy,
- Lynda,
- Skillshare.

It is known that pupils and students, in addition to lessons and doing homework, spend their time on computer games to play and communicate with friends in group chat. The following largest gaming platforms with their large game libraries are available for Windows and Android: Uplay, Battle.net, Origin, Steam and others[8]. Therefore, game activity is close to students.

Currently, scientists are investigating the feasibility of using gamification in education to increase the motivation of pupils and students and their involvement in activities in various fields [9].

Therefore, the development of gamification in modern platforms and the introduction of its elements into the field of education in many countries of the world have recently been observed. For example, Poland already has considerable experience in using environments with elements of gamification in the learning process. We list them in Table 2.

Table 2. learning online platforms with gamification

№	Name of the online platform	Description of the online platform
1.	Codecademy	Learning JavaScript, HTML, Python, Ruby programming
2.	Motion Math Games	Mobile math games
3.	Mathletics	Teaching mathematics for kids
4.	Khanacademy	Video Lessons from various disciplines
5.	Spongelab	Scientific research
6.	Foldit	Solving scientific tests
7.	Dungeons&Dragons	Introduction to probability theory
8.	Classcraft	A role-playing game to improve the performance of students

Thus, the purpose of this work is:

1. To analyze the functionality of modern interactive learning platforms for students of different age categories.
2. Determine the priority functionality of modern online platforms for building a learning gaming environment.
3. Determine the best platform architecture for the digital interaction of teachers and students.
4. Select the technology stack, tools, and core software to create an online platform with gamification and artificial intelligence elements.
5. To demonstrate the work of a new, unique platform with gamification and artificial intelligence elements for creating online lessons.

2. Analytical Review Of Literature

According to the research of Ukrainian scientists E.S. Kryukova, and O.S. Ameridze, in recent years, IT companies in Ukraine have been actively working on improving existing learning platforms. Currently, the most popular in Ukraine are Classcraft, Minecraft: Education Edition, Lingua Leo, Lego Education, WeDo 2.0, etc. These products have become extremely useful modern tools for teachers [10].

According to the research of O. Konevshchynska [11], V. Gavrylina [12], the online game can be made an integral part of the learning process, students can answer questions created by the teacher on the platform using any gadgets that have access to the Internet. Therefore, platforms that use these effective game mechanisms are being implemented in the Ukrainian education system. We list these platforms in Table 3.

Table 3. Use of online platforms with gamification in learning institutions of Ukraine

№	Name of the online platform	Description of online platforms	Using
1.	Kahoot	Creation of online quizzes, tests, surveys, content contains photos, videos	National technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute" in teaching ESP - electronic stabilization of the car.
2.	Minecraft	Communication of the participants of the learning process for the formation of digital competencies.	Institute of Information Technologies in teaching various disciplines
3.	GameHub	Cooperation between universities and enterprises in the field of professional development of the gaming industry.	Odessa National Polytechnic University within the framework of the ERASMUS + KA2 international project, studying informatics at the Department of Nuclear Power Plants
4.	MMORPG	A class of applications that are networked online role-playing games where a large number of players interact in a virtual world	University of Education Management of the National Academy of learning Sciences of Ukraine
5.	ContentGenerator	Creation of interactive games, quests and quizzes	Kyiv National Linguistic University, studying English
6.	Classtime	Командна робота у навчальній грі, що насичена релевантним візуальним матеріалом та миттєвими тестами.	Colleges, institutions of secondary, professional and higher education.

According to the Skilsful research for 2021, the following TOP 5 international platforms for online learning were recognized: Shaw Academy, SkillShare, Udemy, Linkedin Learning, Coursera [13].

It was established that as a result of involving the whole class in joint work using gamification in the learning process, the interest of students, their motivation, and their level of success increased. Students take an active part in the work, which activates their cognitive activity and forms digital competence [14].

According to international studies, the number of online platforms users increased by 98% last year [15].

This indicates a rapid demand for online education, and the widespread use of gadgets and mobile Internet for online games by children indicates the popularity of learning digital platforms with elements of gamification.

3. Object, Subject And Methods Of Research

The object of research in our work is available modern learning platforms for organizing and conducting online classes.

The subject of research is technologies, tools and programming languages that can be used to develop interactive learning platforms.

The work uses general scientific and special **methods of research** in the field of information technologies, in particular: system approach, factor analysis, cluster analysis, index observations.

Expected scientific results: improvement of modern learning technologies, platform architecture and creation of functionality for use in the platform development process.

4. Project Description

The interactive learning platform contains elements of gamification and artificial intelligence. The main feature of the platform is the use of gamification and elements of artificial intelligence in the platform.

The platform service is available in English and Ukrainian. The teacher can conduct online classes on the platform, provide content and monitor the learning process, using artificial intelligence data to accurately analyze student performance. The platform can be accessed from computers, laptops, tablets, as well as mobile devices using third-party applications integrated with the platform via API.

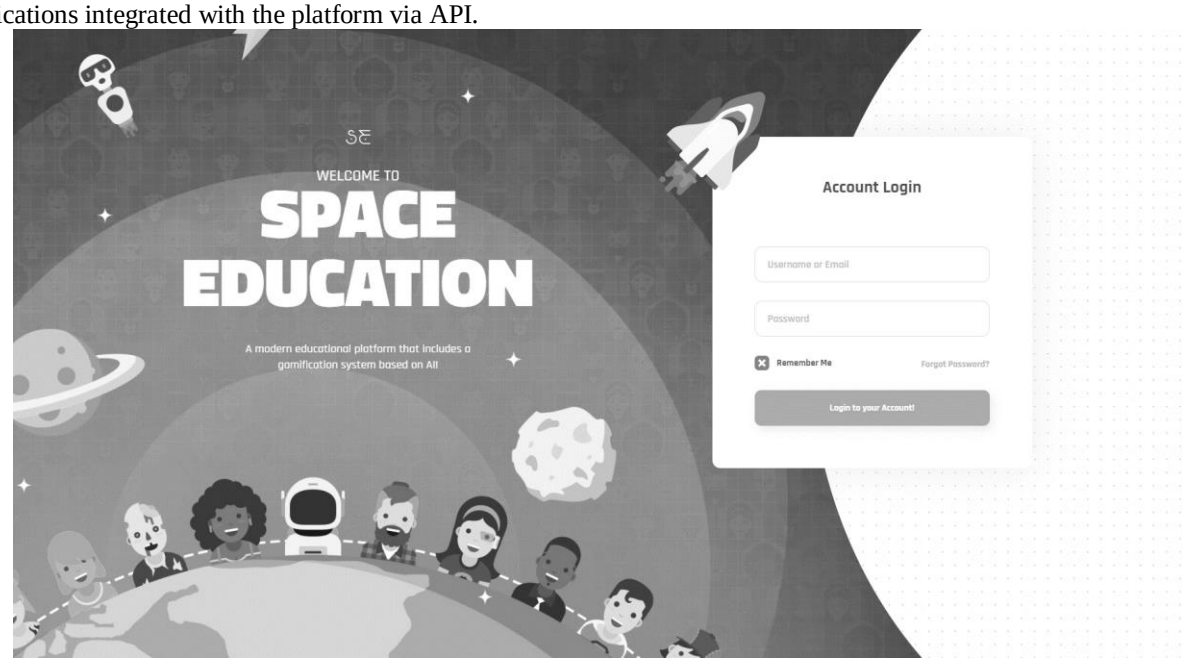

Fig.1. Authorization page

To use the platform, you need to be authorized (Fig. 1.). Using a login and password, the user has a personal account. The login and password are provided by the learning institution.

The platform helps teachers, students, and their parents to track their learning progress.

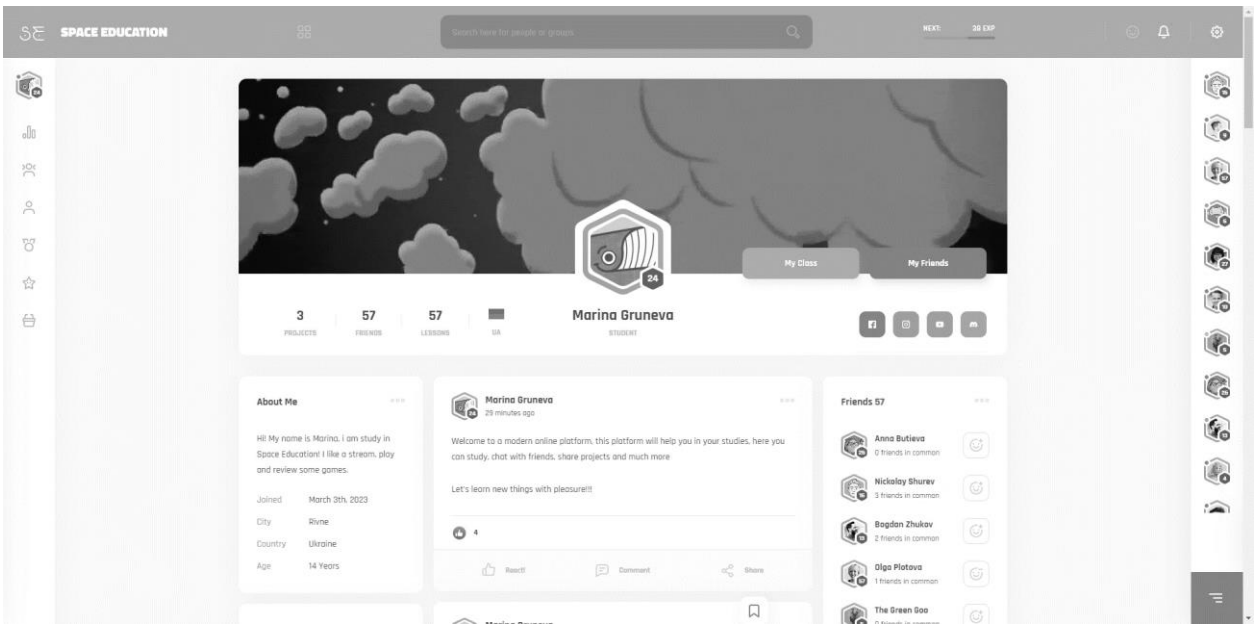

Fig.2. User profile Page

After authorization, the user enters his profile (Fig. 2). The interface design created by professional designers and UX engineers [16] was used.

The profile contains information about added projects, friends, and completed lessons, as well as information about the user. Profiles of all students are available to the teacher, he can monitor the progress of each student. The main menu provides access to all the functionality of the platform.

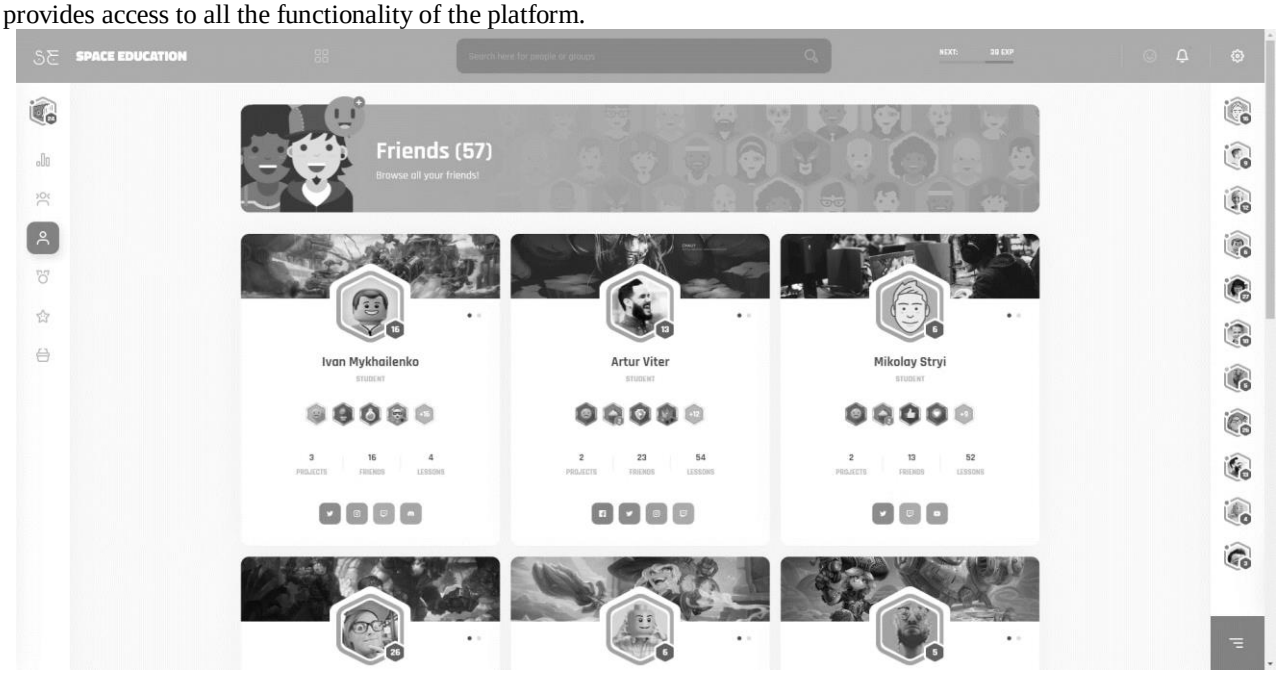

Fig.3. Friends Page

The Friends page (Fig. 3) allows you to access the profiles of all users that the student has added as friends.

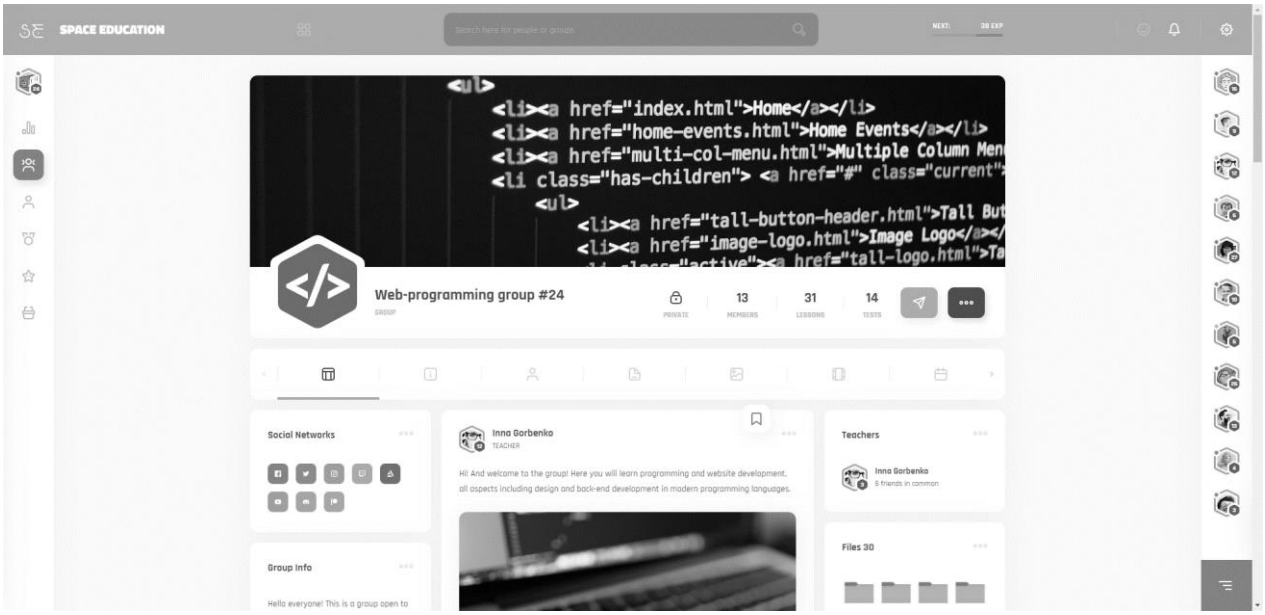

Fig.4. Group Page

On the online group page (Fig. 4) you can get access to all learning content, including video and audio. Users can also get general information about the group, its members, teachers, rules, etc.

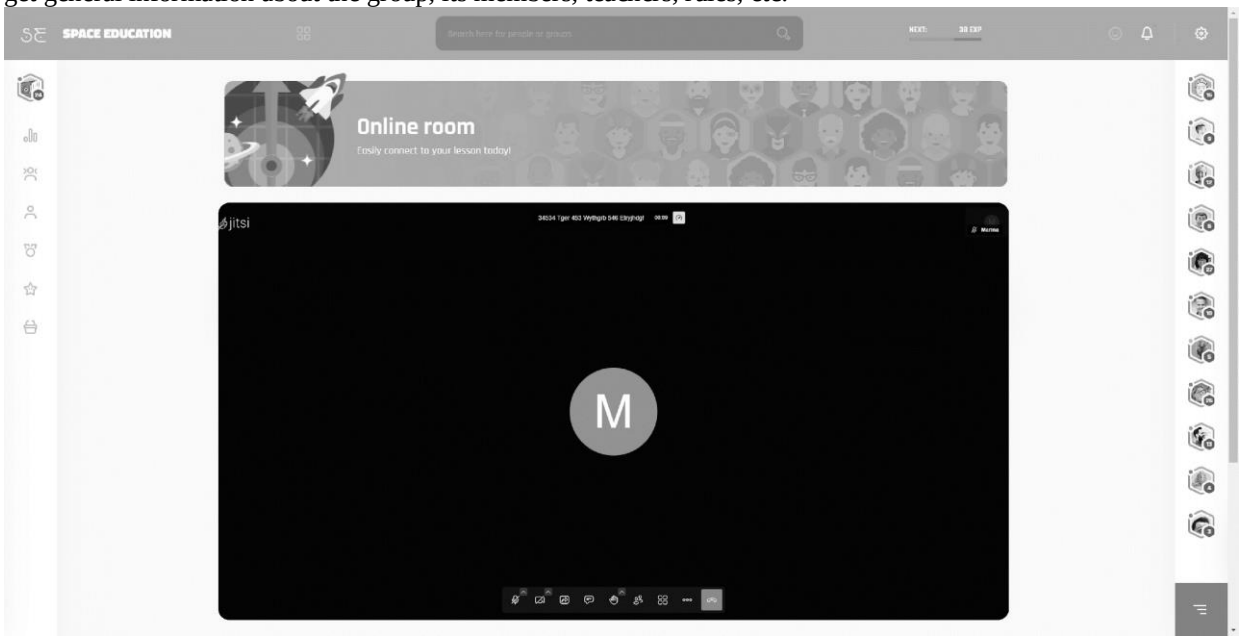

Fig.5. Online room Page

From the group section (Fig. 4) you can go to the online- room section (Fig. 5) for conducting lessons [17]. In this section, access to microphones and cameras of students and teachers is added, all users can show the screen, and the teacher can add his own learning materials, presentations, videos, and more. Also, all users can exchange messages in the chat.

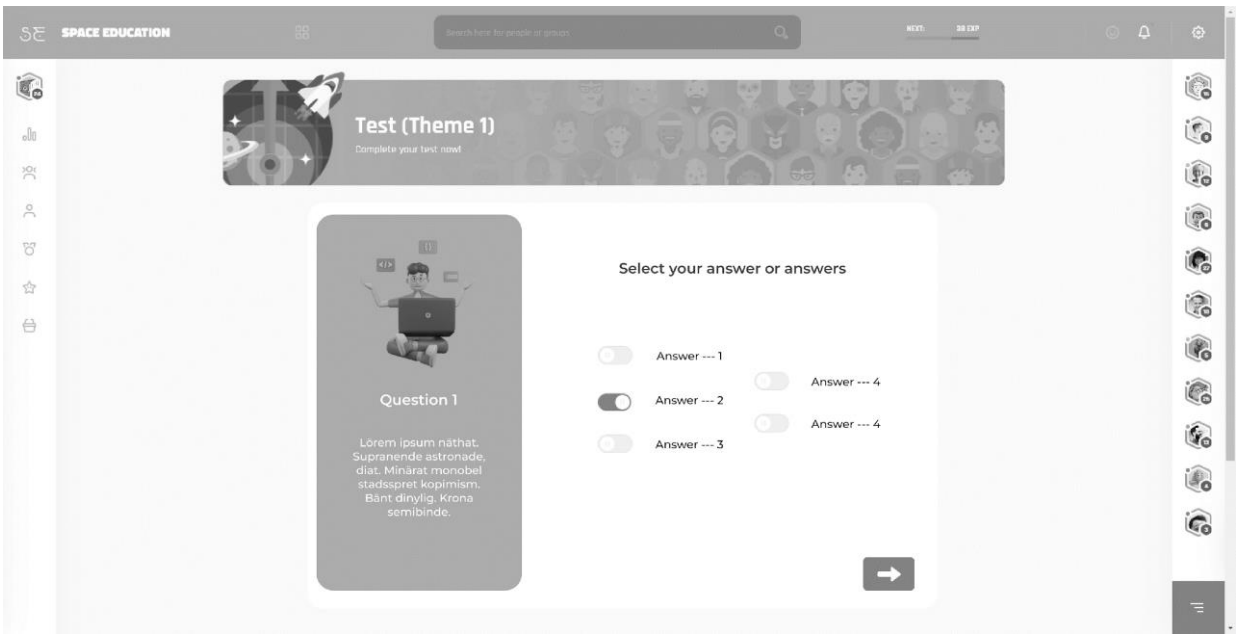

Fig.6. Tests Page

The Tests section (Fig. 6) allows the student to take tests. Test results are used to generate statistics and analytics for each student with the help of artificial intelligence. This data will allow teachers and student's parents to monitor the student's progress.

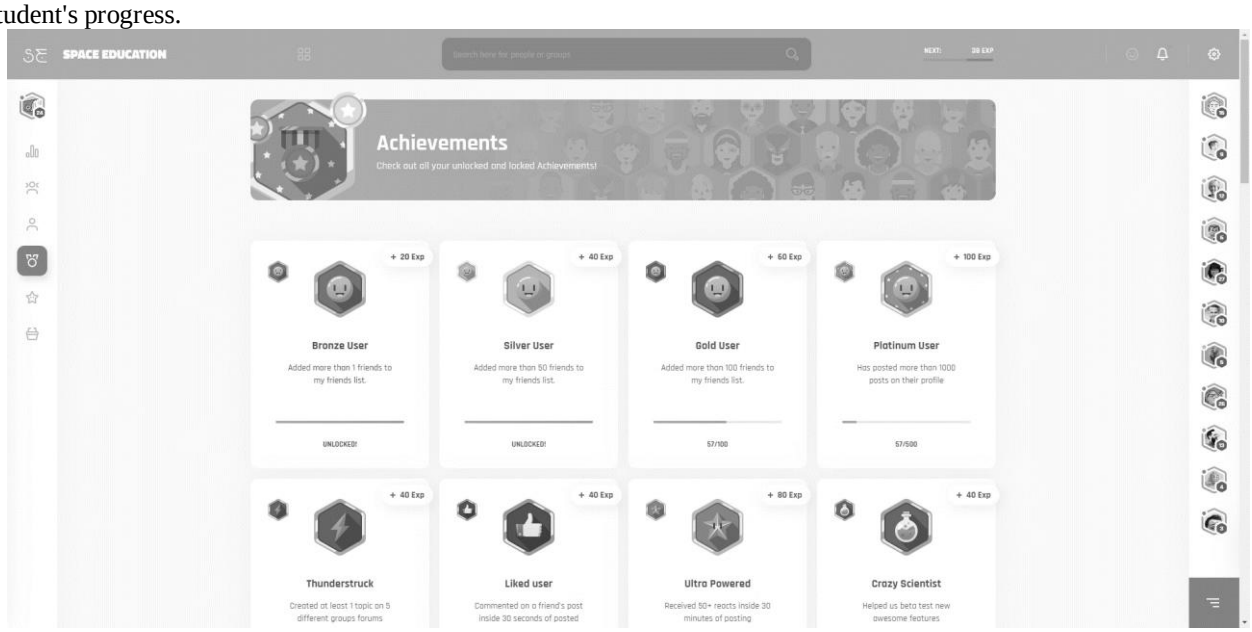

Fig.7. Achievements page

In the Achievements section (Fig. 7) there are all completed and open achievements of the user profile. For each open achievement, the student receives experience, the more experience, the higher the level. For passed levels, the student can receive certain rewards on the platform.

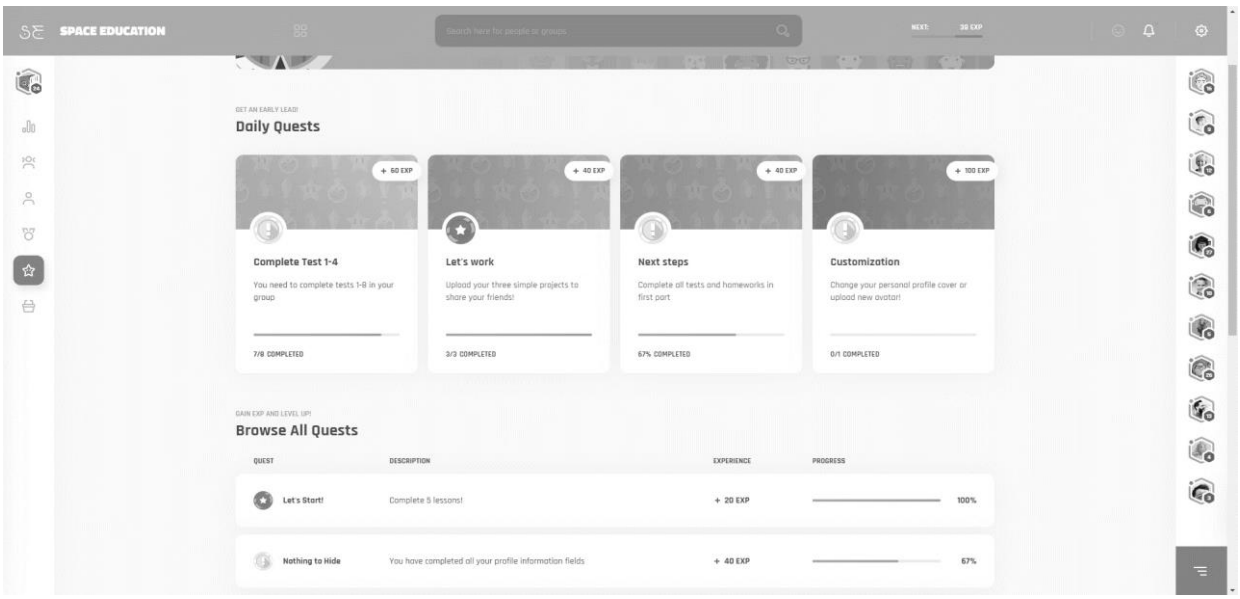

Fig.8. Quest page

A feature of the platform is the creation of quests (Fig. 8). In the list above, there are always personal tasks that are formed by artificial intelligence. Artificial intelligence concentrates attention on the student's weak knowledge and activates his work. This allows him to increase his level of knowledge by completing these tasks. Below are permanent tasks, these tasks are tied to the topics that students pass, and are created manually or automatically based on available learning materials.

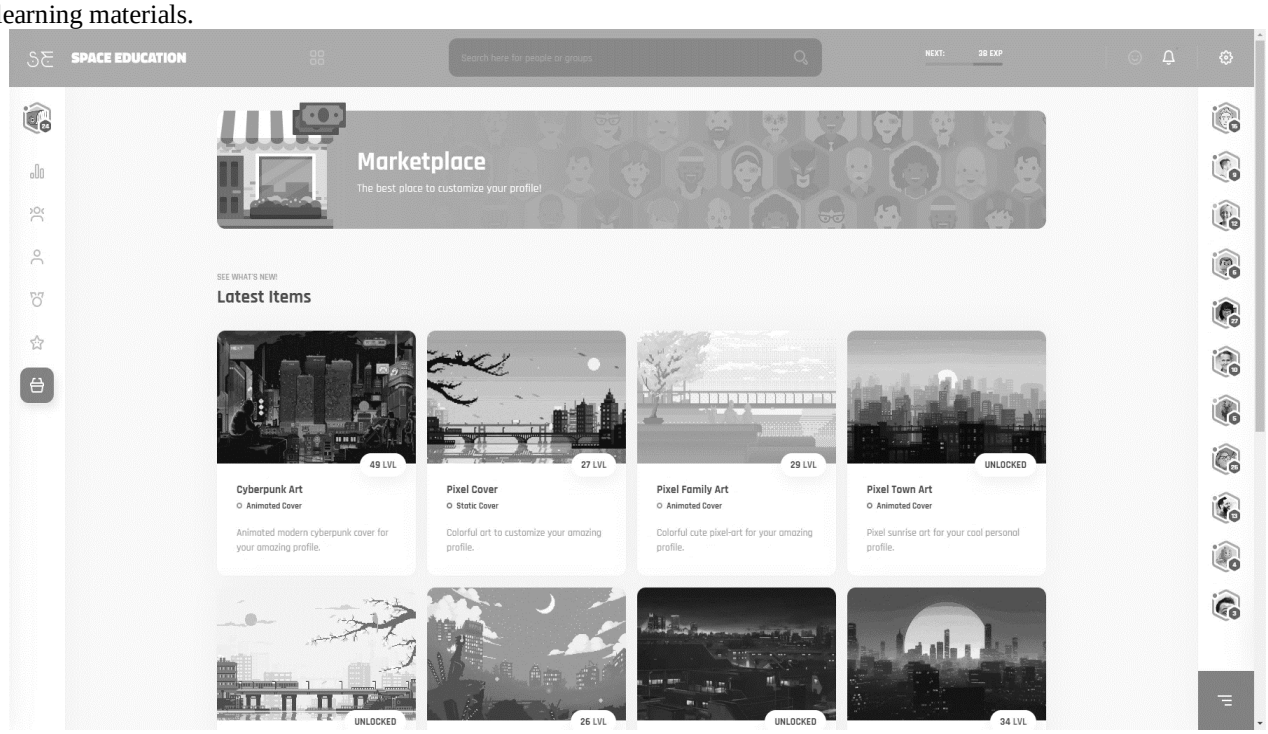

Fig.9. Marketplace page

To increase learning motivation, such elements of gamification as rewards are used [18, 19]. For this purpose, a marketplace (Fig. 9) was created, which allows students with the appropriate level to receive awards and customize their profile, which can be seen by teachers, classmates, and friends. This encourages them to do quests more actively and get new levels faster than others. Gamification allows students to gain new knowledge and learn it faster.

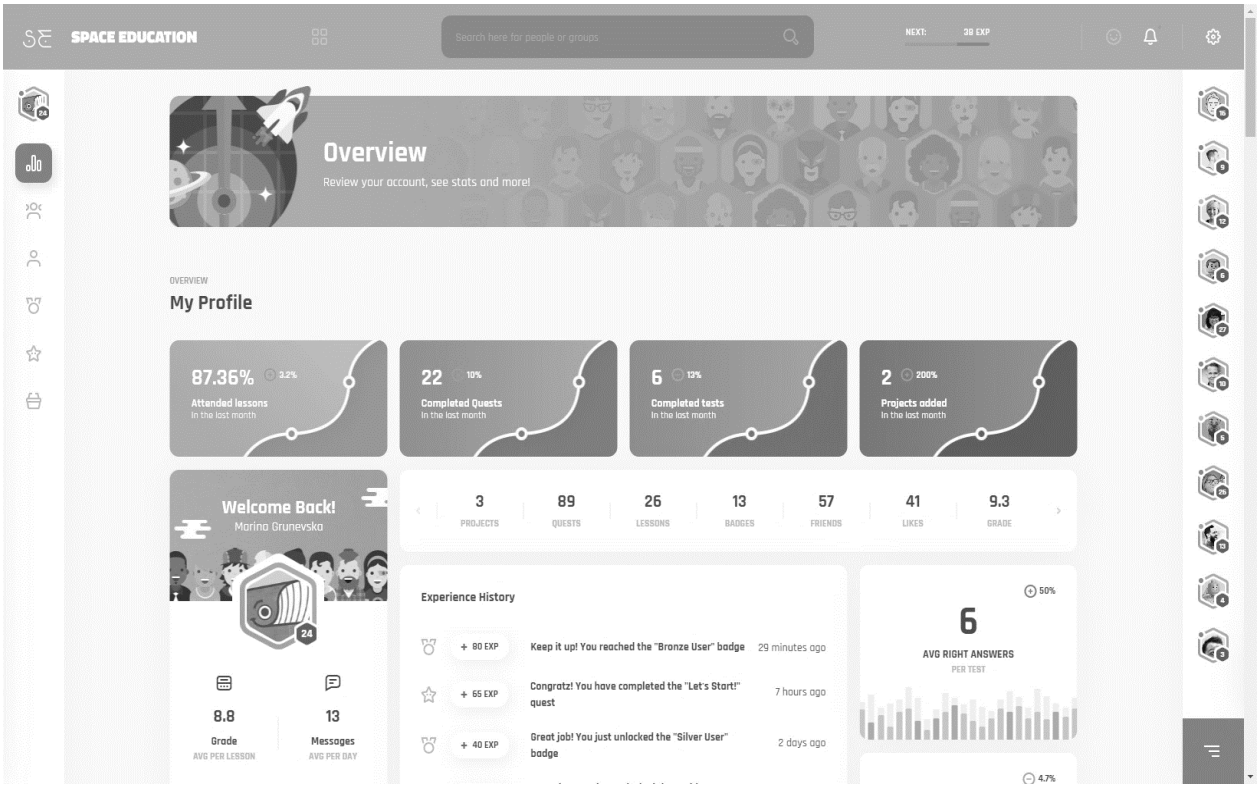

Fig.10. Overview Page

The platform contains statistics (Fig. 10), which contains all the structured information collected and processed by artificial intelligence. This section is formed based on a large amount of data that artificial intelligence collects, processes, and outputs in an accessible form, this section allows both teachers and students to receive all the necessary information about academic progress, which can be used to analyze the effectiveness of the curriculum since the teacher does not may affect AI data. The AI-recommended score is expected to be fair with high accuracy.

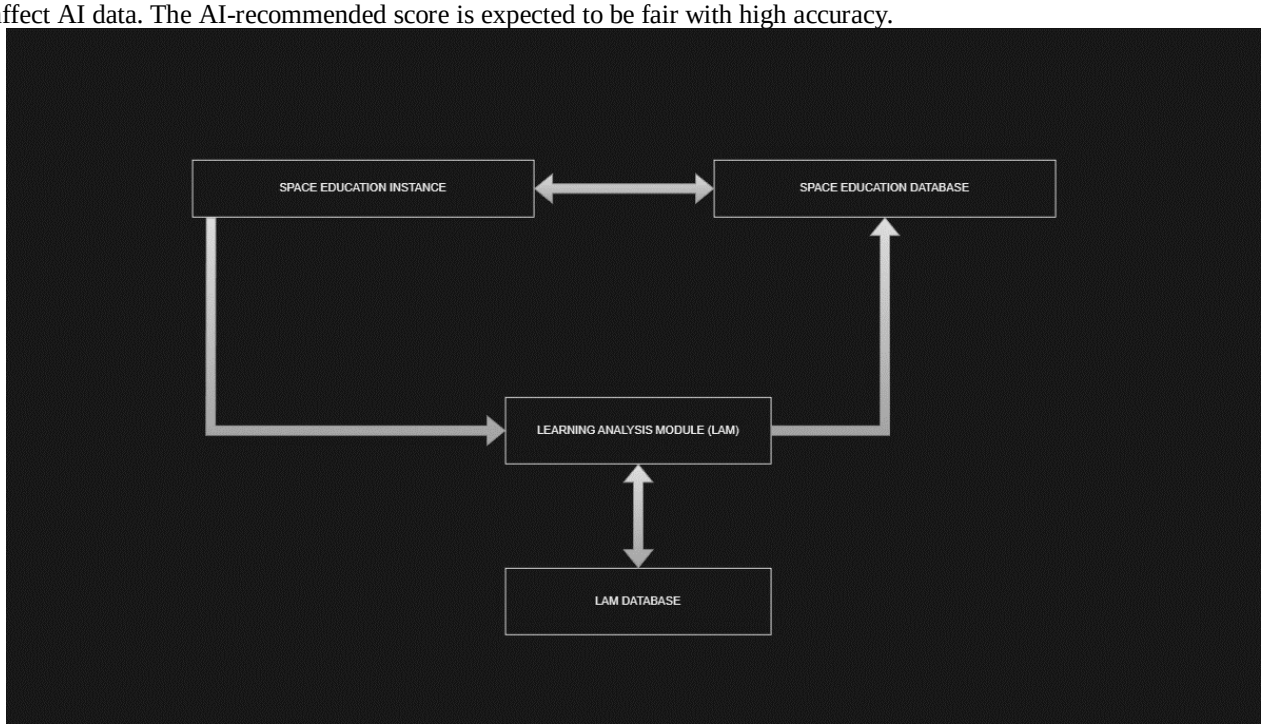

Fig. 11. A simplified diagram of the interaction of artificial intelligence

The artificial intelligence works together with the platform (Fig. 11), which sends data to the LEARNING ANALYSIS MODULE (LAM), which stores temporary data in its own REDIS [20] database. After the analysis is completed, the LAM sends the generated analytics to the SQL database [21] of the platform, from which the user can retrieve data using

the platform or REST API.

To develop the business logic of the platform and the artificial intelligence module, the TypeScript programming language and the NestJS framework with Fastify were chosen [22]. This modern asynchronous framework was chosen because of its simplicity, and the ability to withstand heavy loads, and it is also widely used in the development of modern web applications.

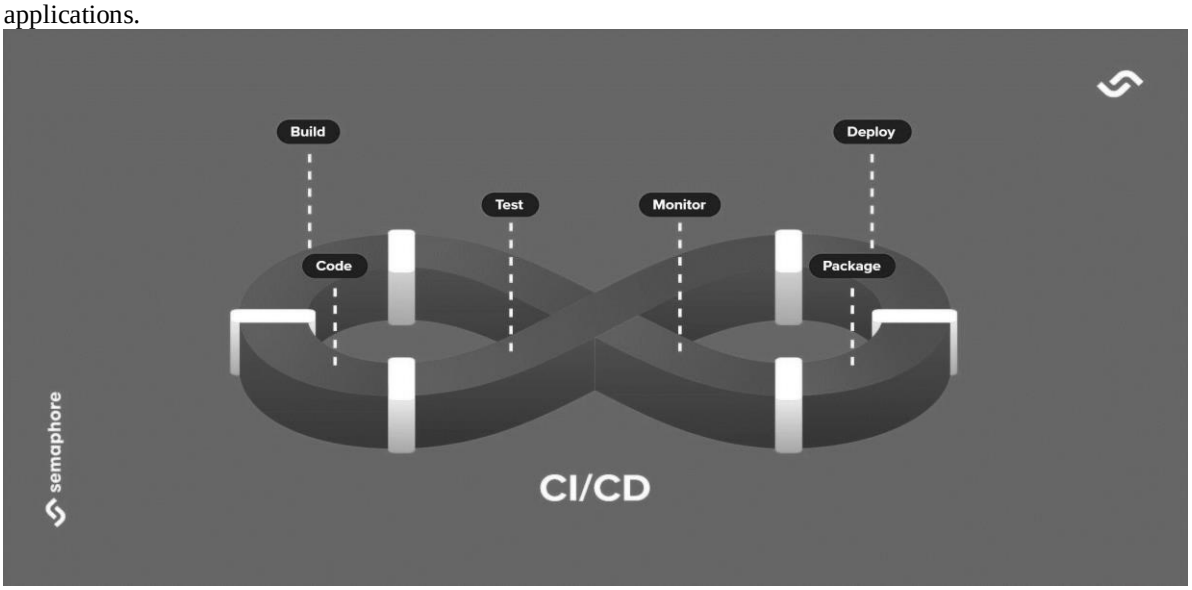

Fig.12. Scheme of operation of CI/CD

The open-source container orchestration system Kubernetes [23] on the Microsoft Azure platform was chosen for the deployment of the platform. CI/CD based on Gitlab CI [24] was also implemented (Fig. 12).

5. Conclusions

In the course of the study, an analysis of available learning platforms, platforms with game mechanics that make up learning content was carried out.

A new interactive learning platform with elements of gamification was demonstrated, which makes it possible to create exciting online classes for students of different age categories in various fields of activity.

Features of the platform are identified:

- constant feedback for effective management of the learning process;
- the latest gamified space in which the student observes his progress;
- system of conducting online classes;
- testing system;
- elements of artificial intelligence for the formation of detailed statistics about each student.

Further research will be devoted to improving the existing and developing new functionality of the online platform to increase its level of competitiveness.

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