Virtual Educational Mathematics Park as a Platform for Educational and Research Activities at the University

M M Kovtoniuk[1], O M Soia[1], O P Kosovets[1] and L A Tiutiun[1]

[1] Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University, 32 Ostrozki Str., Vinnytsia, 21000, Ukraine

E-mail: kovtonyukmm@vspu.edu.ua, soia.om@vspu.edu.ua, kosovets.op@vspu.edu.ua, tiutiun.la@vspu.edu.ua

Abstract. The article is devoted to the problems of creation and functioning of an educational mathematical park as an innovative platform for student research within the university environment. Mathematical parks are considered as unique spaces that combine scientific knowledge with aesthetic aspects, transforming mathematical concepts into interactive exhibits and art objects.

The analysis of research papers and resources containing materials about modern science parks allowed the study to prove that the virtual educational mathematics park is a platform for the teaching and research activities of university teachers and students. The review of thematic publications is the basis for defining the conceptual and categorical apparatus and analysis, systematizing and summarizing existing experience, substantiating the theoretical foundations of the study, developing and implementing the author's ideas.

The article summarizes the definition of math parks and classifies them. The authors have identified two main types: landscape (real) and virtual educational math parks. Among virtual parks, the authors focus on two subcategories: 3D modeling and 3D printing, and virtual math laboratories.

The potential of innovative approaches (landscape mathematical parks and virtual laboratories) to popularize mathematics among young people through the use of interactive teaching methods and applied research at the intersection of mathematics and computer science is studied. The types and didactic possibilities of virtual mathematical educational laboratories are described.

The authors presented in the article two of their own projects, "Platonic Solids Mathematical Park" and "3D Modeling and its Use for Limb Prosthetics", which took part in the competition "Budget of Public Initiatives of Vinnytsia City United Territorial Community" (Vinnytsia, Ukraine), one of which won the competition and was implemented.

The article investigates the specifics of using virtual mathematical laboratories in the process of training bachelors of mathematics. The author's mathematical sites created and implemented as virtual laboratories are one of the platforms for teaching and research activities at the university, meet the main criteria for the successful functioning of virtual educational mathematical parks: strategic focus, complexity, intensity, structuredness, connectivity and mobility.

The authors' idea allows us to harmoniously combine the past and the present: to visualize the outstanding achievements of mathematics by means of modern achievements in the use of digital technologies in education.

1. Introduction

The role of mathematics in the life of every person is undoubtedly enormous. It has always been of undeniable cultural and practical importance, and its role in the technical and economic development of society is hard to overestimate. Today, everyone should realize that mathematics is an effective tool for modeling and studying the processes and phenomena of the surrounding reality, a basic component of general and vocational education of a modern person, an effective means of developing thinking, spatial imagination, scientific outlook of a person, and an integral part of human culture. High-quality mathematics education is a prerequisite for successful mastery of a number of specialties important for the economy and society.

The results of the national multi-subject test in Ukraine and the Program for International Student Assessment (PISA) show that there are problems in mathematics education in many developed countries [1]. Various external factors add to the urgency of this problem: global epidemics, armed conflicts, environmental and economic problems. Therefore, scientists and teachers in the educational systems of states are learning to respond quickly to changes in the external environment, in particular, the organization of the educational process in remote and blended formats using digital technologies and virtual interactive opportunities to present a variety of educational content.

A number of developed countries pay considerable attention to the popularization of mathematics, including the creation of so-called science parks. Among the science parks, we would like to highlight math parks as amazing places to walk, where science is intertwined with art and nature. They invite us to a kind of museum to look at familiar things from a new angle and discover a fascinating world where the exhibits are mathematical formulas, theorems, and objects. It is also an interactive space where visitors can explore mathematical concepts through art, games, and installations.

Among the most famous and visited parks are the Ontario Science Center in Toronto [2], the National Museum of Mathematics (MoMath) in New York [3], the Participatory Museum Do Not Touch Forbidden in Buenos Aires [4], the Chicago children's museum on Lake Michigan [5], A Museum for Mathematics in Priverno [6], the Archimedes Garden: Museum of Mathematics in Florence [7], Mathematical center Mathematikum in Giessen [8], The first state "Science Museum" of the Small Academy of Sciences of Ukraine in Kyiv [9], a mathematical park created in honor of the famous mathematician Srinivas Ramanujan in India [10].

Modern technologies open up new opportunities for teaching and popularizing science. A striking example of this accessibility is virtual tours of math parks. Students from different parts of the world can visit the most famous math parks at the same time without spending money on travel and accommodation. In addition, virtual tours can be conducted at any convenient time, which ensures individualization of the educational process.

Visitors to virtual tours are immersed in the world of mathematics from the comfort of their own homes. Thanks to interactive elements such as 3D models, panoramic images, and videos, students can visualize complex math concepts and see how they translate into real-world objects. This contributes to a deeper understanding of the material and increases motivation to learn math. Interactive elements of virtual tours make learning more interesting and effective. Students can explore the exhibits, answer questions, and complete tasks on their own, which helps develop their critical thinking, creativity, and independent work skills.

Virtual tours of math parks are also a powerful tool for popularizing science. They demonstrate that mathematics is not only a set of abstract formulas, but also a beautiful art that surrounds us in everyday life. This helps to overcome stereotypes about math as a difficult and boring science.

Part of the virtual parks are virtual laboratories that diversify the educational toolkit with numerous illustrative and creative presentation opportunities. Spectacular interactive elements and embedded applications help develop research skills, facilitate the preparation and

implementation of student projects, help students learn the material easier and better, and arouse their interest in science. Virtual laboratories are also an indispensable tool for STEAM education [11], [12], allowing students to create their own mathematical models.

Virtual laboratories are emerging as a tool to support distance education and are a resource for teaching and learning that ensures the achievement of learning outcomes, allows for the confirmation of knowledge gained by students, and assists the instructor in teaching the course (Galvez et al., 2022 [13]).

The article by Tsviakh et al. 2024 [14] explores the use of virtual laboratories at the university to increase students' interest and professional competence. The author discusses the didactic potential of virtual laboratories, their types and advantages in the educational context. The study emphasizes the innovative nature of virtual laboratory work and its contribution to skills development and research. The results demonstrate that virtual laboratories are effective in increasing motivation, building professional skills, and promoting student engagement in research. The study concludes that the integration of virtual laboratories into higher education curricula is crucial for training future professionals in an increasingly digital world.

Virtual laboratories can be offered as an alternative solution when access to a physical laboratory may be limited. Therefore, virtual laboratories can be used either as primary resources or as support systems for students' laboratory activities. To identify the goals, technologies, and benefits of virtual laboratories, (Triejunita et al., 2021 [15]) conducted a systematic literature review of articles on virtual laboratories from 2016 to 2021. This article summarizes six purposes, five types of technologies, and seven benefits of virtual laboratories. Based on the results of the study, the use of virtual laboratories has increased student motivation and engagement in learning, and improved student learning outcomes.

The experience of combining software tools to create a virtual laboratory as an alternative to a real one is presented in (Zayas-Gato et al., 2022 [16]). The proposed modern simulation environment provides students with an online working tool suitable for applying engineering control concepts using a new approach in the Blended Learning methodology. This combination of personal experience and online technologies is an effective approach in the modern educational context.

Kapilan et al. 2021 [17] discussed the basics of virtual laboratories, their different types and impact on student learning, opportunities and limitations of virtual laboratories.

Hassan et al., 2022 [18] examined the use of virtual laboratories (VLabs) and their usefulness in the higher education sector through the lens of learning theories to understand their features and benefits using different VLab approaches, hardware and software settings.

Yusuf et al., 2020 [19] investigated the implementation of an e-learning-based media virtual laboratory for students' metacognitive skills.

The aim of the study Aboraya, 2021 [20] was to assess the learning of abstract mathematical concepts by fifth grade students in a blended learning environment supplemented by a virtual web laboratory. The results showed a clear positive impact on improving students' achievement in abstract mathematical concepts in favor of the experimental group. Students were found to be very favorable to using the simulation website.

The results of the study by Lestari and Supahar, 2020 [21] show that most students need to develop virtual laboratory media to support the media for scientific and practical activities. This condition was confirmed by the interview, teachers suggest that with the help of a virtual laboratory that has materials, videos, images, and simulations, students not only understand the theory, but can also perform practical activities virtually. The teacher argues that it is necessary to develop a virtual laboratory to overcome the limitations of the science workshop in schools because students and teachers need a virtual laboratory to learn science.

The purpose of the article is to search for and study the possibilities and conditions for the creation, development and functioning of landscape mathematical parks and virtual

educational laboratories to popularize, motivate the study and practical application of knowledge in mathematics education through the implementation of applied research in mathematics and computer science through innovative resources.

A thorough analysis of research papers and resources containing materials about modern science parks allowed the study to prove that the virtual educational mathematics park is a platform for educational and research activities at the university. Consideration of publications devoted to the issue under study in periodicals of philosophical, psychological, pedagogical and methodological orientation is the basis for defining the conceptual and categorical apparatus and analysis, systematization and generalization of existing experience, substantiation of the theoretical foundations of the study, development and implementation of the author's ideas.

2. Research results

In the educational space of bachelor's and master's degree in mathematics, let's pay attention to the formation and creation of the so-called mathematical park. The Great Explanatory Dictionary of the Modern Language interprets the word "park" as "a large garden for special purposes, usually open to visitors" [22]. The team of authors understands the term "mathematical park" to mean a natural or virtual area with a prepared infrastructure that demonstrates the connection between mathematics and nature and society. The main purpose of creating a mathematical park is to show that mathematics is the basis of the laws of nature and society, to evoke not only positive emotions of visitors, delight, surprise and enjoyment of mathematical objects, but also the desire to study mathematics.

We will divide the math park into two interconnected parts: a landscape math park and a virtual educational math park (figure 1).

We understand that the implementation of large-scale landscape projects requires significant investments. Studies show that relatively few such parks have been created on the planet.

The main task of landscape museums is to popularize science. Not just to say that science is important, but to show that it is fun, interesting, and there are many opportunities for self-realization in education and science. This completely changes the attitude towards science centers and creates a culture in which science is truly of great value.

Museums of mathematics explain complex phenomena using simple objects as examples, showing how discoveries, formulas, and fundamental research are related to everyday life. You can interact with each exhibit. Museums organize traveling exhibitions, educational newsletters, and educational classes.

The authors of the article propose to create a mathematical landscape park or part of it in a city or university. In 2020, we developed the so-called Big Project "Platonic Solids Mathematical Park" and took part in the competition "Budget of Public Initiatives of Vinnytsia City United Territorial Community" (Vinnytsia, Ukraine) [23]. This project is a unique mathematical art object with green spaces and universal color lighting. It harmoniously combines an architectural complex of five regular polyhedra, saturated with various creative elements of public space. These polyhedra have special QR codes and information support, which will allow residents and visitors to visualize information about this object in several languages using digital technologies (figure 5).

According to the authors of the article, the implementation of such a project will be an important component in ensuring the integrated development of any territorial community and will help create a city where young people, professionals, scientists, business, and tourists want to stay.

The creation of a landscape mathematics park in the city where a modern educational center is located has many advantages: increasing the attractiveness of the city for educational tourism; meeting the needs of young people for open cultural and educational spaces; popularizing mathematics among residents and visitors; creating a creative and creative environment in

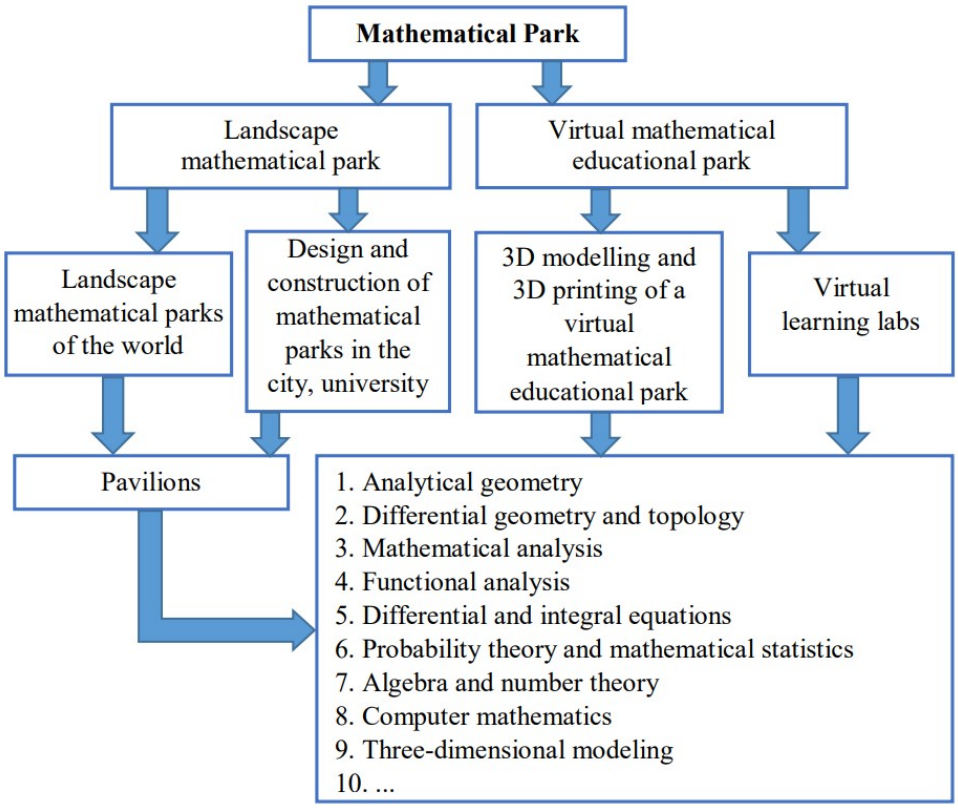


Figure 1. Structural model of designing and modeling mathematical parks (author's development).

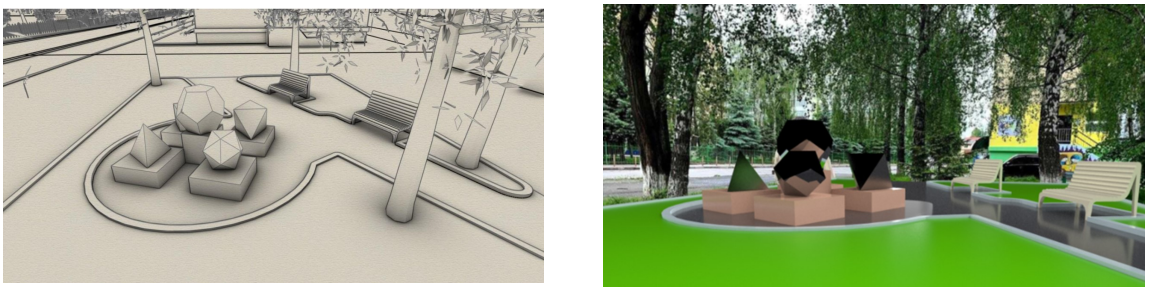


Figure 2. 3D model of the Platonic Solids Mathematical Park (author's development).

the city; visualization of small architectural forms of public space using digital technologies; increasing the attractiveness of the city for carriers of new ideas, experience and knowledge; a calm cozy corner appears that will serve as a place of rest and aesthetic pleasure for residents.

As a result of the meeting of the competition's expert group, our project received a positive assessment and was allowed to vote. As a result of online voting, the project was supported by 477 people, so it has not yet been implemented. Given the quarantine restrictions, in 2020, Vinnytsia residents could support projects exclusively electronically using the Public Budget e-service.

Another area of popularization of math parks is the creation of virtual math educational parks using 3D modeling and 3D printing and virtual learning laboratories with a large number of pavilions (figure 3).

3D modeling and 3D printing of the virtual mathematical educational park implements the visual and interactive component of student learning at the university. Virtual three-dimensional mathematical models can be rotated, moved, and scaled in digital 3D space. In the process of working with the model, students learn the basic ways to create and work with three-dimensional models. In three-dimensional modeling programs, you can design objects based on primitives, polygons, NURBS curves, Bezier curves, metasphere, Boolean operations, and Subdivision Surface. It is possible to download the created mathematical 3D model for texture editing, create animation, or print it on a 3D printer (figure 4). Students acquire professional competencies in working with three-dimensional modeling programs to create mathematical models.

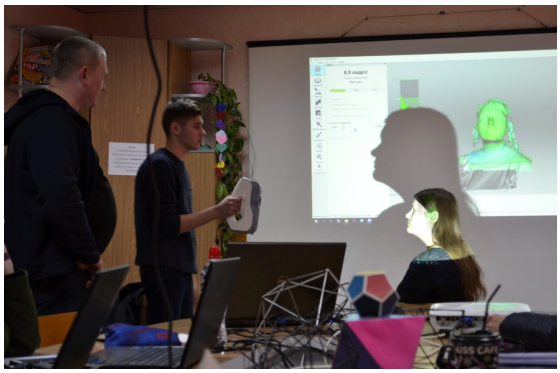


Figure 3. Create a 3D model by 3D scanning.



Figure 4. A 3D printed Klein's bottle.

Another interesting project organized by the authors of the article is "3D Modeling and Its Use for Limb Prosthetics" [24]. This so-called Small Project was submitted to the "Budget of Public Initiatives of the Vinnytsia City Amalgamated Territorial Community" competition in 2020. According to the results of the meeting of the Expert Group of the competition, our project received a positive assessment and was admitted to the citywide vote. As a result of the online voting, the project was supported by people, recognized as the winner, and implemented in 2021. Today, the creation of 3D models is an indispensable process not only in industry but also in many areas of human activity, such as medicine, architecture, construction, design, education, etc. Making 3D models allows you to evaluate the technical and physical features of the modeling object before creating its real sample. The main goal of this project is to design and manufacture prostheses based on 3D modeling, to conduct a series of popular lectures on 3D modeling for residents of the territorial community, which will bring education and research closer to the social needs of community residents and to implement the principles of the UN Convention on the Rights of Persons with Disabilities at the local level (figure 4). An inclusive city policy should promote full and equal participation in the lives of all citizens, take into account the needs (interests) of everyone as much as possible, creating a comfortable city for all residents without singling out a particular category. The developments in 2022-2025 in Ukraine have shown that this type of project is particularly relevant in the context of martial law.

The ideas and principles underlying the Small Project will have a positive impact on the formation of Vinnytsia as a city of social cohesion. The project is in line with the main priorities and objecives of the Vinnytsia 2030 Integrated Development Concept in the vision

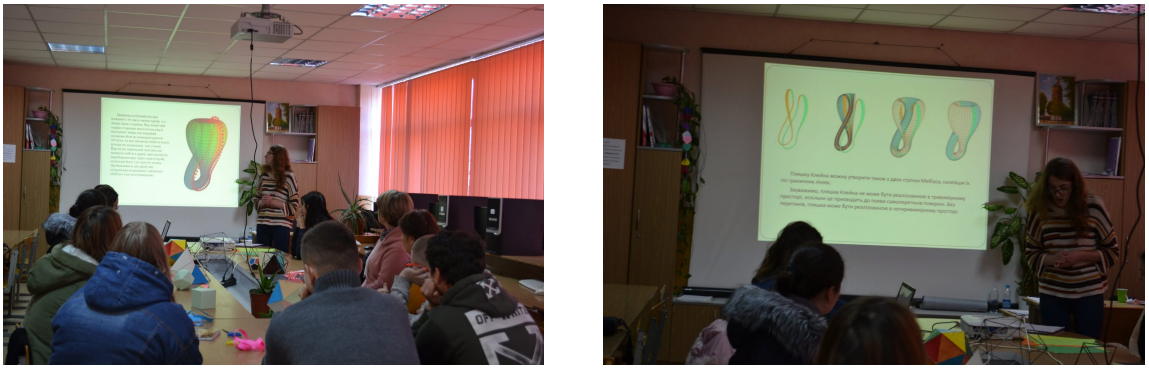


Figure 5. A series of popular lectures on 3D modeling.

"Comfortable, Cultural and Socially Responsible City" [25]. The vision envisages participation in social assistance activities aimed at promoting, protecting and ensuring the full and equal enjoyment of all human rights and fundamental freedoms by people with functional disabilities (people who have lost limbs), creating inclusive spaces and accessibility; expanding the activity and independence of people with disabilities in various spheres of life; introducing modern practices of providing rehabilitation services in the city and disseminating them at the regional and national levels.

An important feature of the Small Project is the involvement of non-governmental organizations and volunteers in solving these problems, training them to provide qualified assistance to people who have lost limbs.

The practical value of the Small Project "3D modeling and its use for limb prosthetics" is to hold a Creative Competition in 3D modeling among residents of the Vinnytsia City United Territorial Community, create conditions for the development of the intellectual potential of community residents, support scientific and creative work, stimulate the interest of community residents in research, and master innovative technologies [26].

The creative competition consisted of two rounds (part-time and full-time) held in November-December 2021. For the correspondence round, the contestants had the opportunity to submit a work (3D model) in accordance with the specified topics and requirements specified in the Contest Regulations. The jury developed criteria for evaluating the entries. A total of 15 works were submitted for the correspondence round, among which the jury selected the best 8 works to participate in the on-site round. The in-person round was held on December 14, 2021, at the NotBox educational hub of Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University. The participants of the Competition demonstrated profound knowledge and practical skills in 3D modeling, which confirmed that the Vinnytsia City Amalgamated Territorial Community has talented young people capable of mastering new technologies, building and implementing models using modern engineering (figure 6).

Another area of implementation of virtual mathematical educational parks (figure 1) is the creation of virtual educational laboratories.

Modern scientists have different interpretations of the concept of "virtual laboratory" (virtual laboratory, VLab, virtual reality laboratory):

- a virtual learning (educational) environment that helps in acquiring new knowledge and skills, allows to model the behavior of real-world objects in a computer environment and serves as a research tool for various natural phenomena with the possibility of building their mathematical models (Semenikhina, 2011 [27]), (Pererva, 2019 [28]), (Shkurenko et al., 2023 [29]). In other words, a virtual laboratory is a special computer system that allows you to reproduce various experiments or studies using software and modeling of

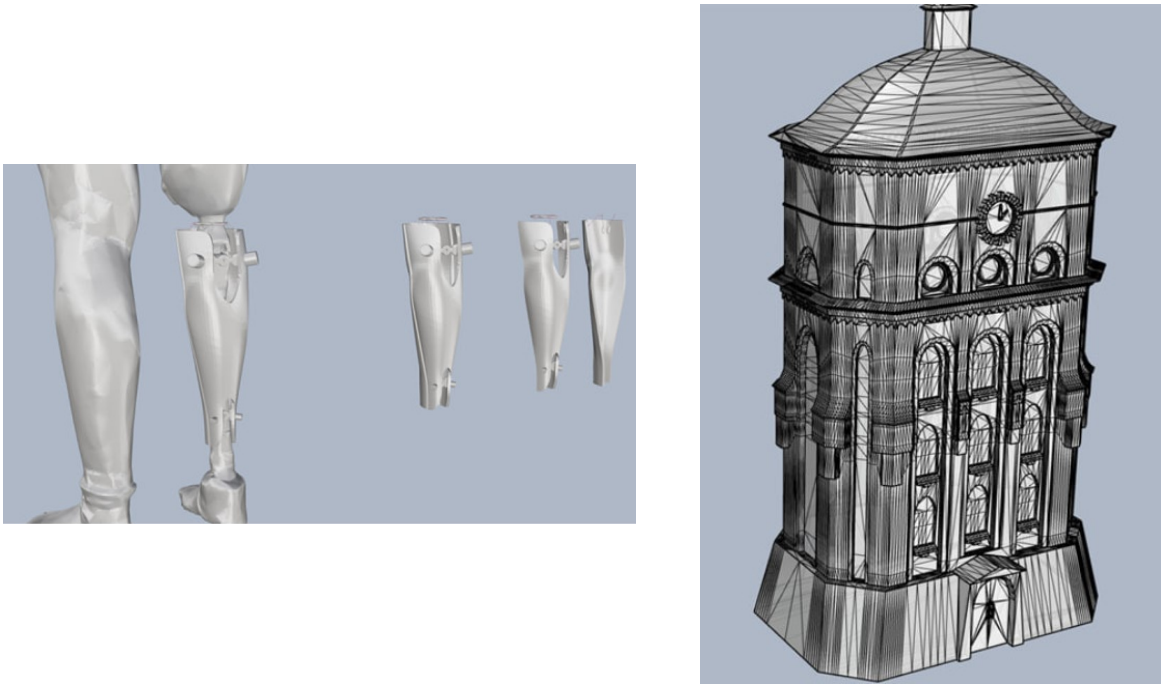


Figure 6. Creative competition in 3D modeling, December 2021.

virtual environments. The advantages of such laboratories cannot be overestimated in the context of blended and distance learning. The main advantage of virtual laboratories is the ability of participants in the educational process to perform various studies without leaving their personal computers. At the same time, this makes it possible to spend time and resources efficiently, which in turn affects the level of knowledge and competence of students (Shkurenko et al., 2023 [29]);

- a technological tool that allows students to contribute to problem-based learning (PBL) and synthesize ideas, develop a learning network and solve any real business problem using theoretical knowledge, establishing connections between ideas embedded in the network [18];
- is an educational technology that "allows modeling the behavior of real-world objects in a virtual computer-based educational environment and helps students to acquire new knowledge and skills" (Buriachok, 2018 [30]), (Palahin, 2017 [31]);
- a type of computer program that facilitates modeling on computer processes (Shuliak et al., 2022 [32]);
- a computer platform or program that enables students, interested parties, and scientists to perform experiments in the biological sciences and to virtually model, observe, and study phenomena that occur in real laboratories (Hnatiuk et al., 2023 [33]);
- a software virtual environment in which the possibility of studying the behavior of object models and their derivative sets, specified by real objects with a certain level of detail, within a certain field of knowledge is organized (Kuchai et al., 2022) [34]).

Thus, we define a virtual learning mathematics laboratory as a virtual educational environment of a university where a student, under the guidance of a teacher, learns to model real or imaginary objects, analyze them, synthesize new ideas using computer mathematics systems and other technological tools. Didactic capabilities of virtual mathematical educational laboratories:

- the use of dynamic and interactive learning environments through the integration of audiovisual elements, hypertext, animation form the professional competencies of a bachelor of mathematics;
- individualization of the educational process, the student can work at a pace that satisfies him or her and focus on those points that are most important for him or her in professional growth;
- computer modeling skills, application of computer mathematics systems;
- development of student's creative thinking and research competencies, ability to make prompt and independent decisions;
- obtaining quality education;
- the use of digital educational technologies in the virtual learning environment contributes to the democratization of access to quality mathematics education, allowing students to acquire the necessary knowledge and skills, regardless of geographical location.

We classify the types of virtual mathematical educational laboratories using the results of research (Hnatiuk et al., 2023 [33]):

1. Virtual laboratories in which students carry out research projects, build surfaces, and interact with three-dimensional stereometric shapes, in particular on the resource mozaweb.com [35], Platonic solids that can be rotated, scaled, and viewed at https://polypad.amplify.com/psolids [36].
2. Virtual laboratories that allow conducting numerical experiments using computer mathematics systems with programming elements, software for processing 3D graphics.
3. Virtual laboratories based on digital measurement technologies, 3D scanning, 3D modeling and 3D printing.
4. Virtual laboratories with augmented or virtual reality.

The authors of the article consider it expedient to create virtual learning laboratories in universities for analytical and differential geometry and topology, mathematical and functional analysis, differential and integral equations, probability theory and mathematical statistics, algebra and number theory, computer mathematics, three-dimensional modeling, etc. in the training of bachelors of mathematics (figure 1). After all, there are great opportunities for students' educational and research activities, in particular, modeling solids in space, calculating surface areas, volumes, solid mass, center of mass, and other physical quantities. During the course of study, students can create their own bank of lines and surfaces (figure 7).

For example, here is a problem of calculating the volume of a solid.

Task. Calculate the volume of the solid bounded by the surfaces $y = 1 + x^2 + z^2$ and $y = 5$.

The solid is bounded by a paraboloid of rotation about the axis O_y and a plane $y = 5$, perpendicular to the axis O_x (figure 8). Its projection on the plane O_{xz} is a circle bounded by the circle $x^2 + z^2 = 4$.

Let's determine the volume of our paraboloid

$$V = \iint\limits_D (5 - 1 - x^2 - z^2)dxdz = \begin{vmatrix} x = \rho cos\varphi \\ y = \rho sin\varphi \\ J = \rho \end{vmatrix} = \iint\limits_D (4 - \rho^2)\rho d\rho d\varphi$$

$$= \int\limits_0^{2\pi} d\varphi \int\limits_0^2 (4\rho - \rho^3)d\rho = 2\pi(2\rho^2 - \frac{\rho^4}{4})\Big|_0^2 = 8\pi \approx 25,132 \ (cubic\ units).$$

Let's determine the volume of our paraboloid

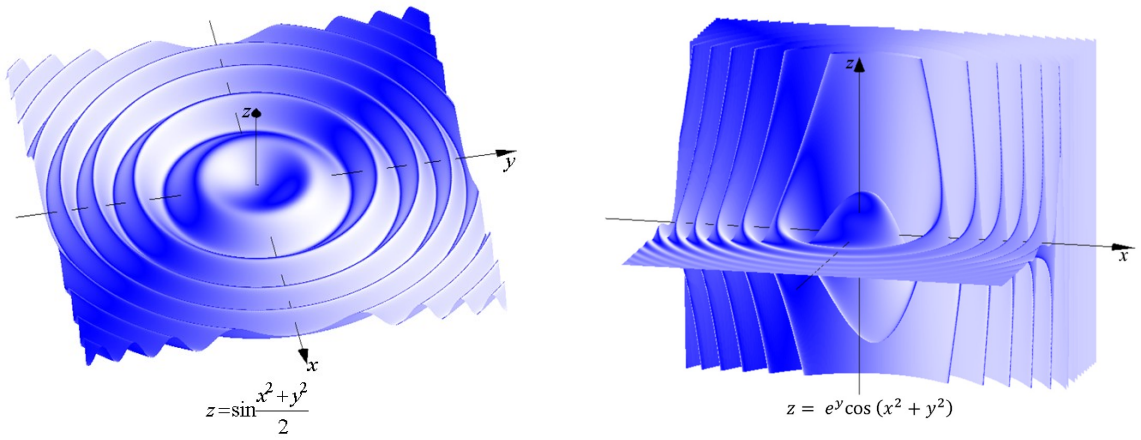


Figure 7. A bank of surfaces created in a virtual laboratory when studying the function of many variables (author's drawings).

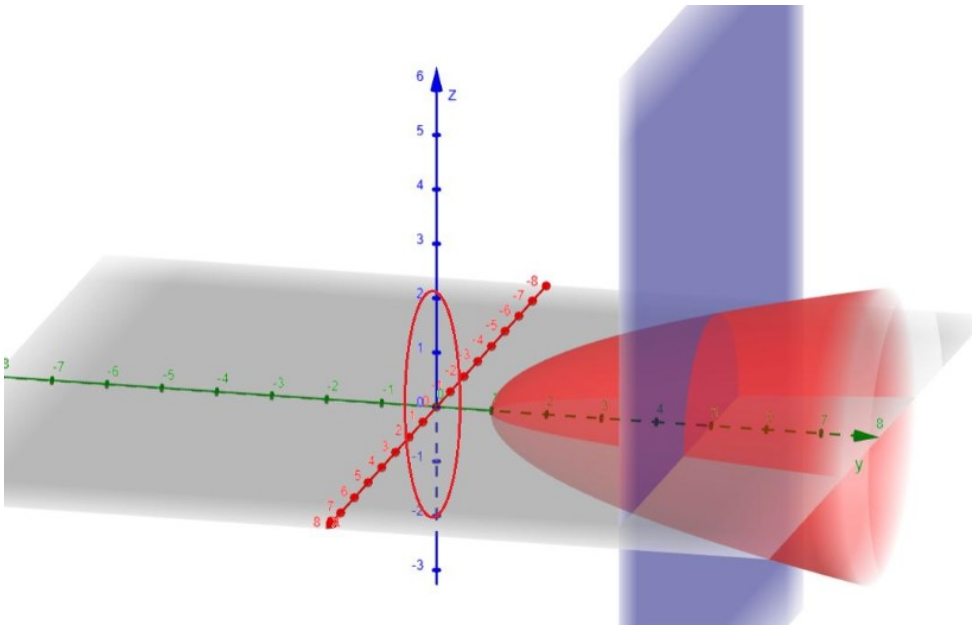


Figure 8. Structural model of designing and modeling mathematical parks (author's development).

In differential equations, students are offered the project "Approximate methods for solving the Cauchy problem". One of the tasks of the project is to construct a field of directions and isoclines of a differential equation. Here are several ways to accomplish this task using computer mathematics systems (figure 9, figure 10).

After completing such projects, students learned how to: apply approximate methods for finding a solution to a first-order differential equation, analyze and compare them, determine the error of calculations, draw isoclines and the field of directions using different software.

We also practice holding a scientific and methodological seminar "Interesting Geometry" as part of the study of the geometric disciplines "Analytical Geometry", "Constructive Geometry", "Fundamentals of Geometry", "Non-Euclidean Geometry" and "Additional Sections of Geometry". During the meetings, higher education applicants presented and defended their

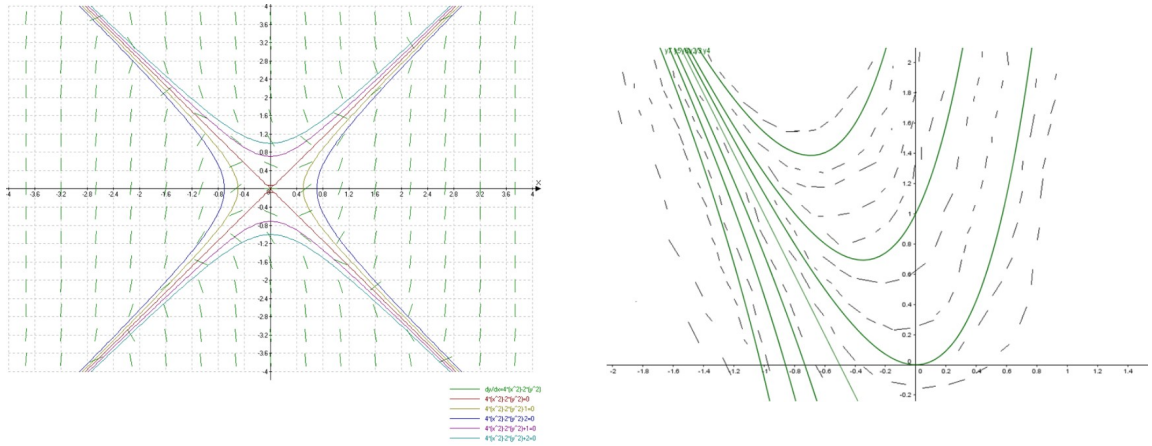


Figure 9. Isoclines and the field of directions of differential equations (student projects).

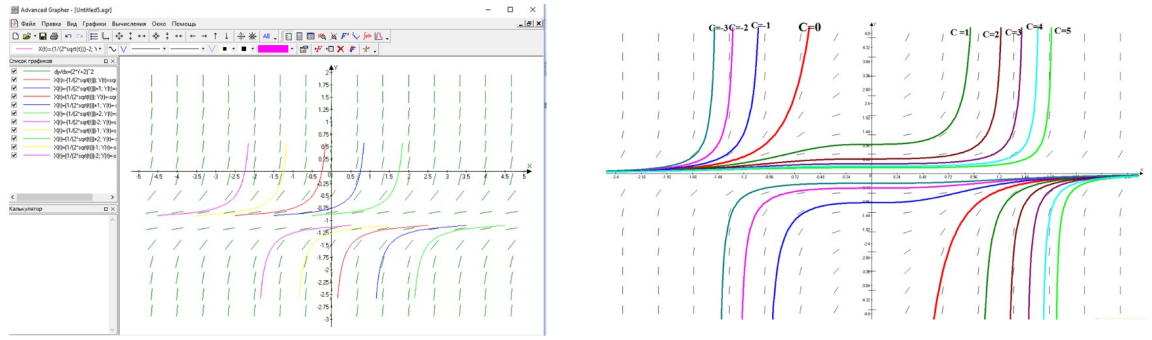


Figure 10. Isoclines and the field of directions of differential equations (student projects).

individual projects on various topics: “Regular polyhedra”, “Klein’s bottle”, “The Möbius strip” (figure 4, figure 11), “Album of second-order lines given in the polar coordinate system”, ”Problems on combinations of spatial solids with a sphere”, “Problems on the construction of spatial solids and their sections” etc. Having visualized the results of research on their chosen topics through interactive presentations and videos, graphs and diagrams, their own stereometric models of regular polyhedra, etc.

At the same time, they demonstrated a high level of mathematical training, analytical thinking and creative approach to the disclosure of topics, ingenuity and resourcefulness. Of particular interest and enthusiasm were the integrated projects that combine geometry with other mathematical disciplines, as well as with various fields of activity, such as architecture, art, engineering, etc.

The purpose of these projects is not only to test the theoretical knowledge of students, but also to develop practical skills in solving various problems and applying them in real-life situations, to popularize mathematical knowledge, and to reveal the main mathematical features of mathematical disciplines.

Such events increase interest in studying mathematical disciplines; expand opportunities for the development of mathematical competence of students; activate their cognitive activity; create a platform for active exchange of ideas; improve the general culture of students and develop their ability to communicate with others; promote the development of public speaking skills, teamwork and the formation of scientific thinking, the ability to use digital technologies (figure 11).

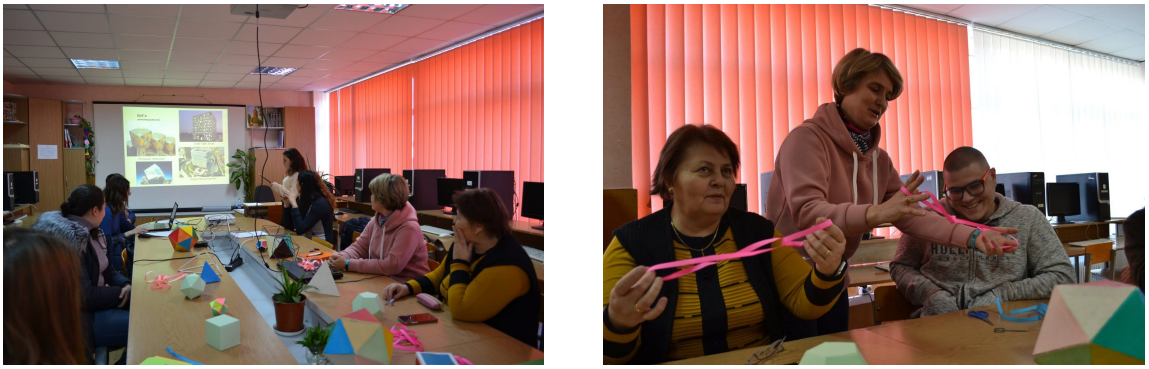


Figure 11. A scientific and methodological seminar "Interesting Geometry".

The authors of the article propose to create a unique learning space - a mathematical park, where real models of geometric bodies are supplemented by virtual interactive elements. At the first stage, this project involves students creating 3D models under the guidance of teachers. At the second stage, the best three-dimensional models will be printed on a 3D printer and placed on the university campus. Each exhibit will be accompanied by a QR code that will redirect the visitor to a webpage with detailed information about the corresponding geometric solid. As part of the project, students will take part in the creation of an innovative educational mathematical park of miniatures of spatial solids.

As one of the ways to organize virtual educational mathematical laboratories, we see the use of a teacher's personal website in the educational process. The teacher's website www.kovtonyuk.inf.ua [37], created by Professor Mariana Kovtoniuk 12 years ago, has a standard list of materials for this type of structure: news; an electronic manual (for independent study of theoretical and practical material, created on a hypertext basis, which allows students to work on an individual educational trajectory); a file section (here, users of the site can access additional educational materials); exhibitions (an opportunity to showcase the best student educational or research projects); information about the curators of the project as a whole and individual sections; a gallery of photos from conferences, competitions, Olympiads, defense of qualification works, etc. [38].

3. Conclusions

The article discusses the problems of developing and implementing an educational mathematical park, which is a component of a mathematical park, as a platform for teaching and research activities of teachers and students at a university. Mathematical parks are amazing places to walk where science is intertwined with art and nature. They invite us to a kind of museum to look at familiar things from a new angle and discover a fascinating world where the exhibits are mathematical formulas, theorems, and objects. It is also an interactive space where visitors can explore mathematical concepts through art, games, and installations.

The authors define mathematical parks, classify them into landscape and virtual educational mathematical parks, and highlight 3D modeling and 3D printing and virtual mathematical laboratories among the latter.

The possibilities and conditions for the creation, development and functioning of landscape mathematical parks and virtual educational laboratories for the popularization, motivation of study and practical application of knowledge in mathematics education through the implementation of applied research in the field of mathematics and computer science through innovative resources are investigated. The types and didactic possibilities of virtual mathematical educational laboratories are indicated.

The authors presented in the article two of their own projects, “Platonic Solids Mathematical Park” and “3D Modeling and its Use for Limb Prosthetics”, which took part in the competition ”Budget of Public Initiatives of Vinnytsia City United Territorial Community” (Vinnytsia, Ukraine), one of which won the competition and was implemented.

The features of virtual mathematical laboratories in the training of bachelors of mathematics are considered. It is shown that the functioning of such laboratories ensures the formation of not only the mathematical culture of the future specialist, but also the formation of such basic competencies as the ability and willingness to self-study, application of knowledge, skills and abilities to work with computer mathematics systems with programming elements to improve the efficiency of education, self-education and professional activity. The developed and implemented author's sites in mathematics as virtual laboratories meet the main criteria for their effective functioning: strategic focus, completeness of coverage, intensity, orderliness, connectivity and mobility.

The authors' idea allows us to harmoniously combine the past and the present: to visualize the outstanding achievements of mathematics by means of modern achievements in the use of digital technologies in education.

We see prospects for further research in the creation of a virtual educational mathematical park as a platform for educational and research activities at the university; in the construction of a landscape mathematical park of miniatures printed on a 3D printer and its information support on the territory of the university; studying the impact of student participation in virtual laboratories on the formation of their mathematical, informatics and pedagogical culture.

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