Использование средств 3D-моделирования при реализации программы магистратуры «Физкультурно-оздоровительные образовательные технологии» для повышения качества подготовки студентов

Е. В. СОБОЛЕВА, Т. Н. СУВОРОВА, Т. В. МАШАРОВА, С. С. БЫКОВА

АННОТАЦИЯ

Проблема и цель. Подготовка педагогов в области физической культуры и спорта предполагает получение ими знаний и навыков в области применения физкультурно-оздоровительных образовательных технологий для пропаганды принципов здорового образа жизни, достижения и поддержания физического благополучия. Средства 3D-моделирования позволяют создавать дополнительные условия для оптимизации финансовых ресурсов, сокращения времени на подготовку и переподготовку соответствующих специалистов. *Цель исследования* – выявление возможностей применения средств 3D-моделирования при реализации программы магистратуры «Физкультурно-оздоровительные образовательные технологии» для повышения качества подготовки студентов.

Методы исследования. Методология основывается на анализе потенциала средств 3D-моделирования для реализации инициатив и государственных программ в сфере физической культуры и спорта. В эксперименте задействовано 54 магистранта факультета педагогики и психологии Вятского государственного университета (Российская Федерация). Выполнена обработка результатов работы студентов по 3D-моделированию в среде Tinkercad. Интеграция 3D-технологий в дидактический процесс выполнена в рамках дисциплины «Цифровые инструменты профессиональной деятельности». Разработано авторское тестирование из 30 вопросов. При статистической обработке данных использован критерий χ2 (хи-квадрат) Пирсона.

Результаты. Магистранты экспериментальной группы изучают основные понятия, назначение 3D-технологий, программное обеспечение и сервисы для 3D-моделирования. Логика работы на занятиях по дисциплине, определяющая особенность информационного взаимодействия: регистрация, изучение интерфейса и функциональных возможностей платформы, создание 3D-модели универсального характера, проектирование и 3D-моделирование объекта с учётом специфики подготовки, 3D-печать, защита проекта и оценка его применимости. Выявлены статистически достоверные различия в качественных изменениях, произошедших в педагогической системе ($\chi^2 = 6{,}388$; $p < 0{,}05$).

Заключение. Определены дидактические возможности 3D-средств: развитие творческого мышления, повышение мотивации и познавательного интереса, проведение виртуальных тренировок, анализ техники упражнений. Выделены и трудности: отсутствие комплексных учебных материалов, соответствующих профилю подготовки; недостаточный первичный уровень знаний и навыков в сфере цифровых технологий.

КЛЮЧЕВЫЕ СЛОВА

3D-технология, спортивная и физическая реабилитация, дидактический процесс, информационное взаимодействие, профессиональная деятельность, Tinkercad

Для цитирования: Соболева Е. В., Суворова Т. Н., Машарова Т. В., Быкова С. С. Использование средств 3D-моделирования при реализации программы магистратуры «Физкультурно-оздоровительные образовательные технологии» для повышения качества подготовки студентов // Перспективы науки и образования. 2026. № 3. С. 602–615. https://doi.org/10.32744/pse.2026.3.38

Поступила: 15.12.2025 | Одобрена: 13.03.2026 | Опубликована: 30.06.2026

Using 3D Modeling Tools in the Implementation of the Master's Program "Physical Education and Health Educational Technologies" to Improve the Quality of Student Training

E. V. SOBOLEVA, T. N. SUVOROVA, T. V. MASHAROVA, S. S. BYKOVA

ABSTRACT

Problem and aim. Training of teachers in the field of physical education and sports involves their acquisition of knowledge and skills in the field of application of physical education and health educational technologies for the promotion of principles of healthy lifestyle, achievement, and maintenance of physical well-being. 3D modeling tools create additional conditions for optimization of financial resources, reduction of time for training and retraining of relevant specialists. *The objective of the study* is to identify possibilities of application of 3D modeling tools in the implementation of the master's program "Physical Education and Health Education Technologies" to improve the quality of students' training.

Research methods. The methodology is based on an analysis of the potential of 3D modeling tools for the implementation of initiatives and state programs in the field of physical education and sports. The experiment involved 54 master's students of the Faculty of Pedagogy and Psychology of Vyatka State University (Russian Federation). Processing of the results of students' work on 3D modeling in the Tinkercad environment was performed. Integration of 3D technologies into the didactic process was carried out within the framework of the discipline "Digital tools of professional activity". The author's testing of 30 questions was developed. The statistical data processing was performed using the Pearson's chi-squared test.

Results. The experimental group of master's students studies the basic concepts, the purpose of 3D technologies, software, and services for 3D modeling. The logic of work in the discipline classes, determining the specifics of information interaction: registration, studying the interface and functionality of the platform, creating a universal 3D model, designing and 3D modeling an object taking into account the specifics of training, 3D printing, project protection, and assessment of its applicability. Statistically significant differences in the qualitative changes that occurred in the pedagogical system were revealed ($\chi^2 = 6.388$; $p < 0.05$).

Conclusion. The didactic capabilities of 3D tools are defined: development of creative thinking, increased motivation and cognitive interest, virtual training, and analysis of exercise technique. The following difficulties are also identified: lack of comprehensive educational materials corresponding to the training profile; insufficient primary level of knowledge and skills in the field of digital technologies.

KEYWORDS

3D technology, sports and physical rehabilitation, didactic process, information interaction, professional activity, Tinkercad

For Citation: Soboleva, E. V., Suvorova, T. N., Masharova, T. V., & Bykova, S. S. (2026). Using 3D Modeling Tools in the Implementation of the Master's Program "Physical Education and Health Educational Technologies" to Improve the Quality of Student Training. *Perspektivy nauki i obrazovania = Perspectives of Science and Education*, (3), 602–615. https://doi.org/10.32744/pse.2026.3.38

Received: 15 December 2025 | Approved: 13 March 2026 | Published: 30 June 2026

INTRODUCTION

UNESCO's Global Education Monitoring 2023 report states that learners' interests must always be the central. Digital technologies are tools to support learning based on human interaction. Particular attention is paid to ways to improve the quality of education, both in the area of universal competencies and in the area of digital skills development [1]. Support for quality physical education (QPE) is the main focus of the new UNESCO "Fit for Life" sports programme [2]. It involves training under the guidance of qualified mentors and taking into account the latest achievements of science and technology. QPE activities help students develop physical, social, and emotional skills to form healthy, resilient, and socially responsible citizens. Russia is one of the co-founders of the already mentioned UNESCO project in the field of physical education and sport "Fit for Life". The goal of the initiative is to accelerate recovery from COVID-19 and support the inclusive and unified systemic formation of international policy. Under the auspices of "Fit for Life", sports programs are being implemented in the country aimed at supporting people's recovery from health-related crises.

The UNESCO Department of the Faculty of Global Processes of Moscow State University not only actively joined the project, but also supports the initiatives of the Organization for Bioethics, Ethics of Science and Digital Technologies [3]. That is, the department is developing fundamentally new approaches to studying the world around us, which involve taking into account the achievements of scientific and technological progress, including for preserving human health. The study and practical application of these fundamentally new approaches are planned to be implemented within the framework of training specialists in physical education and sports.

R. Xu notes that technical support for the process of teaching physical education is a defining link between the theory and practice of teaching physical education [4]. New modern technologies directly affect the quality and effectiveness of teaching physical education. For example, E. V. Soboleva et al. raise the issue of the need to change the training programs for master's degree teachers focused on working in the field of physical education and maintaining a healthy lifestyle [5]. The authors consider the potential of mobile technologies for the home, educational institutions, and gyms. E. V. Soboleva et al. describe a sample training plan and offer specific practical assignments for master's students. A. N. Ivleva suggests that 3D models can be actively used to create virtual simulators [6]. These simulators will allow athletes to train in a virtual environment and improve their skills without the risk of injury. Virtual simulators can also be used to test new exercises and training programs. M. Franzò et al. reveal the possibilities of three-dimensional modeling in a virtual environment for visualizing exercise technique [7]. Although the current federal standard stipulates that professionally oriented events using modern interactive educational technologies are held in universities during the implementation of the training program. There is still insufficient research directly related to the inclusion of 3D tools in the training of specialists whose profile of activity is related to the implementation of physical education and health educational technologies. As a result, as noted by S. P. Evseev et al., many university graduates are not ready [8]: to evaluate existing/ develop their electronic educational materials for introducing children to physical education and using developing forms of health work; to model scenarios and design virtual (three-dimensional) reality to reduce the risk of injury and rehabilitation.

Research hypothesis – the inclusion of three-dimensional modeling elements in the training program for specialists whose profile of activity is related to the implementation of physical education and health educational technologies will contribute to improving the quality of their professional training.

Thus, the aim of the work is to study the possibilities of using 3D modeling tools in the implementation of the master's program "Physical Culture and Health Educational Technologies" to improve the quality of student training.

Research objectives:

- to justify the possibility of including the study of 3D technologies in the content of the discipline "Digital Tools of Professional Activity";
- to describe the options for using 3D graphics to achieve and maintain physical well-being, reduce the risk of disease, and rehabilitation;

- to identify factors influencing the effectiveness of using 3D modeling tools to develop physical qualities and support motor activity;
- to experimentally test the effectiveness of the proposed option for improving the content of the master's program.

MATERIALS AND METHODS

Physical culture and health education technology is a method of implementing activities aimed at achieving and maintaining physical well-being and reducing the risk of developing diseases (injuries) through physical culture and health improvement. 3D modeling in the presented study is considered a productive activity for creating 3D models of exercise machines, the trainees themselves, and the training process, sports games, various forms of health-saving work (gymnastics, physical education minutes, etc.). These models can be used to analyze the technique of movement and their changes throughout the training period. They can also be used for comparison with models of other trainees (athletes) for learning and improving the technique of performing an exercise.

The study and application of 3D modeling tools in the implementation of the master's program 44.04.01 – Pedagogical education, training profile "Physical Culture and Health Educational Technologies" is carried out within the framework of the discipline "Digital Tools of Professional Activity". In the first semester of the second year, students study the basic concepts and didactic potential of 3D modeling to achieve and maintain physical well-being, reduce the risk of diseases, and for rehabilitation. Master's students evaluate existing 3D modeling tools: Blender, 3D Paint, Vectary, Tinkercad, and SketchUp. Evaluation criteria: ease of use, functionality, distribution policy and cost, language, and convenience of the interface, saving in various formats, need for special software, support for the implementation of the specifics of the training program. Tinkercad is used to create 3D models – a free online modeling program that runs in a web browser. The set of tools includes only the most essential ones.

The authors have developed a 30-question test (presented in the research program). Its questions are compiled by the current standard for the training area, the fund of assessment tools for the discipline, and are agreed upon and approved as part of the work program. The experiment involved 54 students of the Faculty of Pedagogy and Psychology of Vyatka State University. The average age is 25 years (65% are men, 35% are women). All students are second-year bachelor's students. The quality of training a specialist in the field of implementing physical education and health educational technologies is determined by the availability of knowledge, skills, and abilities necessary for: introducing children to physical education and using developing forms of health work; modeling electronic educational materials (including exercise machines) and using them in professional activities; designing virtual (three-dimensional) reality to reduce the risk of injury and rehabilitation.

Pearson's chi-squared test was used in statistical data processing.

LITERATURE REVIEW

C. Chen and X. Gao determine that modern society, characterized by the globalization of the knowledge economy, puts forward social demands on higher education [9]. The development of science and technology, based on information and biotechnology, determines special requirements for higher physical education. C. Chen and X. Gao, training specialists in physical education and sports at the level of higher education, involve adapting the content of disciplines to the pace and level of development of information technology [9]. This is an important condition for professional self-realization and the success of a university graduate.

H. Li et al. indicate that due to the increased attention of the population of most countries to their health, physical education, and health education technologies, sports rehabilitation has become an important area for a range of scientific studies [10]. T. Yuswanto, F. Solikhah, and N. Ernawati present a systematic review of the assessment of the current impact of digitalization on training in various branches of physical education, health, and sports [11]. For example, the effectiveness of digital technologies for improving the quality of learning outcomes is analyzed. It also summarizes the existing data on the integration of digital tools in sports medicine fields and identifies gaps or limitations in the existing literature. The authors also address ethical aspects and the challenges of the phased implementation of digital innovations in sports. They emphasize the importance of adhering to ethical standards when students strive for higher achievements and when deepening specialization.

Y. Lee et al., after analyzing 229 articles published between 2005 and 2022, determined that in the scientific community on physical education methodology, different terms are used to describe the same phenomenon [12]. For example, eSports or competitive video games. This inconsistency makes it difficult to comprehensively study sports in a digital environment. The study lays the foundation for further research and discussions at the intersection of sports and technology. J. Zheng and D. Mason believe that the professional sports industry has achieved great success in the information society, actively attracting traditional media for business development and revenue growth [13]. However, the emergence and spread of new media technologies have radically changed the media landscape. According to the authors, we should talk about a much more complex cross-media environment. The new space: determines the evolution of the professional sports industry; actualizes the issues of mastering innovative digital tools by physical education specialists to achieve professional success. J. Zheng and D. Mason emphasize the importance of the theoretical basis of the cross-platform ecosystem, the formation of which should occur at the stage of training specialists.

V. Händel et al. conducted a critical analysis of the literature and web pages up to May 2022 in the field of using digital and gaming technologies to improve the quality of training specialists in the field of physical education and sports medicine. The authors identified 81 results and 44 illustrations [14]. They combined them into six categories: inclusion of game elements in training; the relationship between game and educational and cognitive activities; digitalization of teaching; teamwork; solving spatial problems; receiving rewards for participation in activities. The analysis showed that the integration of game learning and digital technologies in the process of physical training helps to increase student motivation due to rewards, cooperation, and creativity. However, such integration imposes new requirements on the content of academic disciplines and their pedagogical support. A. Vai et al. indicate that technological advances, including multimedia educational resources, are actively being introduced into the field of education [15]. The authors suggest using the capabilities of TikTok social networks to increase the interest and motivation of students of the Faculty of Physical Education when writing scientific papers.

C. Herrera-Ligero, J. Chaler, and I. Bermejo-Bosch summarize that rehabilitation is a direction in the field of sports medicine, which is becoming increasingly popular in the world [16]. The need was identified for a unified set of actions by international organizations (the European Union of Medical Specialists (UEMS) and the International Society of Physical Medicine and Rehabilitation (ISPRM)) and educational institutions involved in the training of relevant specialists. When assessing physical condition, the authors recommend using not only self-assessment questionnaires and traditional clinical examinations, but also high-tech assessment methods: motion analysis systems, 3D modeling, virtual reality, digital simulators, and wearable devices (chest belt, action camera, etc.). According to the conclusions of C. Herrera-Ligero, J. Chaler, and I. Bermejo-Bosch, future specialists should be trained to use such tools and technologies within the framework of relevant educational programs for undergraduate and graduate students [16].

A. Kiefer and D. Martin address the scientific community dealing with problems in sports and physical education practices about the need to introduce new digital technologies into traditional methods (training, assessment, risk management, rehabilitation) [17]. The authors conclude that society is moving into an era when drawings and papers are no longer needed. 3D modeling, in addition to being a volumetric representation and working with an object inside, is a new principle, and it is applied not only to metal. This includes, for example, health-medicine, bone augmentation, artificial tissues, organs, polymer products, and of course, metal. M. Geisen et al. indicate that accurate movement analysis is necessary for sports training [18]. The authors present a new approach to identifying differences in movements, using data from suit sensors for visual comparison of joint positions in the form of a three-dimensional skeleton model with reference values. I. S. Petlenko et al. perform a comparative assessment of the effectiveness of standard methods and technologies of 3D visualization in surgical treatment [19].

A. V. Yarikov et al. consider the possibilities of 3D printing for reconstructive neurosurgery. The authors prove the effect of new technologies using the example of creating high-precision implants [20]. I. Cikajlo and M. Pogačnik developed a 3D virtual environment pick-and-place task (10 cubes) used to treat tremor [21]. T. Kanyılmaz et al. evaluate the effects of exercises in a 3D VR environment on dizziness, static and dynamic balance, functional mobility, anxiety, and depression in rehabilitation participants [22]. A. Ozdil, G. Iyigun, and B. Balci complement their studies by evaluating the effectiveness of 3D (volume) vestibular rehabilitation therapy to improve gait, balance, and information processing speed in patients [23]. A. Jouini, M. Elloumi, and F. Chaieb use 3D modeling to solve problems related to ball registration from video recordings in game situations on sports courts [24].

L. Monezi et al. consider the possibilities of using 3D technologies for team games, in particular basketball [25]. The authors conclude that 3D technology in basketball allows players to analyze their form and technique in virtual space, helping to improve performance and prevent real injuries. A. N. Ivleva explores the features of 3D fitness in adaptive physical education as a method for correcting speech disorders in students [6]. I. V. Mikhailova et al., using the example of the activities of the Russian State Social University, substantiate the need to change the training program for master's students in the field of physical education to meet the challenges of the modern digital society [26]. S. P. Evseev et al. raise the issue of the need to use innovative technologies to modernize additional professional education in adaptive physical education [8]. E. A. Mamaeva et al. define the didactic potential of 3D technologies in teaching, both from the perspective of the teacher and from the perspective of the student [27]. The authors describe how three-dimensional modeling contributes to the formation of popular universal competencies, socialization, and career guidance. 3D modeling for the teacher provides tools that can be used to activate knowledge, increase interest, and take into account the individual needs and interests of students. 3D space as a virtual environment for information interaction allows you to study a number of processes and phenomena at a qualitatively new level that are inaccessible in real practical experience. For example, a model of a spaceship, an animated jump of a hero in a game world, and a human skeleton.

M. Franzò et al. indicate that innovative digital technologies can help specialists in various areas of sports medicine [7]. For example, in diagnostics and rehabilitation, in the analysis of movements and sports results. The authors propose a real-time visualization model – a 3D virtual model of the anatomical components of a subject performing specific exercises. J. Maksimović and N. N. Lazić determine that the inclusion of digital technologies in the teaching of physical education lays the foundation for internal improvements [28]. Digitalization of sports, support for physical activity, and development of students are global trends. Physical education teachers should develop competencies that will enable them to implement digital technologies in sports and rehabilitation in accordance with the requirements of a modern digital society [29]. At the Academy of the State Fire Service of the Ministry of Emergency Situations of Russia, it was found out during the study that the analysis of the technique of performing exercises in 3D projection improves the qualitative formation of motor skills [30]. The performed analysis of the literature allows us to conclude that: the study and application of 3D modeling tools for solving practical problems of a specialist in the field of implementing physical education and health educational technologies is an important step in the training of sought-after and highly qualified specialists; the use of 3D modeling to solve problems in the field of implementing physical education and health educational technologies has certain methodological and organizational problems.

RESEARCH PROGRAM

At the first stage of the study, the analysis and generalization of scientific and methodological literature on the issues of training specialists in the field of implementing physical education and health educational technologies was carried out. A comparative analysis of the curricula of university educational programs was carried out regarding the inclusion of 3D tools in sports, rehabilitation, training, and promotion of a healthy lifestyle. It was established that: health-improving physical culture, which considers human health concerning the level of their physical activity and lifestyle, is a vital priority in the digital society; the use of digital tools, including 3D tools, contributes to the implementation of the labor functions of a specialist. For example, in the development and implementation of scientific and methodological approaches to organizing work to preserve children's health and design a health-preserving educational space. 30 questions were compiled for monitoring (before and after the experiment): 10 questions for each indicator. Indicators according to the working program of the discipline. Indicator 1. Design of individual and joint educational and cognitive activities (defines goals, requirements for results). Examples of questions:

1.1. List the tasks that can be solved using the APC in the implementation of educational physical education and health programs.

1.2. Choose a program for the presentation of the experimental conclusions in the table and their visual demonstration for students with disabilities. Answer options: text editor, spreadsheet processor, graphic editor, publishing system, computer-aided design system.

Indicator 2. Design of individual and joint educational and cognitive activities (uses justified content, forms, methods, and techniques). Examples of questions:

2.1. Compose 5 questions/tasks for an interactive quiz based on the results of a physical education and health event.

2.2. Select an example of a formal information model that a specialist in physical education and health education activities (trainer or mentor) can create independently: a physical health passport, a means of supporting virtual reality, a hardware and software complex, or a digital educational platform.

Indicator 3. Uses modern technologies that support inclusivity to achieve the goals of professional activity. Examples of questions:

3.1. Describe the software for managing an experiment to study the cardiorespiratory system.

3.2. Which of the following applies to compact wearable gadgets designed to accurately monitor human physical activity: fitness trackers, Bluetooth, a smart umbrella, and an external battery.

The correct answer to an open-ended question was estimated at 2 points. For a closed-ended question, 1 point. As a result of the initial diagnostics, each graduate student scored from 0 to 90 points. To determine the level of professional training, the following levels were introduced: "Low" (from 0 to 39 points (inclusive)), "Average" (from 40 to 80 points (inclusive)), and "High" (more than or equal to 81 points). Their interpretation is in the research results. A control (27 master's students) and an experimental (27 master's students) group were formed.

At the second stage of the study, the theoretical and accumulated empirical experience was systematized in terms of the problem posed. An assessment of platforms and programs for 3D modeling was performed. Based on the criteria previously specified in the research methods, the Tinkercad service was selected.

At the third stage of the study, the main conclusions and recommendations for the use of 3D tools for scientific and methodological support of the training process of specialists in the field of implementation of physical education and health educational technologies were formulated.

RESEARCH RESULTS

During the analytical work, the authors found that information activities on the design of a three-dimensional object in the implementation of physical education and health educational technologies have their specifics, which involve the use of models not only in pedagogical activities, but also for promoting a healthy lifestyle, developing physical activity, reducing the risk of injury, and rehabilitation. Sports simulators and devices for analyzing athletes' movements have become an integral part of physical education and sports. However, these products cannot be created without 3D modeling, which allows mentors (trainers) to bring their ideas to life. 3D modeling in the implementation of physical education and health educational technologies begins with the design of simulators using software that allows you to design each element of the device. The created 3D models can be used to test prototypes and evaluate the ergonomics and effectiveness of the simulator. This speeds up the design process and allows you to create more accurate and thoughtful devices. The creation of 3D models is also necessary for creating devices for analyzing students' movements. These devices track a person's movements and generate data that can be used by coaches or physical therapists to analyze technique and prevent injuries. According to the approved work program, master's students study topics in the following sequence:

1. Theoretical aspects of the use of digital tools in the professional activities of specialists in the field of physical education;

2. The use of digital tools in the activities of physical education teachers as a priority area in international and federal projects;

3. Hardware and software systems, their use in physical education;

4. The use of mobile devices in the implementation of the master's program to improve the quality of professional training of students;

5. Digital services to support modern educational technologies:

5.1. Automation of calculations and data processing;

5.2. Digital tools for working with timelines;

5.3. Portfolio as a means of developing professional and personal competencies;

5.4. Multimedia storytelling, game interactive resources.

Each block includes questions and tasks for independent work. Thus, it was decided to supplement the work program content (item 5) with the study of 3D modeling elements. The master's students of the experimental group studied the basic concepts of 3D modeling, tools, and software, and worked on websites with 3D human models:

1. Body Visualizer (https://bodyvisualizer.com/) – a website where you can choose a male or female model, select a body type, and a viewing angle.

2. Sketchfab (https://sketchfab.com/search?q=anatomy&type=models) – paid and free 3D models. You can rotate any model.

3. Anatomy360 (https://anatomy360.info/anatomy-scan-reference-dump/) – the site is engaged in the promotion of 3D references that can be rotated and change the lighting. But, there is also a free section with references taken from different angles. To access them, you need to register.

4. Human biodigital (https://human.biodigital.com/) – a resource for doctors, where, among other things, you can study muscles and skeleton by rotating a 3D model. There are male and female models. Registration is required.

Next, the experimental group undergraduates briefly reviewed different types of software: Blender, 3D Paint, Vectary, Tinkercad, and SketchUp. But they studied the Tinkercad service and its features in detail:

- ease of use: the interface is clear and allows you to create 3D models by redrawing and connecting basic geometric shapes;
- export: models can be exported in STL format for 3D printing or OBJ for use in other 3D modeling programs;
- availability: the service is available through a web browser, which does not require software installation;
- training resources: include a variety of training materials, video tutorials and projects that help users master the various functions of the platform;
- the presence of a community of like-minded people: there are a large number of participants in information interaction. They develop their projects and ideas, which contributes to the exchange of experience and inspiration.

Tinkercad application areas:

1. Education. Used in schools and universities to teach the basics of 3D modeling, engineering, and programming.

2. Hobbies and creativity: helps hobbyists create and implement their projects.

3. Rapid prototyping: engineers and designers quickly create and test prototypes of their products.

Step 1. Go to the website and register (https://www.tinkercad.com/). To get to the registration page, click "Registration" in the upper right corner. Then select "Create a personal account". It is possible to register via Google. The main page of the site appears, where you click on the "Create" button and select "3D project". Go to this page, and a working platform for creating projects opens for you.

Step 2. Before working in the program, understand the interface and controls.

- "mouse wheel" is responsible for zooming in and out of an object;
- "left mouse button" allows you to select the part of the object you need to work with;
- "right mouse button" allows you to rotate the object in all XYZ areas;
- Shift + "right mouse button" allows you to move the object in space.

The left panel contains: a button with a house drawn on it, allowing you to return to the initial position of the camera; a button that allows you to center the camera on the selected object; the key combinations "+" and "-" perform the same functions as the mouse wheel. There is a cube above the panel. This tool is designed to move the camera along all axes. To use it, move the mouse cursor over the cube. It will display the area in which you can move the camera in blue. By clicking the left mouse button on the area, the camera will change its position. To the right of the interface area is a menu that allows you to drag and drop figure templates, then work and modify them on the work plane. Next, pay attention to the top menu. Above the work area are functions that are designed to modify the figure. This horizontal panel contains tabs that can also be used with hot keys. Methodological recommendation - leave them for independent study by students.

Step 3. Creating a universal project that involves the use of knowledge in pedagogy/psychology. For example, participants were offered instructions for creating a Bloom's Cube.

Step 4. Create a 3D model taking into account the specifics of the training. In this case, the Apple Watch. It was chosen by the graduate students as an option for one of the most popular brands of "smart" watches that allow you to maintain a healthy lifestyle.

4.1. Modeling the dial. To do this, find an image of the dial on the Internet and save it to your computer.

4.1.1. Convert the downloaded image to "*.svg" format. To do this, use the online converter https://image.online-convert.com/ru/convert-to-svg. Download the image in "*.svg" format. In Tinkercad, select the "Import" action and add your image.

4.1.2. As you can see, the internal buttons are transparent. To fix this, do the following: insert a rectangle inside the watch at the very top edge. It will serve as a background for the buttons. To do this, select the "Cube" figure and place it in the working area of the dial with the left mouse button. Stretch it to fit the dial. Adjust the size. Do not forget to change the orientation of the space to make sure that the button is attached to the dial. Methodological recommendation: give the graduate students time to look at where the rectangle is located, at the change of orientation, and the color.

4.1.3. Similarly, add the second button. To do this, select the "Round roof" figure.

4.2. Creating a strap. Select the "Ring" figure in the right menu. Click on it with the left mouse button. Move the "mouse" – place the figure in the work area. Adjust the size using the "auxiliary" squares. Don't forget to change the orientation; the dial should fit the strap. You can change its color. To do this, left-click on the ring. In the section that appears, click "body" and select the color you like. Following these rules, you can change the color of any part.

Step 5. Modifying the design. Try to create your unique watch design using figures. Evaluation criteria: use at least 2 different figures; change the color of the dial and the color of the added figures. Additional task: demonstrate how your watch will look on your hand; for this, you can use the "Cylinder" figure. Don't forget to change the color of the cylinder. Methodological recommendation: make sure that all parts of the figure are grouped.

Step 6. Preparation for printing. Click the "Design" button and the "Download for 3D printer" item. Select "Save *.stl:". Now you have a ready-made file to send to the printer.

Step 7. Creative task. Master's students thought out and implemented their model of didactic purpose. For example, a rowing machine, a Smith machine, a school gym with equipment, a swimming pool, and a human skeleton.

Step 8. Presentation of a 3D model of didactic purpose with a justification to implement physical education and health educational technology. That is, they described educational situations in which the model could help a digital school mentor.

Participants in the control group also studied electronic and digital services for physical education and sports. For example, they studied the simulators of the "Stabilan-01-2" system. The last of them is a software complex based on biofeedback for improving motor skills and accelerating the development of complex coordination movement skills. Simulators: "Balls", "Figures on the cross", "Building pictures", "Three balls", "Hunting", "Ski slope", "Tetris", "Arkanoid", "Labyrinth", "Flying cubes", "Rectis", "Skeet shooting", "Rectis" with optokinetic stimulation. The set of simulators also includes a set of stabilographic computer games performed by the method of biological feedback (BFB), of varying degrees of complexity for the rehabilitation and restoration of motor functions. They independently created a multimedia educational resource for the promotion of a healthy lifestyle. However, they were not involved in practical work on 3D modeling. Then, control testing was carried out again, and the levels of professional training of graduate students were determined again.

High level – a specialist in the field of physical education and health educational technologies understands and actively applies the capabilities of digital tools, in particular 3D graphics, to diversify the developmental forms of health work, involve children in physical education, model scenarios, and design virtual reality to reduce the risk of injury and rehabilitation. The master's student can critically evaluate ready-made hardware and software solutions, electronic educational resources, and model their own within the framework of the implementation of work functions.

Average level – a specialist in the field of physical education and health educational technologies understands, but does not always actively apply the capabilities of digital tools, in particular 3D graphics, to diversify the developmental forms of health work, involve children in physical education, model scenarios, and design virtual interaction space. The master's student can critically evaluate ready-made hardware and software solutions, and electronic educational resources. When creating their models (materials), they make some minor mistakes.

Low level – in some cases, due to the specifics of training, a specialist does not understand and does not correctly use the capabilities of digital tools to diversify developing forms of health work, introduce children to physical education, model scenarios and design virtual reality to reduce the risk of injury and rehabilitation. The master's student makes serious mistakes in critically assessing ready-made hardware and software solutions, EOR. Without the help of a mentor, he is not able to design his materials (models).

Information on the level of training before and after the experiment is presented in Table 1.

The hypotheses were accepted: H_0: the level of professional training of master's degree students in the experimental group is statistically equal to the level in the control group; H1: the level in the experimental group is higher than the level of the control group. For $\alpha = 0.05$, χ^2_{crit} is equal to 5.991. We get: $\chi^2_{obs.1} < \chi^2_{crit}$ (0.105 < 5.991), and $\chi^2_{obs.\,2} > \chi^2_{crit}$ (6.388 > 5.991). Let's analyze the dynamics by training levels:

1. The number of specialists whose level of training is defined as "High" in the experimental group increased by 11% (from 3 teachers to 6).

2. The number of students whose level of training is defined as "Average" in the control group increased by 3%. In the experimental group, the dynamics are 24%.

3. The number of students whose level of training is defined as "Low" in each group changed qualitatively. But in the control group, the number of participants with a "low" level decreased by 7%. In the experimental group, by 44%.

Table 1 Results of using 3D modeling tools in the implementation of the program to improve the quality of students' training

Level of training	Groups			
	Experimental (27 master's students)		Control (27 master's students)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
High	3 (11%)	6 (22%)	3 (11%)	4 (15%)
Average	6 (22%)	15 (56%)	7 (26%)	8 (29%)
Low	18 (67%)	6 (22%)	17 (63%)	15 (56%)

Therefore, the improvement in the quality of professional master's training in the direction of "Physical Culture and Health Educational Technologies" can be considered non-random. It is due to information interaction and manipulation in a three-dimensional virtual environment.

DISCUSSION OF RESULTS

The research materials correspond to the priority areas of UNESCO [1] and the Russian education system in terms of training specialists in the field of physical education and sports medicine [3]. The findings on the potential of 3D technologies for training relevant highly qualified specialists complement the findings of J. Maksimović, N. N. Lazić that the inclusion of digital technologies in teaching physical education lays the foundation for internal improvements [28]. It has been confirmed that 3D modeling supports physical education teachers in developing competencies, the use of which will facilitate the introduction of digital technologies in sports classes and rehabilitation activities. The presented study is an addition to the works of:

- a team of scientists, E. V. Soboleva et al., who presented an option for changing the training program for master's students in the field of physical education using mobile technologies [5];
- authors E. A. Mamaeva et al., who examined in detail how three-dimensional modeling contributes to the formation of sought-after universal competencies of graduates, socialization, and career guidance [27].

As areas for the development and clarification of the results formulated in this work, we can propose: adding an alternative software solution for 3D modeling, both individually and in a team; at the organizational level – transferring the discipline to the second semester of the first year, so that graduate students can apply the resulting 3D models in schools, fitness clubs, and rehabilitation centers.

CONCLUSION

The study describes the information activities of master's students whose training profile is the direction of "Physical Culture and Health Educational Technologies", suggesting that graduates of the program will be able to: engage in educational activities; promote a healthy lifestyle, physical education, and sports at a high level. The first circumstance determined that the master's students did not just study the tool for 3D modeling. They also developed a model for didactic purposes with its help and thought out educational situations in which the 3D model could support the implementation of the teacher's work functions. The second circumstance determined the inclusion in the activities of master's students of work with services offering ready-made 3D models – anatomical elements. In addition, the projects obtained during development in Tinkercad – master's students could print on a 3D printer and apply in practice.

The revealed didactic potential of 3D modeling tools: development of creative thinking, increase in motivation and cognitive interest of students, conducting virtual training, and analysis of exercise techniques. Based on the results of working with 3D modeling services, master's students identified the following didactic rules:

1. Determine your priorities. The choice of a 3D modeling tool largely depends on the goals of your professional activity. For example, if you just want to illustrate a figure in three-dimensional space, then 3D Paint will be enough for you.

2. Study the ratings and recommendations. It is also useful to read the opinions of users who have already used this software or platform. Their reviews will help you understand whether it is worth trying this site.

3. Familiarize yourself with the capabilities of the service/software. It is recommended to study reviews dedicated to specific software to learn about its functions. You can also install the service to test its capabilities to understand whether it will meet your needs.

4. Check the interface. It is important that the interface is intuitive and convenient. If the interface does not meet these requirements, other options should be considered.

The following positive effects from the introduction of 3D modeling in the training of master's students were identified: development of students' creative thinking, increased motivation and cognitive interest, virtual training, and analysis of exercise technique. The master's students noted the following difficulties that complicate the study and use of 3D modeling tools in the implementation of physical education and health educational activities: lack of comprehensive educational materials corresponding to the training profile; insufficient primary level of knowledge and skills in the field of digital technologies. A significant result of the study is the description of the structure of the discipline "Digital tools of professional activity" in accordance with the trends in international education in the field of physical education and sports.

REFERENCES

1. Global education monitoring report summary, 2023: technology in education: a tool on whose terms? Available at: https://unesdoc.unesco.org/ark:/48223/pf0000386147 (accessed 23 August 2025).
2. Fit for Life. Using sport to drive health, education and equality outcomes. Available at: https://www.unesco.org/en/fit4life (accessed 21 June 2025).
3. UNESCO Chair for the Study of Global Issues at the Faculty of Global Processes. Available at: http://unesco.fgp.msu.ru/ (accessed 28 June 2025).
4. Xu, R. Research on Collaborative Interaction Mode of Intelligent Physical Education Teaching Based on Cloud Platform under the View of Digitization. *Applied Mathematics and Nonlinear Sciences*, 2024, vol. 9. DOI: 10.2478/amns-2024-3478
5. Soboleva, E. V., Suvorova, T. N., Masharova, T. V., Zaslavskaya O. Yu. The Use of Mobile Tools when Implementing the Master's Degree Program "Adaptive Physical Rehabilitation" to Improve the Quality of Students' Professional Training. *European Journal of Contemporary Education*, 2023, vol. 12 (3), pp. 987-1001. DOI 10.13187/ejced.2023.3.987
6. Ivleva, A. N. 3D fitness in adaptive physical culture as a method of correction of speech disorders in preschool children. *Vestnik Tambovskogo universiteta. Seriya: Gumani-tarnye nauki = Tambov University Review. Series: Humanities*, 2023, vol. 28, no. 2, pp. 434-443. DOI: 10.20310/1810-0201-2023-28-2-434-443
7. Franzò, M., Pica, A., Pascucci, S., Marinozzi, F., Bini, F. Hybrid System Mixed Reality and Marker-Less Motion Tracking for Sports Rehabilitation of Martial Arts Athletes. *Applied Sciences*, 2023, vol. 13, pp. 2587. DOI: 10.3390/app13042587
8. Evseev, S. P., Evseeva, O. E., Aksenov, A. V., Vishnyakova, Y. Y. Innovative technologies for supplementary adaptive physical education specialist training service. *Theory and Practice of Physical Culture*, 2021, vol. 10, pp. 63-65.
9. Chen, C., Gao, X. Construction of 3D Model of College Public Physical Education Class Based on Text Mining Model. *Wireless Communications and Mobile Computing*, 2022, pp. 1-7. DOI: 10.1155/2022/2490960
10. Li, Han., Zhai, X., Yang, Z., Tang, X., Wang, J., Qiu, X. Modification and application of sports rehabilitation materials based on conjugated materials. *Frontiers in Chemistry*, 2023, vol. 11. DOI: 10.3389/

fchem.2023.1294152
11. Yuswanto, T., Solikhah, F., Ernawati, N. How is digitalization influencing transformative learning in sports and nursing?: Systematic Review. *Retos*, 2025, vol. 63, pp. 326-337. DOI: 10.47197/retos.v63.107423
12. Lee, Y., Kang, J.-H., Lee, S., Oh, T., Choi, S. M. The Evolution of Terminology: A Scoping Review of Terms and Concepts Used to Research Sport in the Digital Realm. *Quest*, 2024, vol. 76(4), pp. 462–480. DOI: 10.1080/00336297.2024.2357370
13. Zheng, J., Mason, D. New Media, Digitalization, and the Evolution of the Professional Sport Industry. *Frontiers in Sports and Active Living*, 2022, vol. 4, pp. 921329. DOI: 10.3389/fspor.2022.921329
14. Händel, V., Schrøder, V., Birkefoss, K., Händel, M. Interplay between playful learning, digital materials and physical activity in higher education: A systematic review of qualitative studies using meta-aggregation and GRADE-CERQual. *International Journal of Educational Research Open*, 2023, vol. 5, article 100284. DOI: 10.1016/j.ijedro.2023.100284
15. Vai, A., Desviyanti, E., Ndayisenga, J., Ahmadi, D., Nevitaningrum. Exploring the potential of TikTok as a learning resource for enhancing scientific writing skills in physical education. *Edu Sportivo: Indonesian Journal of Physical Education*, 2023, vol. 4, pp. 169-177. DOI: 10.25299/es:ijope.2023.vol4(2).12304
16. Herrera-Ligero, C., Chaler, J., Bermejo-Bosch, I. Strengthening education in rehabilitation: Assessment technology and digitalization. *Frontiers in Rehabilitation Sciences*, 2022, vol. 3, p. 883270. DOI: 10.3389/fresc.2022.883270
17. Kiefer, A., Martin, D. Phenomics in sport: Can emerging methodology drive advanced insights? *Frontiers in Network Physiology*, 2022, vol. 2, p. 1060858. DOI: 10.3389/fnetp.2022.1060858
18. Geisen, M., Seifriz, F., Fasold, F., Słupczyński, M., Klatt, S. A Novel Approach to Sensor-Based Motion Analysis for Sports: Piloting the Kabsch Algorithm in Volleyball and Handball. *IEEE Sensors Journal*, 2024, pp. 1-1. DOI: 10.1109/JSEN.2024.3455173
19. Petlenko, I. S., Fedyunina, S. Y., Aliyev, A. G., Bilyk, S. S., Zakhmatov, N. S., Shubnyakov, I. I. Effectiveness of 3D visualization technologies in planning and performing reconstructive plastic surgeries in patients with elbow contractures caused by ossification. *Traumatology and Orthopedics of Russia*, 2024, vol. 30 (2), pp. 120-130. DOI: 10.17816/2311-2905-17531
20. Yarikov, A. V., Gorbatov, R. O., Denisov, A. A., Smirnov, I. I., Fraerman, A. P., Sosnin, A. G. et al. Application of additive 3D printing technologies in neurosurgery, vertebrology, traumatology and orthopedics. *Clinical Practice*, 2021, vol. 12(1), pp. 90-104. DOI: 10.17816/clinpract64944
21. Cikajlo I, Pogačnik M. Movement analysis of pick-and-place virtual reality exergaming in patients with Parkinson's disease. *Technology and Health Care*, 2020, vol. 28(4), pp. 391-402. DOI: 10.3233/THC-191700
22. Kanyılmaz T, Topuz O, Ardıç FN, Alkan H, Öztekin SNS, Topuz B, Ardıç F. Effectiveness of conventional versus virtual reality-based vestibular rehabilitation exercises in elderly patients with dizziness: a randomized controlled study with 6-month follow-up. *Brazilian Journal of Otorhinolaryngology*, 2021, vol. 88, pp. 41-49. DOI: 10.1016/j.bjorl.2021.08.010
23. Ozdil A, Iyigun G, Balci B. Three-dimensional exergaming conjunction with vestibular rehabilitation in individuals with Benign Paroxysmal Positional Vertigo: A feasibility randomized controlled study. *Medicine (Baltimore)*, 2024, vol. 103(27), e38739. DOI: 10.1097/MD.0000000000038739
24. Jouini, A., Elloumi, M., Chaieb, F. A Deep Learning-Based Framework for Racket Sports Court Registration. *Artificial Intelligence Applications and Innovations*, 2024, pp.17-29. DOI: 10.1007/978-3-031-63219-8_2
25. Monezi, L., Calderani Junior, A., Mercadante, L., Duarte, L., Misuta, M. A Video-Based Framework for Automatic 3D Localization of Multiple Basketball Players: A Combinatorial Optimization Approach. *Frontiers in Bioengineering and Biotechnology*, 2020, vol. 8, p. 1. DOI: 10.3389/fbioe.2020.00286
26. Mikhailova, I. V., Seselkin, A. I., Makhov, A. S., Eremin, M. V. Diversification of master's training content in adaptive physical culture. *Uchenye zapiski Universiteta imeni P. F. Lesgafta*, 2015, vol. 11 (129), pp. 194-198. DOI: 10.5930/issn.1994-4683.2015.11.129.p194-198
27. Mamaeva, E. A., Abilova, G. J., Zaslavskaya, O. Yu., Nimatulaev, M. M. Using 3D Modeling to Develop Schoolchildren's Research Skills in the Process of Studying Natural Science Disciplines. *European Journal of Contemporary Education*, 2024, vol. 13 (1), pp. 141-161. DOI: 10.13187/ejced.2024.1.141
28. Maksimović, J., Lazić, N. N. Competences of Physical Education Teachers in Education Supported by Digital Technology. *International Journal of Cognitive Research in Science, Engineering and Education (IJCRSEE)*, 2023, vol. 11(2), pp. 331–341. DOI: 10.23947/2334-8496-2023-11-2-331-341
29. Bondarenko, E. V. Fitness technologies in professional bachelors training of physical and sports specialisation in the pedagogical education direction. *Pedagogical review*, 2022, vol. 51-59. DOI: 10.23951/2307-6127-2022-1-51-59
30. Eltemerov, A. A. Digital competences of specialists in the area of physical education and sport. *International Research Journal*, 2023, vol. 7(133), pp. 1-5. DOI: 10.23670/IRJ.2023.133.66

Авторы

Соболева Елена Витальевна
(Россия, Киров)
Кандидат педагогических наук, доцент кафедры цифровых технологий в образовании
Вятский государственный университет
E-mail: sobolevaelv@yandex.ru
ORCID ID: 0000-0002-3977-1246

Суворова Татьяна Николаевна
(Россия, Москва)
Доктор педагогических наук, заведующий лабораторией развития цифровой образовательной среды
Центр развития образования
Федеральное государственное бюджетное учреждение «Российская академия образования»

Профессор кафедры прикладного искусственного интеллекта, факультет искусственного интеллекта
Российский университет дружбы народов имени Патриса Лумумбы
E-mail: suvorovatn@mail.ru
ORCID ID: 0000-0003-3628-129X

Машарова Татьяна Викторовна
(Россия, Москва)
Профессор, доктор педагогических наук, главный научный сотрудник кафедры психологии семьи и детства, профессор кафедры психологии и педагогики образования Института психологии имени Л.С. Выготского
Российский государственный гуманитарный университет
E-mail: mtv203@mail.ru
ORCID: 0000-0001-5974-7748

Быкова Светлана Станиславовна
(Россия, Киров)
Доцент, кандидат педагогических наук, доцент кафедры педагогики
Вятский государственный университет
E-mail: vetabykova@mail.ru
ORCID ID: 0000-0002-2382-0496

Authors

Elena V. Soboleva
(Russia, Kirov)
Cand. Sci. (Educ.),
Associate Professor of the Department of Digital Technologies in Education
Vyatka State University
E-mail: sobolevaelv@yandex.ru
ORCID ID: 0000-0002-3977-1246

Tatyana N. Suvorova
(Russia, Moscow)
Dr. Sci. (Educ.), Head of the laboratory of Development of Digital Education Environment
Education Development Center «The Russian Academy of Education»

Professor of the Department of Applied Artificial Intelligence, Faculty of Artificial Intelligence
Peoples' Friendship University of Russia
E-mail: suvorovatn@mail.ru
ORCID ID: 0000-0003-3628-129X

Tatyana V. Masharova
(Russia, Moscow)
Professor, Dr. Sci. (Educ.),
Chief Researcher at the Department of Family and Child Psychology
Professor at the Department of Psychology and Pedagogy of Education
Russian State University for the Humanities
E-mail: mtv203@mail.ru
ORCID: 0000-0001-5974-77488

Svetlana S. Bykova
(Russia, Kirov)
Associate Professor, Cand. Sci. (Educ.),
Associate Professor of the Department of Pedagogy
Vyatka State University
E-mail: vetabykova@mail.ru
ORCID ID: 0000-0002-2382-0496

Вклад авторов

Соболева Е. В.: концептуализация, методология, создание рукописи и ее редактирование, руководство исследованием, администрирование проекта
Суворова Т. Н.: верификация данных, проведение исследования, создание черновика рукописи
Машарова Т. В.: формальный анализ, проведение исследования, визуализация
Быкова С. С.: ресурсы, программное обеспечение, проведение исследования

Authors contribution

Elena V. Soboleva: Conceptualization, Methodology, Writing - Review & Editing, Supervision, Project administration
Tatyana N. Suvorova: Validation, Investigation, Writing - Original Draft
Tatyana V. Masharova: Formal analysis, Investigation, Visualization
Svetlana S. Bykova: Software, Investigation, Resources

Авторы заявляют об отсутствии конфликта интересов

The authors declared no conflicts of interest