

Ministry of Science and Higher Education of The Republic of Kazakhstan.
Suleyman Demirel University



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Online preparation website for the UNT in informatics for LLP
"JOO High School Almaty"

A thesis submitted for the degree of
Bachelor in Information Systems
(degree code: 6B06101)

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Abstract

The article follows the process of the development of an educational platform dedicated to 10th - 11th grade students of "JOO High School Almaty" LLP. The study aims to create a convenient and motivating platform for students and support them to require quality education through engaging and interactive ways. The platform provides educational materials, quizzes and practical tasks. To determine the demand and objective of the platform we conducted a survey among a group of high school students, preparing for the UNT, planning to pursue higher education in the IT field. The research shows that the e-learning platform is a valuable tool for students, allowing them to achieve better results in exams and conveniently gain relevant knowledge in the field of interest.

Аңдатпа

Мақалада "JOO High School Almaty" ЖШС 10-11 сынып оқушыларына арналған білім беру платформасын әзірлеу процесі баяндалады. Зерттеудің мақсаты-студенттер үшін ынғайлы және ынталандыруши платформа құру және оларды қызықты және интерактивті тәсілдер арқылы сапалы білім алуға үмтүлуда қолдау көрсету. Платформа оқу материалдарын, викториналар мен практикалық тапсырмаларды ұсынады. Платформаның қажеттілігі мен мақсатын анықтау үшін біз IT саласында жоғары білім алуды жоспарлап отырган ҮБТ-га дайындалып жатқан жоғары сынып оқушыларының арасында сауалнама жүргіздік. Зерттеу көрсеткендей, платформа студенттер үшін емтихандарда жақсы нәтижелерге қол жеткізуге және қызығушылық саласы бойынша тиісті білімді ынғайлы алуға мүмкіндік беретін құнды құрал болып табылады.

Аннотация

В статье прослеживается процесс разработки образовательной платформы, пред назначенной для учащихся 10-11 классов ТОО "JOO High School Almaty". Цель исследования - создать удобную и мотивирующую платформу для студентов и поддержать их в стремлении к качественному образованию с помощью увлекательных и интерактивных способов. Платформа предоставляет учебные материалы, викторины и практические задания. Чтобы определить востребованность и цель платформы, мы провели опрос среди группы старшеклассников, готовящихся к ЕНТ, планирующих получить высшее образование в сфере ИТ. Исследование показывает, что платформа электронного обучения является ценным инструментом для студентов, позволяющим им добиваться лучших результатов на экзаменах и удобно получать соответствующие знания в интересующей области.

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List of abbreviations

KPI Key Performance Indicators

UI User Interface

UX User Experience

UI/UX User Interface and User Experience

LLP Limited Liability Partnership

UNT Unified National Test

MPA Multi-page Application

SSR Server-side Rendering

SQL Structured Query Language

DOM Document Object Model

WYSIWYG What You See Is What You Get

ORM Object-Relational Mapping

Introduction

1.1 Motivation

The education worldwide had undergone major reformations in terms of digitization in the last decade. The rapid switch to the distance learning put the majority of schools and universities in front of the choice of either develop and adapt technologies in the learning processes or shutdown. Therefore, due to this specific situation, such incorporation happened in a fairly short amount of time. This caused a flourish and high popularity of e-learning platform, such as Coursera, EdX, and Udemy, because a number of educational institution were not ready and adapted these platforms into the curriculum.

However, since then it became clear that bespoke educational platforms are the necessity rather than a privilege and EdTech industry started attracting additional investments as a perspective field. The perspectives of the market possible to estimate by the financial investment of investors in the field of education. According to Education Technology Insights estimates, by the end of 2020, 16 billion dollars has been invested in Educational Technologies startups, which exceeds 32 times the amount of the global indicator of 2010. The income of the world market in 2020 amounted to 89.5 billion dollars. Analysts of the global economy assume that from 2021 to 2028 the average annual growth rate of EdTech will be 19.9%. [23]

In the neighboring country of Kazakhstan in Russia, EdTech appeared relatively recently and is under development. According to Smart Ranking reports, the volume of revenue in 2021 amounts 15.3 billion rubles. Which shows that during the post-pandemic period, Russian income from online education has doubled.[26]

Smart Ranking analyses calculated the total profit for 2022 of Kazakhstani startups by 27 billion tenge, which exceeds only by 1.17 percent compared to 2021.[27] Total revenue from Ed Tech 60%, which amounted to 17 billion tenge. In 2020, at a meeting of the Council of Ministers of Kazakhstan, ex-Minister of Education Askhat Aimagambetov highlighted that there are more than eight online platforms designed for education in the country, which have positive effects and their own limitations.[25] Enumeration of primary education platforms that are currently in use: Daryn online, Bilimland, kundelik.kz, Sabaq.online. At the universities wide use attracted platforms Moodle, Platonus, and Univer. However, almost all of these platforms were developed by international companies. For instance, Bilimland is supported by Coursera, which is a system of courses from American developers. Another university platform Moodle similarly provides services for Kazakhstan and other countries from the American IT industry.

World statistics show the profitability of Information Technology development. According to the Statista portal, the annual global income for 2020 amounted to 5.2 trillion US dollars. Expected that by 2025 the amount will be increased to 7.1 trillion dollars. Below is the average salary of in-demand IT specialists in the market:

Nº	SPECIALITY	AVERAGE SALARY
1	INFORMATION SYSTEMS SECURITY MANAGER	\$127,895
2	CLOUD COMPUTING ANALYST	\$100,981
3	DEVOPS ENGINEER	\$120,750
4	SYSTEMS ENGINEER	\$109,392
5	SECURITY ARCHITECT	\$166,919
6	NETWORK/CLOUD ARCHITECT	\$132,860
7	BIG DATA ENGINEER	\$121,484

Figure 1.1.1 Engineers' salaries for August 2022

1.2 Aim and Objectives

The aim of the project is to create a multifunctional platform with the necessary educational materials for preparing for the Unified National Testing in informatics

Objectives:

1. Development of a user-friendly and adaptive interface
2. Provide the necessary materials in electronic form
3. Increase the motivation of students in the field of Information Technology
4. Improve students' programming skills by solving coding tasks on the platform
5. Create an appropriate environment during testing, as in the UNT format

1.3 Thesis outline

The Chapter 1 (Introduction) outlines the goals of the project and our motivation to work within the chosen theme. Chapter 2 (Background) shows the analysis of the existing international and Kazakhstani educational platforms. The Chapter 3 (Literature review) observes the overall discurs in the e-learning platforms research trajectory. The Chapter 4 (Methodology) outlines the detailed process realization description that includes the parts of Design, Front End, Back End and Product Test results. The Chapter 5 (Conclusion), summarizes the outcomes of the work produced and describes its future development.

Keywords— informatics, educational platform, UNT, e-learning, blended learning, EdTech, students, programming

Background

2.1 Introduction

In this chapter, we analyzed in detail the structure of education after the pandemic period in foreign countries and in Kazakhstan to form the general vision of our project. Provided an overview of the Kazakhstani and foreign markets based on online educational platforms. This chapter details the advantages and disadvantages of the currently relevant online and blended education formats.

2.2 Changes of worldwide educational system after pandemic period

After the influence of Covid 19, the education system was significantly changed and a substantial number of schools, universities and other educational institutions modified the category of teaching from traditional full-time education to more convenient, namely online learning. Teachers had a possibility to completely change the structure of teaching and create an improved educational environment with many privileges. Due to the arrival of e-learning, students have the opportunity to develop a clear graph of learning for themselves in order to compose their schedule according to the progress of their learning. Also, students can study from anywhere in the world and can share information with various people with separate cultures, expanding their networking and worldview. To improve the methods of distance learning, teachers had to cover new teaching methods and technologies, such as multimedia schemes, various quizzes, video tutorials, etc.

In education, online learning has its favorable aspects, for instance, it affects academic performance, and provides entire education for those who live in remote areas or children with disabilities. However, distance education, with all these advantages, is not appropriate for everyone.

With the advent of distance education, students will have the opportunity to develop their worldview regarding modern IT technologies. The experience of rapidly developing countries demonstrates that online education is becoming necessary in the modern world. The digitized environment requires students to have computer literacy skills and continuous development of technical abilities. Modern youth confidently use tools such as online forums, online courses, informative applications to develop the cognitive function of their mind. This is an incentive where in the modern labor market there is a high demand for highly qualified personnel with the skills to quickly master digital skills. Due to the shortage of employees in the labor market, the world's leading universities are demonstrating online training to provide affordable paths to high-quality education.

The Massachusetts Institute of Technology has created a pilot project "MicroMasters" for obtaining a master's degree in a short period of time. [11] Students were offered the opportunity to take certain subjects in an online format. In 2018, MIT announced the recruitment for a full master's program, where more than 1,000 applicants applied for admission to one of the leading

universities in the world. The program included such specializations as Supply Chain Management, Principles of Manufacturing, Data Science and Artificial Intelligence. The program was aimed at high-quality results despite the complexity of the selected subjects. The structure was built to give students an in-depth understanding of the subject and practical skills that will be used in real life.

With the success of the “MicroMasters program”, students from around the world graduated from the Massachusetts Institute of Technology. According to the experiment, there is a high demand for those wishing to receive distance education.

2.3 Demand of distance learning platform in world market

There is a demand for distance learning platforms in aspects where students do not have entrance to education. Some subjects of knowledge have certain limitations that have a need for accessibility among students who do not have admittance to them through distance learning. In recent years, specifically after the pandemic, the tuition sphere has been swiftly modified with the onset of online learning programs.

Online programs and distance learning have made a revolution in the entire teaching sphere, replacing the well-known traditional way of learning, thereby providing students to study online anywhere. Coursera has provided open access to courses from top universities from around the world for students damaged by the closure of schools and institutes during the Covid 19 pandemic. This platform cooperates with many renowned universities in the QS universities ranking list, such as Harvard, University of Michigan, University of California and University of Pennsylvania. With the support of this, plenty of students were able to persevere studying and acquire new awareness and abilities in those challenging times. By virtue of the free access to Coursera courses during the pandemic, the wide potential of online education was revealed.[21] For example, online courses can provide flexible and affordable learning opportunities. Especially for those who did not have access to traditional educational resources before.

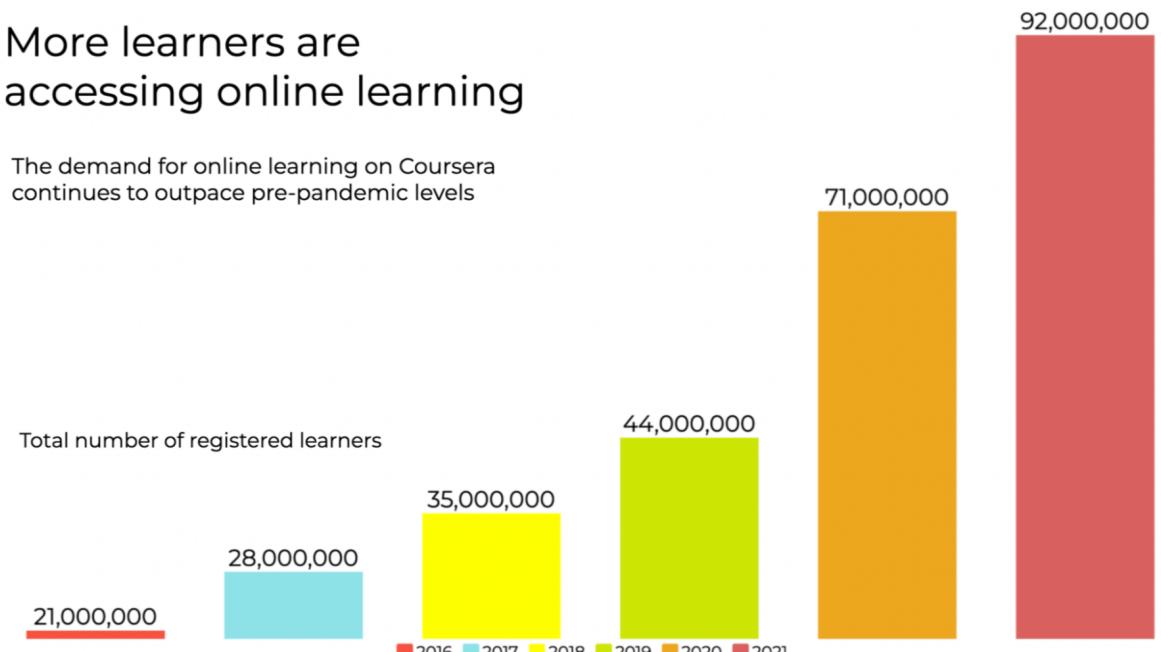


Figure 2.3.1 The demand for online learning on Coursera

These days, in many backward countries, there are financial hardships in providing students with the required funds, despite the fact that technology is continuously developing. This significant gap in education was influenced by economic and social factors, such as the lack of appropriate infrastructure, learning facilities and the necessary resources. For example, in African countries where there is a very poor population and because of the insufficient number of educational institutions, some students need to travel long kilometers to get to school. In some localities, students have to give up learning due to the lack of schools, costly tuition fees and other unavoidable causes.

Despite thriving in a globalized world, distance education has huge benefits in solving problems in the education gap, as it is a substantial part of education that provides students with acquaintance and skills from anywhere in the world. Regardless of their geographical location, any student receives highly qualified education and resources, such as videos or lectures from experienced and famed teachers from around the world. Thanks to this, students from remote areas are provided to study online, despite the limited resources that have had a detrimental effect.

2.4 Solving the problem of education for people with disabilities

The privilege of online education is the profitability in terms of financial costs and time savings. Distance education does not require extra money for the route to the educational institution, the purchase of textbooks, school uniforms, some school supplies, which makes it an optimal option for people with financial difficulties and for people with disabilities. Students who are focused on quality education leave their cities and countries and face housing problems. In addition, online education has become a good solution to this challenge. Universities and schools that have figured out the effectiveness of distance education do not require the purchase of educational materials, since most of them are available for reading on any devices. In addition, for people who do not have the opportunity to attend an educational institution, online education is an affordable alternative without compromising the quality of education.

2.5 Approach to online education of students and teachers

It should be noted that despite the advantages of online learning, the format is not suitable for all students. In some cases, a traditional classroom lesson with a teacher and classmates is more effective for obtaining the necessary knowledge in certain areas. The lack of the necessary conditions for a student can lead to a decrease in motivation and academic performance. The school curriculum is not designed for the individual academic performance of each student's intelligence and is not divided into sections for fast learners and slow learners. For some students, the physical presence of the teacher is important for immediate feedback in case of difficulties. Additionally, the presence of other students creates an environment for knowledge competition, which increases interest in learning.

One of the common problems of distance learning that causes a decrease in motivation is technical network failures when connecting to the Internet. Students who find it difficult to manage their time may not be able to keep up with online education due to the requirement of concentration and self-discipline.

Researchers from the Russian Higher School of Economics conducted an experiment to compare online, offline and blended learning formats.[13] Students studied in the appropriate formats during the semester. At the end of the semester, in order to obtain the results of the study, the participants were examined and interviewed. According to the test results, students of online and mixed groups received more points, but the online learning group was dissatisfied

with the learning process. The study shows that online learning has not reached its peak. Traditional teaching has proven effective for complex subjects requiring interaction and discussion between students and teachers.

Training with electronic devices causes psychological pressure in some participants. There is a high probability that students, not controlling their inner excitement, may fail the course. In order not to face this problem, it is necessary to give teachers and students the freedom to choose the appropriate learning format.

Ultimately, the effectiveness of the above methods depends on various factors. It is necessary to take into account the opinion of each student and determine the most adaptable learning system for the student and teacher.

2.6 Blended education in Kazakhstani market

Blended education in Kazakhstani market is becoming more common because the majority of schools are implementing online tools to facilitate classes and still maintain the classical methodologies. Therefore, we chose a format of blended education and created an educational platform to support after class assessment. Blended education, better known as hybrid learning, which is a type of education that combines both online distance learning and the traditional method of classroom learning. Since this method combines a more flexible and convenient structure, it is very widespread these days, especially in the Kazakh market.

According to a recent report by the Ministry of Education and Science of the Republic of Kazakhstan, in general, more than 80% of all universities use this method of teaching to provide higher education. Such growth and demand in blended education is closely linked to the prosperity of technology and the need for more flexible methods for teaching. The main and more significant advantage is ease of use and obtaining affordable and high-quality education, regardless of where and when to study. It is especially essential for students of large countries like Kazakhstan with certain areas where it is very difficult to find sustainable access to resources for education.

However, there are significant difficulties with blended education in Kazakhstan, and in some parts of the country this is mainly due to the lack of infrastructure and necessary equipment. Due to these problems, some online learning tools and materials are not available to students to participate in online events and meetings.

For blended learning, teachers should prepare and support students, so that they can effectively conduct courses. This requires investments in a program of professional development and continuous support of tutors. Even if there are obstacles related to the implementation of this approach, the advantages for students and institutions make it beneficial investment. As technological progress goes on, it is obvious that blended learning has become a crucial part of the educational system of Kazakhstan.

The study involving students from the University of Hanover examined aspects of blended learning. The aim of the pilot program was to effectively combine online learning with a traditional format.

In order to explore this model of teaching online video lessons, textbooks, discussions, practical tasks, online interviews were used as a part of the teaching process. One special aspect of the given research is implementation of the diaries, which were completed by participants everyday as a reflection about their experience of taking part in this research. Overall, 65% of the participants were satisfied with the blended learning format.[13] However, some of the participants claimed that the process of writing a diary was time consuming, since it was necessary to think over what had been done and to formulate thoughts in order. During practice it turned out that providing real examples is quite informative for students, and online

multimedia content is effective in lecture times to consolidate the lesson.

2.7 International market review

Today, platforms for getting online education are commonly used and it is considered that demand for these platforms will significantly increase in the global market. Due to the report of Technavio, it is expected that the global e-learning market will rise at a Compound Annual Growth Rate (CAGR) of over 13% from 2020 to 2024.[20]

Platforms	Advantages	Disadvantages
Coursera	verification of the material passed, a wide selection of narrow specialties from world universities	too complicated registration process, time limitation of courses
Udemy	use of multimedia materials, cognitive ways of transmitting information	not appropriate quality of some courses, not available to all students
LinkedIn Learning	use of hard software with simplest detailed steps, certificates are displayed in the LinkedIn profile	mandatory to have LinkedIn account
edX	opportunity to get a bachelor's and master's degree education from top universities	courses are mainly in special areas, not creative
Treehouse	use of interactive environment(text editor and etc. for quizzes and projects)	more focus only on programming
MasterClass	learning from well-known world celebrities, practical and extra information	initial level of training
SkillShare	a large number of courses, some courses are free, comfortable mobile app	non-advanced courses
Thinkific	comprehensible structure for using	lack of individual course libraries

Figure 2.7.2 Comparison of educational platforms

There are three main factors which cause the rise of the e-learning market. These factors are the adaptability of e-learning in corporate training, the necessity of online education, and the spreadness of gamification in both e-learning and traditional learning. One of the biggest markets of e-learning platforms is North America followed by Europe and Asia-Pacific. However, according to forecasts the Asia-Pacific region is going to witness the highest growth because of the high necessity in mobile learning and the skill-based training.

Highly qualified teachers from European countries were interviewed about their attitude to online learning using educational platforms.[9] Countries such as Poland, Germany and Italy were selected for testing, where the educational system is promoted using the most productive methods and various formats. According to the answers of teachers, the effectiveness of learning through platforms directly depends on the positive attitude of the students. The motivating criteria for learning through platforms is simplicity and convenience, and the application should not emotionally strain the user. One of the important aspects of high-quality distance education is the confident use of information technology by teachers and students. Taking into account the above criteria , European educational institutions prefer platforms such as Virtual Teacher Centre, SchoolNet, EduNet and others.Teachers noted the availability of programs in their native languages, access to the resumption of the course and convenience of use in any devices.

2.8 Kazakhstani market review

Since the outbreak of COVID-19, Kazakhstani universities have started actively using educational platforms. Institutions provide a variety of educational platforms, including blended, online, and on-campus learning, to enable students to realize their academic aspirations in the most convenient way. Students of Al-Farabi Kazakh National University, Kazakh National Women's Pedagogical University, Kokshetau State University by Sh.Ualikhanov, Almaty Technological University, Arkalyk Pedagogical University and others have passed an anonymous survey on the quality of educational platforms provided by the educational institution. According to a survey conducted among students of various universities in Kazakhstan, the majority

use platforms such as Moodle, Platonus and system “Univer”. Other least used platforms: Hero Study, Google Classroom, Zoom, Sirius.

The advantage of moodle participants noted unlimited access to course materials, the ability to take exams, communicate with each other and their teachers and send assignments electronically.

Another widely-used platform in Kazakhstan is Platonus. Platonus is a cloud-based platform that offers a range of features for academic institutions, including course management, virtual classrooms, and online assessments. Platonus also provides tools for academic planning, student performance tracking, and automatic grading. The Table A.1.1 which is provided in Appendix A contains the data on the survey of students of universities of Kazakhstan. The aim of this survey is to examine educational platforms used in Kazakhstani universities from the sight of students.

Contrary to universities, the school system of Kazakhstan uses the Bilimland educational platform in a single way. Bilimland was implemented in the post-pandemic period. It includes video tutorials, educational materials and quizzes that are available to all students. The platform has unlimited access to all school subjects. There are other platforms such as Sabaq.online and Daryn.online, but in order to complete the courses, the student must make a payment. Another video conferencing program, Zoom, has been massively used during the pandemic. Despite the fact that the program has serious shortcomings, Kazakhstan has not found a replacement platform. School markets in Kazakhstan still experience a deficit of electronic educational tools.

Literature Review

Over the past decade, two significant and innovative educational tools have attracted rising notice and recognition. These tools are Massive Open Online Courses (MOOCs) and Virtual Learning Environment (VLE). This review aims to provide an overview of the literature on MOOCs and VLEs, concentrating on their benefits and drawbacks, as well as the effect in the school and higher education systems.

Massive Open Online Courses (MOOCs) are up-to-date advancements that have altered the online education systems. MOOCs have become widespread among students and teachers due to their flexibility and approachability. Virtual Learning Environment (VLE) is an extensive platform for the management of educational institutions, as well as, in particular, for the administration of e-learning courses.

The example of the management use is M.Couch's study, during which the author performed a comparison analysis of the four prevalent MOOC platforms, such as Coursera, Udemy, Udacity and EdX. Coursera's precedence is providing immediate feedback to the student. In addition, Coursera has a unique feature called CourseMatch, which offers courses for each user based on their preceding course history. Also a very well-known platform created by Massachusetts Institute of Technology and Harvard University is EdX, which offers students a wide range of courses in fields of study such as business, engineering, etc. By using Coursera and EdX, students can study regardless of time. However, due to the limited time to set up courses, they will not be able to adjust the pace of learning for themselves. Udacity and Udemy differ from them in that they allow students to take exams at any time, without specific deadlines, because they are adaptable and include separate structures of courses. All these platforms provide certificates of study at the end of the course, which will be useful for admission to most higher educational institutions across the globe. Also, for students and teachers, these platforms are available in mobile versions of iOS and Android, which is extremely convenient [3].

In addition, MOOCs can play a significant role in the enhancement of students' academic performance. Thus, a group of researchers D.G. Glans, M.Fors and M.Riley investigated several pedagogical bases of MOOCs and their effect on student learning results. The standing out attributes of MOOCs are lectures proposed in the form of educational videos mixed with formative tests, automated evaluation, mutual evaluation and self-evaluation, as well as online conversation meetings. This study only considers students who are more satisfied and involved in MOOCs that are designed to provide connectivism, self-managed learning, social and dynamic studying. The probability of finishing the course is high for those students who are committed to the course and satisfied with it, and they will reach the best educational results. The researchers compared MOOC courses and traditional university courses, using them as a principle for various studies. They came to the conclusion that attending online courses is convenient for the part of the population that is experiencing difficulties for financial, geographical and other reasons. Moreover, according to research, some MOOC courses are more effective than traditional ones [8].

Furthermore, in the article "Research on MOOCs: Trends and Methodologies" authors investigated MOOC trends and methodologies . Three main features were emphasized to the

trends: gamification, which includes quizzes, quest tasks, a leaderboard to increase student interest; group training, which the main advantage is the exchange of knowledge between students; certification at the end of the course, which are recognized throughout when applying for specialization. Successful methodologies indicate data mining, which scientists investigate using complex algorithms; experimental plans to control the effectiveness of the strategy; surveys to get feedback from the user. Specified trends and methodologies have a high probability for promoting and determining the potential of MOOCs in the online learning arena [15].

Apart from the MOOC, the VLE is also widely used in the learning processes. To evaluate the use of a platform called Moodle in training at universities and colleges, Gabriela Kyu made her own research. Moodle platform is a one type of VLEs, where the learning procedure is completed online. Moodle is a software that aims to support a collective learning environment. This is a new way of teaching, which relies on constructivist pedagogy, where teachers and students meet, collaborate and exchange knowledge. The interface of the platform is straightforward and comprehensible for everyone, organized by modules; it is also accessible for users who do not have very sophisticated digital gadgets. This platform is used for interactive interaction between students and teachers in a virtual environment. In Moodle, both students and teachers can have free entrance to the platform either synchronized or not. However, despite the fact that the platform is very convenient and versatile, according to the results of a survey conducted among students, the platform cannot replace traditional classroom classes. The Moodle platform can be used to a greater extent as a supplementary learning instrument [18].

Additionally, in order to investigate the influence of VLE on the learning process, Yun Jia and Ruimin Qi conducted their experiment. It was attended by two groups of Bachelor's Foreign Language programs with relatively close average scores. Also, teachers took part in the experiment, whose main task was to create a convenient environment for the learning process. Group A studied at a traditional pace, group B studied in a classroom with active use of virtual learning environment platforms and with the participation of teachers. According to the results of the control exam, the average score of students on the provided online platform was about 10 points higher [12].

Finally, Anna Ayub in her article explores the current problem of the lack of classrooms and highly qualified instructors for the growing number of students around the world every year. She considers the creation of Smart future classes with the introduction of virtual learning environments as a potential solution to the problem. The advantage of this class is the use of advanced technologies such as virtual whiteboards, high-quality audio and video communication, interesting multimedia resources. According to the researcher's expectation, in the near future majority of the educational institutions will utilize virtual learning environments [2].

To understand the use of MOOC and VLE we addressed the article "Lessons for the Future – The VLE and the MOOC" (2016), where the authors raise the topic of VLE and MOOC adaptation in higher education. According to their investigation, VLEs have limitations in choosing the desired elective university courses, compared to MOOCs which have thousands of courses available. Subsequently, the problem might ruin the reputation of a future specialist in a certain field and lead to a loss of motivation. However, authors claim the need for both VLEs and MOOCs, which merges into one hybrid online learning format [16].

In conclusion, it is important to note that VLEs and MOOCs have revolutionized the improvement and transformation of education. Both methods represent significant potential in the system of school and higher education. However, it is necessary to take into account the negative aspects while teaching on a particular platform.

Methodology

4.1 Introduction

In this chapter, we will describe in detail from the creation process to the implementation of the project. Source code of our project: <https://github.com/Adilkhanweb/diploma/>

4.2 Problem statement

This academic year (2022-2023) is the first year when applicants for admission to the Information Technologies bachelor's degree programs are obligant to pass an informatics test at Unified National Test (UNT). It leads to the situation, when applicants face a lack of an effective online platform with ready materials to prepare for the UNT in the informatics subject.

4.3 Project realization

It was decided to make an educational platform in informatics for school students in grades 10-11 after huge hours of brainstorming (Figure 4.3.1) and considering all the details of the university and school learning system. In order to find supportive stakeholders, we sent our project idea to about 10 educational institutions by email. The company that responded and was willing to work with our project was "JOO High School Almaty" LLP. This company is a network of modern educational schools in three major cities of Kazakhstan. The company's clients and thus, the potential platform users are students of grades 10-11 preparing for the UNT and their instructors.

Realization Plan

1. Meeting with the stakeholder, find out expectations and technical requirements
2. Preparation of a KPI plan and distribution of responsibilities
3. Analysis of the Kazakhstan and foreign marketplace
4. Creating a UI/UX design for the platform based on the conducted UX research
5. Maintain feedback with stakeholders
6. Development of Front End and Back End parts of the website
7. Launching a website
8. Testing the platform on the students of "JOO High School Almaty"
9. Correction of minor errors. End of the project

To implement our idea, we started with the distribution of roles for website development:

- Alua Otezhan - UI/UX and Graphic designer, Business Analyst
- Assem Koilanova - UI/UX designer, Data Analyst
- Tangsholpan Abdipaiyz - Front End developer
- Adilkhan Kuchkarov - Back End developer, Front End developer

The platform, which is called "JOO informatics", was created to provide applicants with high-quality preparation for exams. It includes sections for passing the mock test, presentations with theoretical information and practical tasks to improve coding skills. In case of any difficulties users can send relevant questions to the "Talqylau" page. This is a discussion page with the help of which students may ask for help or discuss problematic topics. Another equally important page was created to reinforce the technical mindset and improve coding skills. This is the "Bagdarlamalau" page, before creating this one similar analogues such as Hackerrank, Leetcode, Codeforces were overviewed by team members. It is necessary to emphasize that "JOO informatics" provides free mock tests with one and several correct answers to the question, because, before the creation of our platform there was the one and only website of the National Testing Center on which students could pass mock tests in informatics on paid basis. Finally, students have an opportunity to work on the mistakes after finishing the test on the platform.

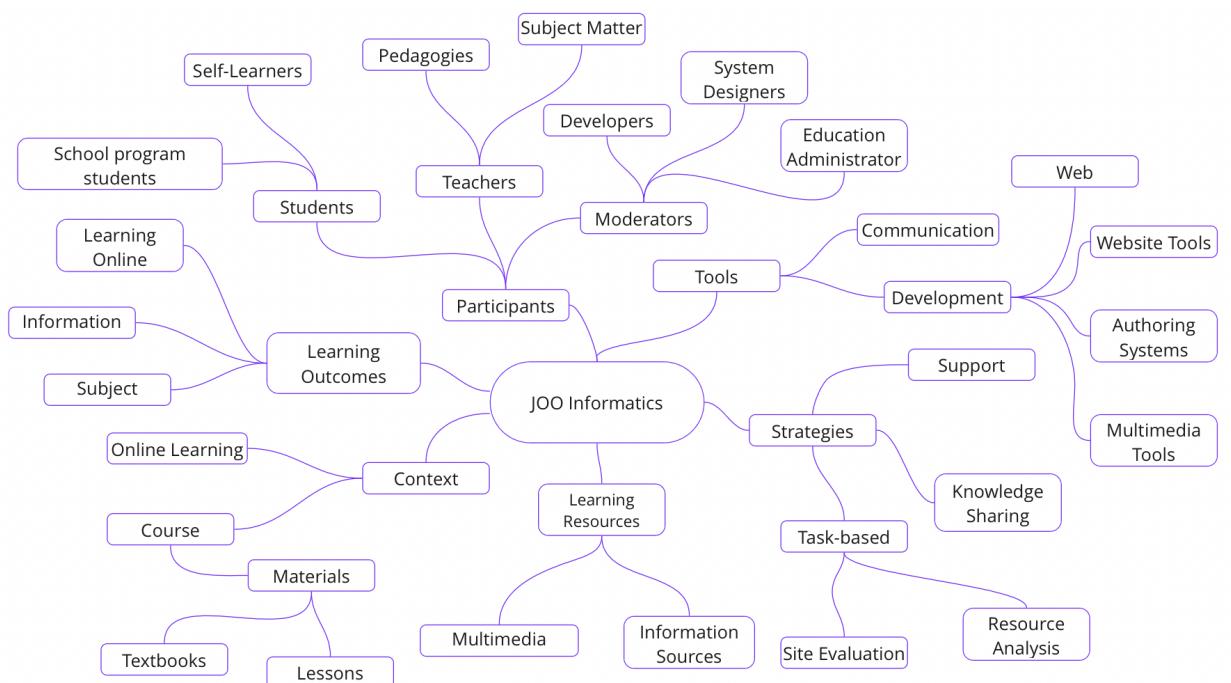


Figure 4.3.1 Mind Map of the project

Stack of the project: Django, Judge0, Docker, HTMX, hyperscript, Bootstrapp, Tabler, Postgresql

4.4 Design

Design of the website plays a significant role in the given project, because it was necessary to create both mobile adoption and desktop versions of the site. Also, it was required to develop a version of the site and mobile adoption for students, teachers and administrators. That's why

it was decided to work on the design collaboratively. As a main task, it was identified to create a user-friendly interface design by the Figma graphics program. To create the design of the project, the needs of the stakeholder and the target audience were specified. Additionally, personas cards were created in order to identify students' areas of interests in IT.



Figure 4.4.2 Personas Cards

Moreover, based on the reviewed references of similar applications and websites, we have built a visual of an educational platform. We visited the official website and social network of the cooperating company to determine the style. As a result, following color palettes were selected:

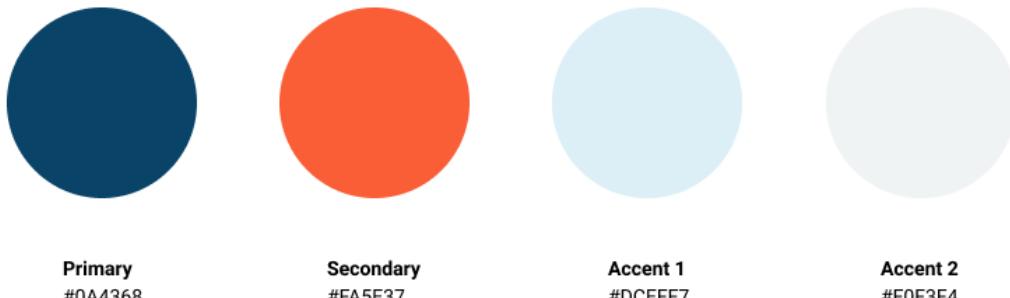


Figure 4.4.3 Color Scheme

By the request of the stakeholder, the platform supports only the Kazakh language, since the students of this school take the UNT in their native language. We found that the "SF Rounded" font family (Figure 4.4.4) is favorable for our website. The font is available on the Kazakh keyboard.



Figure 4.4.4 Typography

After building an approximate prototype, we assembled the UI components (Figure 4.4.5).

To create original content, we manually drew illustrations in the Adobe illustrator graphics program. The first illustration is intended for the main page of the online platform, which shows

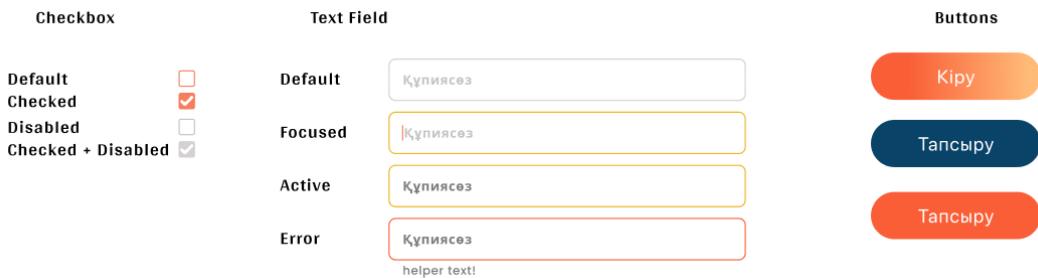


Figure 4.4.5 UI Components

the format of blended learning with the use of traditional books and the current convenient laptop device for obtaining knowledge at a distance. In the (Figure B.1.1) the screen shows a coding competition among the students of "JOO High School Almaty". To give uniqueness , schoolchildren with the uniform of this school were added to the illustration. (Figure B.1.2) Two similar-style illustrations have been added to the testing and coding pages. One character was chosen for both drawings. Patterns with test variants, coding symbols have been added to clarify test and coding pages.



Figure 4.4.6 Testing Page Illustration

Two similar-style illustrations have been added to the testing and coding pages. One character was chosen for both drawings (Figure 4.4.6). Patterns with test variants, coding symbols have been added to clarify test and coding pages (Figure B.1.3).

Another feature was the addition of stickers on the laptop. (Figure B.1.4) The "Never forget" sticker is made to remind students to save the project. A person with virtual glasses is associated with multimedia in IT. Also added a sticker with the Turkish word in the translation "learn", which has become fashionable among young people.

In the (Figure 4.4.7a), the student who successfully passed the test, in the (Figure 4.4.7b) is focused on solving programming problems.

The designs of some pages such as the login, the main and the coding pages are provided in Appendix B.



Figure 4.4.7 Illustrations

4.5 Front End

In this subsection, we describe how we made client side of our website. By the discussion of our team, we decided to develop Multi-page Application (MPA) with Server-side Rendering (SSR). Because SSR has more advantages in security than CSR. One of the main advantages is the authentication and authorization logic takes place on the server side and it will be difficult to steal user data.

SSR (Server-side Rendering)

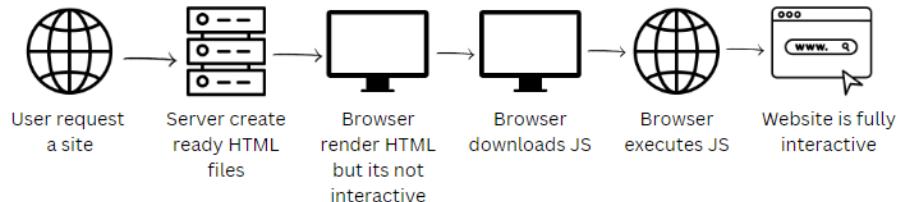


Figure 4.5.8 Server-side Rendering Visualization



Figure 4.5.9 MPA and SPA difference Visualization

4.5.1 Architecture

As we mentioned above we decided to develop MPA with SSR, so for Front End part we will not use huge frameworks as ReactJS[19], VueJS[24], AngularJS[1] and etc. Instead we used small and lightweight libraries as JQuery[7], HTMX[14], hyperscript[10].

- JQuery - fast, small, feature-rich library.
- HTMX - is high power DOM manipulation library. It's easy to use AJAX requests with it.
- hyperscript - to write JS in inline mode with intuitive human language syntax.

```

<form method="post" class="form-control question-form mb-2"
      {# HTMX usage #}
      hx-post="{% url 'quiz:save' quiz.url form.attempt_question_id %}"
      hx-trigger="change delay:500ms"
      hx-indicator="#ind-{{ form.attempt_question_id }}"
      {# hyperscript usage #}
      |= "on htmx:afterRequest put 'Сакталды' into the #q-{{ form.attempt_question_id }}
          on htmx:beforeRequest put '' into the #q-{{ form.attempt_question_id }}
          on change call reinitForm(me)
          on load call reinitForm(me)"
>
<h3>{{ form.question }}</h3>
{% if form.figure %}
    
{% endif %}
{{ form.form }}

<button class="btn btn-ghost-danger clear-choice-btn btn"
        hx-post="{% url 'quiz:save' quiz.url form.attempt_question_id %}" hx-trigger="click">
    Тандауды тазалау
</button>

<span class="text-success" id="q-{{ form.attempt_question_id }}"></span>
</form>

```

Figure 4.5.10 HTMX and hyperscript usage example in project

In the (Figure 4.5.10) we can see usage of front end libraries. hx-post attribute sends POST request to the given URL if hx-trigger attributes is True. If form was changed, after 500ms will be sended POST request. hx-indicator attribute takes DOM element (spinners or progress indicators) as argument it will show it while the request is in flight. _(underscore) attribute is hyperscripts [10] attribute. In first line hyperscript code means put 'Saved' into specified element after POST request completed, second line means put " into specified element before request. Third and last lines means call reinitForm(me) on form changed or loaded to reinitialize form state.

It is simple work creating tables, forms, menu bars and other functionalities of a website just with HTML and CSS . But to make them adaptive, dynamic and functional, we have to use CSS frameworks.

The list of used CSS frameworks and benefits:

- Bootstrap 5[4]. Responsibility of design, adapt screen sizes , fonts, images, logos on any given devices.
- Tabler[5]. Tabler - web application UI kit based on Bootstrap 5, with hundreds responsive components.

Other used libraries:

- TinyMCE[22] - open-source online rich-text editor
- Moment.js[17] - a popular open-source WYSIWYG editor for web content.

4.6 Back End

4.6.1 Framework

As a backend framework we choose Django[6]. Django is a high-level Python web framework with ability of full-stack web application development. Why we choose Django?

Key features of Django:

- Template Engine. Django provides template inheritance, which allows developers to create a base template with common elements and define child templates that inherit and extend the base template. This promotes code reuse and modularity by separating common layout elements from specific content. Also Django provides powerful, customizable template tags and filter for manipulating data in template.
- Admin Panel: Django provides easily customizable admin interface out of box. It allows developers to manage database records without writing SQL queries.
- Object-Relational Mapping (ORM). In Django no need to write raw SQL queries for managing database records, raw SQL can be hacked using SQL injection. Django provides a powerfull ORM to manage database using Python code.

4.6.2 Users

Users can enter the website by three statuses:

- Moderator. Creates new users or delete existing ones and change statuses.
- Teacher. Can create new tasks, online testing, coding and add new materials.
- Student. Read all the materials, pass the exams, see the results and ask or answer questions.

If students or teachers don't have an account, they can create a new account to enter the website by default, but to change their statuses they have to address the moderator. In the Figure 4.6.11 shown permissions for each user type.

4.6.3 Database

As a database, we used PostgreSQL. Our website consists of five main models:

- Lesson (same model for the books, because of data structure similarity) - model for Lessons and Books
- Quiz - model for Tests
- Assignment - model for assignments
- Discussion - model for discussions
- Problem - model for programming problems

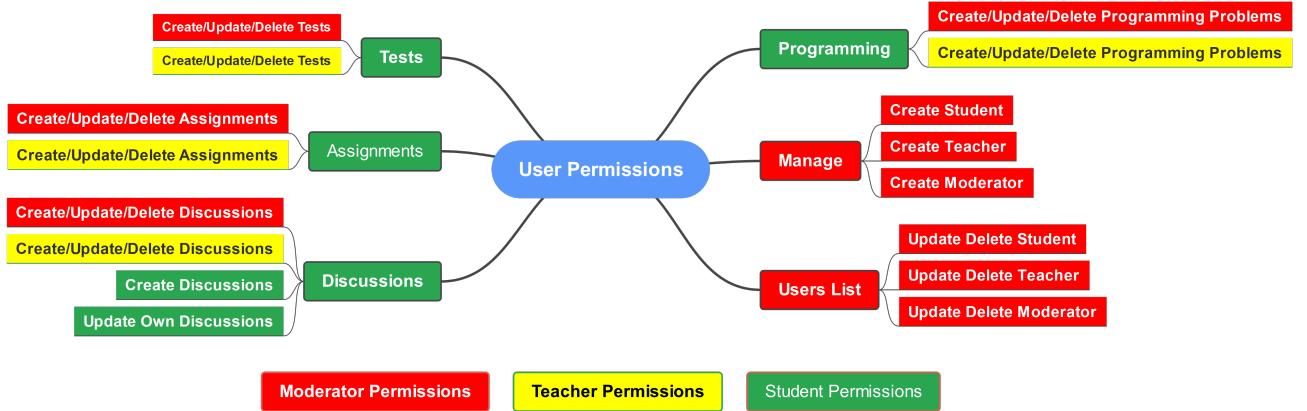


Figure 4.6.11 User Permissions

4.6.4 Quiz score calculation

All possible cases for questions with 6 answer options and their scores

Questions with 1 correct answer	Questions with 2 correct answers	Questions with 3 correct answers
0	0	0
0	0	0
2	2	1

correct answer the wrong answer is selected the correct answer is selected

Figure 4.6.12 A table for calculating points for questions with multiple correct answers.

```

def get_score(correct_answers, given_answers, question):

    correct_set = set(correct_answers) # Question correct answers set
    given_set = set(given_answers) # # Student answers set

    max_possible_score = 2 if question.answers.count() > 4 else 1
    """
    If Question with 6 options - maximum score will be 2,
    If Question with 4 options - maximum score will be 1,
    """

    correct_given = correct_set.intersection(given_set) # Student's correct answers

    score = len(correct_given) / len(correct_set) * max_possible_score
    """
    If length of student correct answers and correct answers are equal will be returned max. score
    else will be returned rounded score 1 or 0
    """

    return int(score)
  
```

Figure 4.6.13 Function to calculate score for student answer to a question.

Math equation representation for quiz scores calculation:

A — Student answers, set of \mathbb{N} numbers

B — Question correct answers, set of \mathbb{N} numbers

C — Student correct answers, set of \mathbb{N} numbers

D — Question Max Possible Score

$$D = \begin{cases} 2, & \text{if question options} > 4 \\ 1, & \text{otherwise} \end{cases} \quad (4.6.1)$$

$$[Score] = \frac{|A|}{|B|} * D \quad (4.6.2)$$

This equations above are mathematical representations of function in our project in Figure 4.6.13. In function *getscore(correct_answers,given_answers,question)* we get subset of ID's of correct answer options to the *question* as *correct_answers*. *question* - instance of Question model's object. *given_answers* - subset of ID's of answer options to the question which were received from the student as an answer to the question. In the equation 4.6.1 we determine the maximum score for the question. In the equation 4.6.2 we calculate what score to give for the student's answer to the question.

```

all_answer_options = {1,2,3,4,5,6}
correct_answers = {1,2,3} ⊆ all_answer_options # subset of all_answer_options
given_answers = {1,2} ⊆ all_answer_options # subset of all_answer_options

if length(all_answer_options) > 4: # this is True
    max_possible_score = 2 # then max_possible_score will be 2
else: # else will be ignored
    max_possible_score = 1

answered_correctly = correct_answers ∩ given_answers
# intersections of two sets are {1,2}, because in both set we have this elements

score = int(length(answered_correctly)/length(correct_answers) * max_possible_score)
# it will be 2/3*2 rounded floor => 1 point out of 2.

```

Figure 4.6.14 Pseudocode explanation of question score calculation function

4.7 User Test

An anonymous survey was conducted with a link to the website and sent to the general group of students of grades 10-11 "JOO High School Almaty". Of the 29 students who participated in the survey, 12 students from the 10th grade, 17 students from the 11th grade, which shows a great interest in future applicants this year. When registering through the website, the participants did not have any problems, when registering through the Google form, it was noted that users could not register on the website through google account. This error has been fixed immediately. The students rated the design on average by 4.6 points, the convenience of the interface by 4.8 points out of 5.

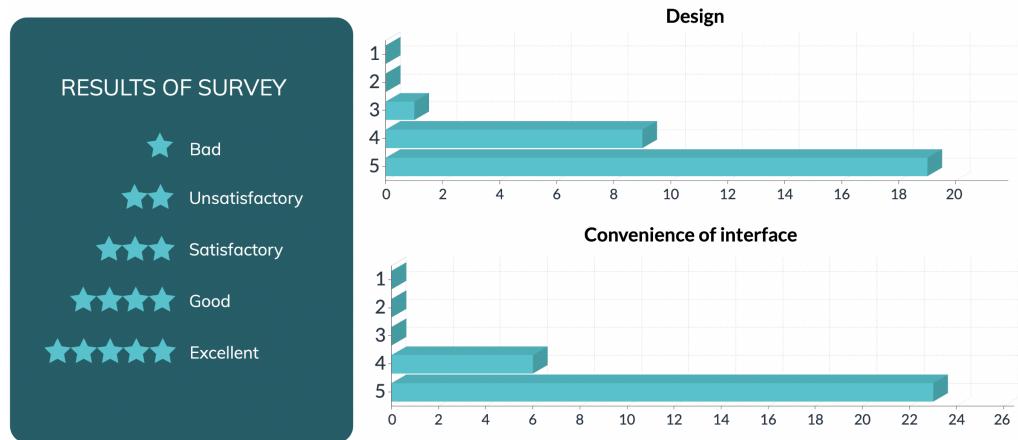


Figure 4.7.15 Survey results

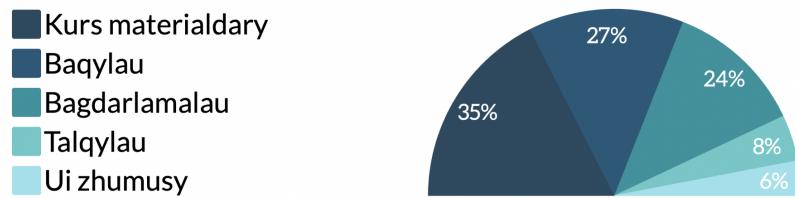


Figure 4.7.16 Beneficial Pages

To the question "Which pages of the website have the greatest impact on attracting users to familiarize themselves with the preparatory materials?" the majority answered "Kurs materialdary". Students highlighted the pages "Baqylau" and "Bagdarlamalau" where they can perform test tasks, work on mistakes and do practical coding tasks. The pages "Talqylau" and "Ui zhumusy" received fewer responses.

Regarding the amount of materials and availability on the website, it received ratings of 3,4 points. After the launch of the site, a small part of the educational materials for testing the site was added. After updating the server, we added all the materials from the stakeholder. The platform gives the administrator and the teacher access to add the necessary files themselves, thereby not creating a shortage of educational materials.

To the question "What specific problems of students related to the preparation for the UNT in informatics did a website help to solve?" the answers below were received:

- lack of educational materials
- lack of a database of test for preparation
- location of educational materials in different places (social media groups, channels)
- lack of practice and practice tasks

As a result of the survey, it can be concluded that the platform which was created is quite convenient to prepare for the UNT in informatics, because it provides a decision for some common challenges which students face during their preparation for the UNT.

Conclusion

The modern world provides a wide choice of training formats and methodologies. One of them is the online format of education, the use of which is increasing from year to year. The online format differs with the convenience of distance learning and a convenient schedule. However, there is a possibility of problems with personal interaction and loss of motivation to study. Unlike online education, basic traditional education provides a connection between the instructor and the student, but it lacks a modern educational multimedia for the fascination of the lesson. Blended learning combines the advantages of both formats, but there is a possibility of illiterate drawing up of the curriculum without analyzing the nuances. However, according to the current experiences of educational institutions for the educational system of Kazakhstan, blended learning using educational platforms has a positive effect. But there is an acute shortage of local products in the country that support blended and distance learning, especially at the school market. Positive results from the currently developed online platform "JOO informatics", which will allow students to meet unique needs by providing access to educational materials and practical tasks are expected. The educational platform in the form of a website also provides a personal learning experience that helps students identify their strengths and weaknesses and improve them. In general, the platform for online preparation for the UNT in informatics is a valuable resource for students with the desire to succeed in exams.

For future work, the team plans to create a startup with the development of similar platforms to eliminate the shortage in the market and strengthen the IT sector of Kazakhstan

Appendix

A.1 Survey of students of universities of Kazakhstan

Nº	University	What educational platform do you use at your university?	How often do you visit this platform?(Choose from 1 to 5)	Does the learning platform work without technical failures?	Is it convenient for you to take assignments and tests on a learning platform?	Does the platform provide enough materials and information to study subjects?	Evaluate the effectiveness of educational platform(from 1 to 5)
1	Al-Farabi Kazakh National University	Univer	5	Yes	Yes	Yes	5
2	Kazakh National Women's Pedagogical	Univer	5	Yes	Yes	Yes	4
3	Kokshetau State University by Sh.Ualikhanov	Platonus Google Classroom	4	Yes	Yes	Yes	5
4	Almaty Technological University	Hero Study	5	Yes	Yes	Yes	4
5	Arkalyk Pedagogical University	Platonus	4	Yes	Yes	Yes	5
6	Suleyman Demirel University	Moodle	5	the website often does not work due to updates	Yes	Yes	4
7	Kazakh Head Architectural and Construction Academy	Moodle	5	Yes	Yes	Yes	5
8	International University of Information Technology	Platonus	2	No	Yes	Yes	4
9	Kazakh National Medical University	Sirius	5	Yes	Yes	Yes	4
10	Astana International University	Platonus	3	Yes	Yes	No	3

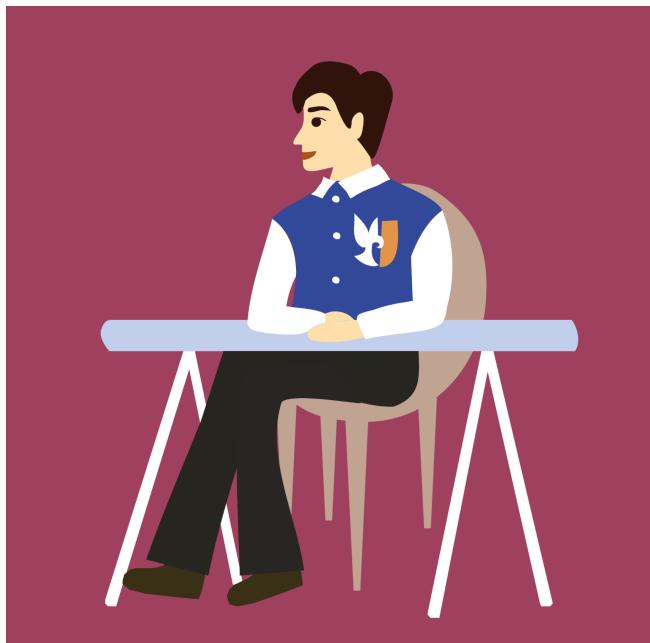
Table A.1.1 Survey among students of Kazakhstani universities

Appendix

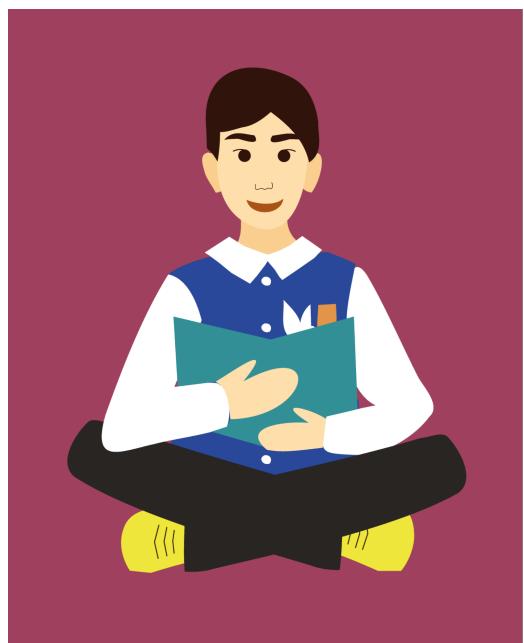
B.1 Illustrations



Figure B.1.1 Coding Competition Illustration



(a) Uniform Illustration



(b) Uniform Illustration

Figure B.1.2 Student Uniform

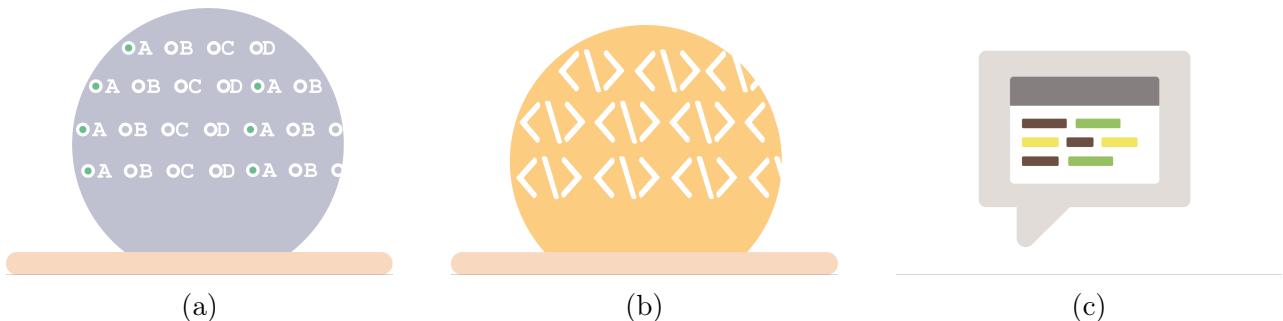


Figure B.1.3 Variations of Illustrations

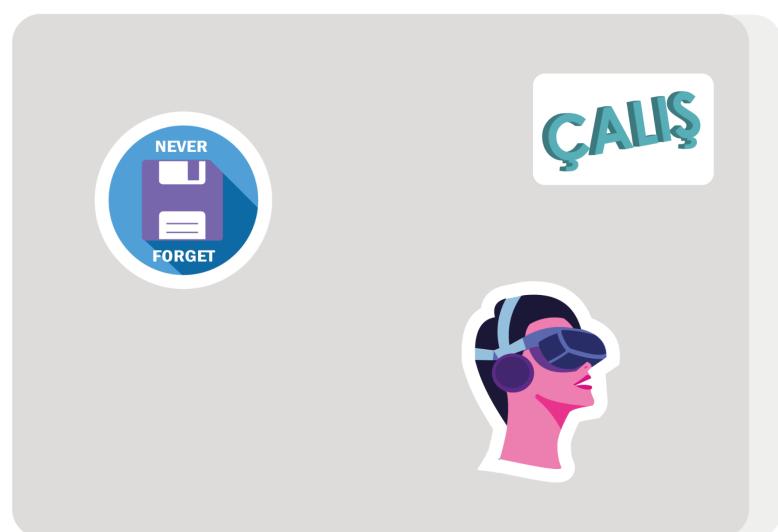


Figure B.1.4 Laptop with stickers

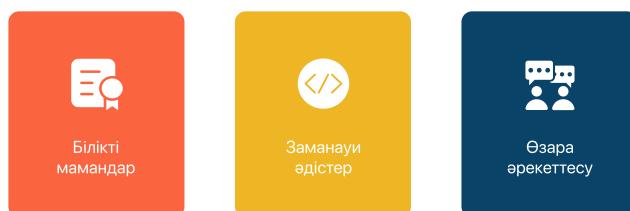


ӨЗ БОЛАШАҒЫНЫҢ АВТОРЫ БОЛ!

JOO HIGH SCHOOL
ҰБТ-ға дайындық платформасы



МЕКТЕБІМІЗДІҢ ЕҢ НЕГІЗГІ АРТЫҚШЫЛЫҚТАРЫ



КОНСУЛЬТАЦИЯҒА ТІРКЕЛУ

Аты _____
Тері _____
Сыныбы _____ Байланыс телефоны _____
Электрондик пошта _____
Email _____

Растау

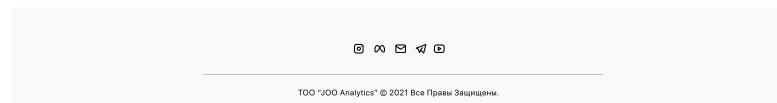


Figure B.1.5 Home Page

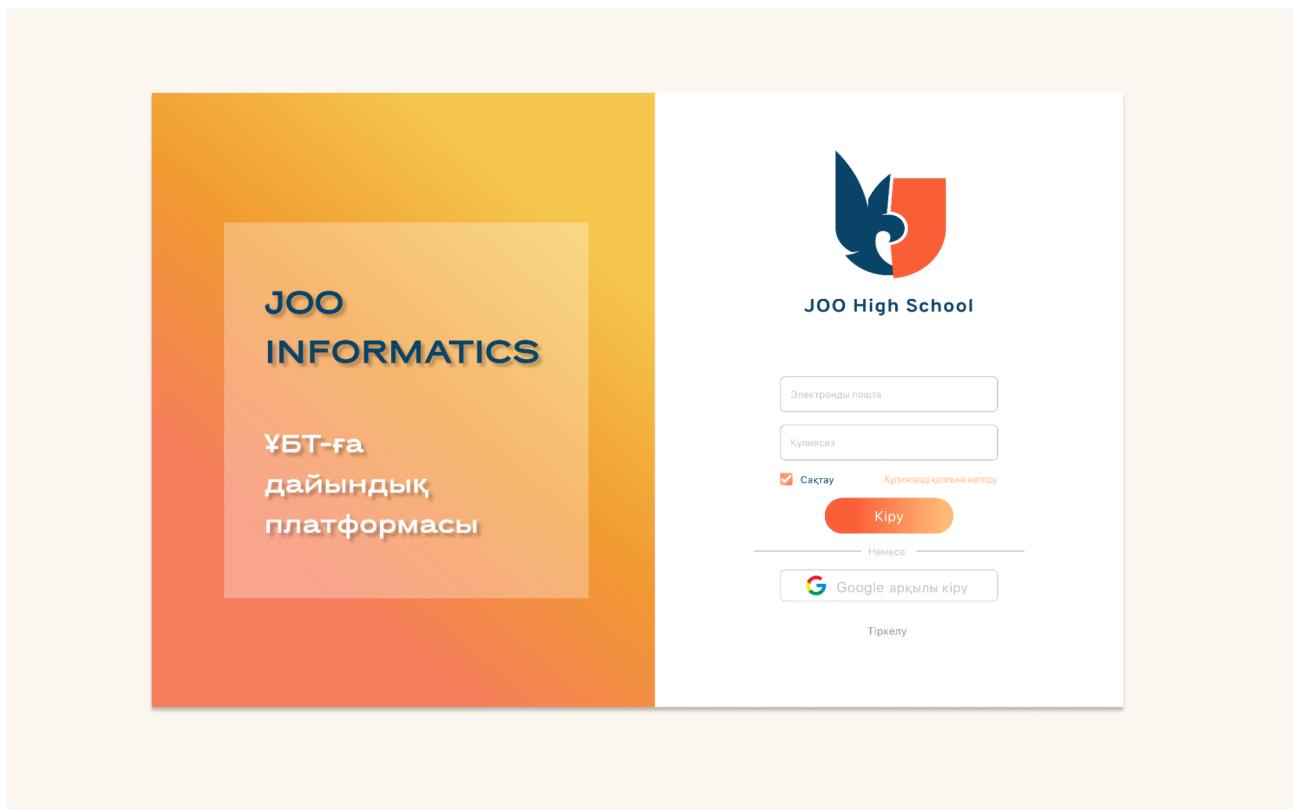


Figure B.1.6 Login Page

	Денгей	Орындау
1. Цилиндр ауданын табу	Оңай	Орындау
2. Цилиндр ауданын табу	Оңай	Орындау
3. Цилиндр ауданын табу	Оңай	Орындау
4. Цилиндр ауданын табу	Оңай	Орындау

On the right, there is a calendar titled 'Күнтізбе' showing events for the month of April. Below the calendar, there are sections for 'Тапсырма' (Tasks) and 'ЕРТЕН' (Events), each listing tasks and events with their respective times.

Figure B.1.7 Programming Page

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