USE OF AN INTERACTIVE ANATOMICAL COMPLEX IN A REGIONAL SUBJECT COMPETITION AMONG STUDENTS IN THE FINAL YEAR OF VOCATIONAL SECONDARY EDUCATION

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DOI: 10.46594/2687-0037_2026_1_2157

Abstract. This article describes the potential applications of the "Pirogov" interactive system in conducting a regional subject competition in human anatomy and physiology for students majoring in 34.02.01 "Nursing" (N) and 31.02.01 "General Medicine" (GM). It reveals the effectiveness of using interactive simulators in teaching and developing professional skills among students. In accordance with the current federal state educational standard for the course module, students must: know human anatomy and physiology and be able to apply knowledge of anatomy and physiology to examine patients and make a preliminary diagnosis. The results obtained will allow for adjustments to educational activities.
Keywords: "Pirogov" interactive anatomical complex, creative competition, team assignment, innovative methods.
Conflict of interest. The authors declare no conflict of interest.
Citation: Menshikova E. A., Mardarovskaya T. A., Lyubov A. S. Use of an interactive anatomical system in a regional subject competition among final-year students of secondary vocational education // Virtual Technologies in Medicine. 2026. No. 1. Pp. 28–33. DOI: 10.46594/2687-0037_2026_1_2157
Scientific specialty: 3.3.1 "Human Anatomy," 3.2.3. Public Health and Health Care Organization, Sociology and History of Medicine, 3.1.4. Obstetrics and Gynecology.

Received by the editorial office on February 5, 2026.
Received after peer review on March 4, 2026.
Accepted for publication on March 4, 2026

Introduction

The implementation of interactive teaching methods is one of the most important areas for improving student training in the medical professional education system. These tools allow students to visualize anatomical structures in three-dimensional space. The "Pirogov" Anatomy Complex is not merely a 3D anatomy atlas, but a collection of numerous detailed structures depicting the normal and pathological human anatomy, accompanied by comprehensive descriptions [1].

Working with interactive equipment allows users to view objects from any angle, zoom in or out, examine them in different planes, hide or restore human organs to the anatomical scene, obtain detailed textual descriptions of the displayed 3D objects, and study the Latin terms for anatomical structures. Any pedagogical technology is an information technology, since the technological process of learning is based on the acquisition and transformation of information [3]. The most important area is the use of digital educational technologies with interactive equipment. Modern virtual reality tools are viewed as a source of technological opportunities in education and medicine, complementing the set of traditional approaches to teaching.

Research Objective

To analyze the experience of using the "Pirogov" anatomical complex, reveal the advantages and disadvantages of this virtual reality technology, and determine the organizational and pedagogical conditions for its effective use in preparing students of secondary vocational education for the regional academic competition.

Materials and Methods

In November 2025, a regional subject Olympiad was held at the Arkhangelsk Medical College for students of state vocational educational institutions in the Arkhangelsk Region in the specialties 31.02.01 "General Medicine" and 34.02.01 "Nursing". The venue for the regional competition among vocational educational institutions in the Arkhangelsk Region was the classroom of the Primary Simulation and Accreditation Educational Center at the Arkhangelsk Medical College. The program for the regional competition was developed jointly by T. A. Mardarovskaya, instructor of obstetrics and gynecology, and A. S. Lyubov, acting director of the Arkhangelsk Medical College (AMC) and instructor of the fundamentals of resuscitation.

Objectives of the regional competition among students of secondary vocational education in the Arkhangelsk Region:

- to stimulate intellectual curiosity;
- to consolidate and systematize knowledge;
- to develop intellectual and professional competencies;
- to develop creative and communication skills.

The "Pirogov" anatomical complex is designed for examining and documenting specimens during dissections, helping medical students understand the relationships between organs. The «Pirogov» interactive tables are modern 3D atlases with touchscreens that allow users to study normal and pathological anatomy, ultrasound, CT, and MRI in an interactive mode. The software generates tests linked to 3D models to assess mastery of the material and automatically process results, improving knowledge retention by 20% compared to traditional methods.

The structure of the competition task on "Human Anatomy and Physiology" included a test, an intellectual quiz called "Your Game," and a creative contest.

The subject test consisted of 50 test items of varying difficulty: single-choice, multiple-choice, matching, and sequencing tasks . Students were given 60 minutes to complete the test. The "Your Game" quiz included questions on the body's systems (cardiovascular system, digestive system, nervous system, musculoskeletal system, endocrine system) and lasted 30 minutes. Each section on the body's systems contained 5 questions, each worth 1 point. In total, the quiz consisted of 25 questions.

The creative competition took place at the Pirogov Anatomical Complex over a 90-minute period and was a team event. The following educational scenarios were presented during the competition: locating and describing anatomical structures, describing the topography of organ structures, creating anatomical models and scenes, and solving clinical problems. Participants were given a choice of questions. Each task was worth 1 point, with an additional 1 point awarded for the situational task. The creative competition consisted of a total of 8 tasks, worth 11 points in total. The tasks were divided among 2 teams of participants, with 4 questions to choose from.

The tasks in the creative competition included the following questions:

Task 1. Demonstrate and describe on an anatomical model the origin of the arteries of the female reproductive system.

Task 2. Locate and demonstrate the sinoatrial node of the heart on an interactive stand.

Task 3. Create an anatomical model of the respiratory organs. Identify the tracheal bifurcation. Solve a case study: a child has aspirated a foreign body into the airways. Which bronchus is the foreign body likely to enter?

Task 4. Locate the pancreas on the interactive display. Demonstrate that the pancreas is a mixed-secretion gland. Solve the following scenario: A person ate a buttered sandwich. Explain how the ingested food will change as it moves through the digestive tract.

Task 5. Solve the following scenario: A person suddenly lost consciousness and stopped breathing while defecating. Cyanosis of the head, neck, and shoulder region is immediately apparent. What do you think happened to the patient? Identify the anatomical structure on the "Pirogov" model that caused the problem.

Task 6. Identify the visceral branches of the internal iliac artery using the "Pirogov" model.

Task 7. On the anatomical model, recreate the pulmonary circulation and find the "error" in the vessels.

Task 8. Using the "Pirogov" model, demonstrate the location of the pituitary gland. Describe the structure and function of the gland.

Sixteen people participated in the competition (Table 1), 12 of whom are students in their final year of study in the following programs: 31.02.01 — "Nursing" (N) and 34.02.01 — "General Medicine" (GM) at secondary medical educational institutions in the Arkhangelsk Region. For the purposes of analyzing the competition results, the students were divided into two groups (the N department group and the GM department group).

Table 1

Total number of Olympiad participants

No.	Role name	No. of participants
1	Students of the N Department	6
2	Students in the GM department	6
3	Jury	2
4	Instructors (experts)	2
Total		16

Descriptive statistics were used in the analysis of the results, showing the average score and the percentage of the analysis.

Upon completion of the competition, a feedback survey was conducted among participants, in which students were asked to answer the following questions:

1. Please indicate your status at Arkhangelsk Medical College and other secondary vocational education institutions in the Arkhangelsk Region.
2. How often did you study at the simulation center for the course "Human Anatomy and Physiology"?
3. What forms of instruction do you find useful and helpful for your learning?
4. What sources did you use to acquire theoretical knowledge of human anatomy and physiology?
5. What practical skills do you practice in anatomy classes using the "Pirogov" interactive system?
6. What knowledge of human anatomy and physiology do you possess?
7. Were there any assessments of your knowledge after the topics covered in the practical classes?
8. How well do you understand human anatomy and physiology?
9. Are you satisfied with the level of practical training in this discipline?
10. What difficulties do you encounter when using the interactive anatomical equipment?

The survey material on the use of the anatomical complex is provided in Appendix 1 and is included at the end of the article.

Results and Discussion

The curriculum for "Human Anatomy and Physiology" serves as the foundation for developing general and professional competencies in future specialists with secondary medical education. Innovative devices in modern education help display, record, and analyze information [2]. The "Pirogov" anatomical system is a complex comprising numerous detailed structures of the normal and pathological anatomy of the body, with built-in descriptions in Russian and Latin.

The final results of the regional competition were as follows.

The average score for the regional competition among students in the "General Medicine" vocational program was 54 points, while among students in the N department it was 35.5 points.

The performance level on the first stage of the test among students in the "General Medicine" program was 1.6 times higher than that of students in the N department (39 and 27 points, respectively). The assessment results of the test tasks among participants from the General Medicine department and Nurse Department programs were evaluated as a percentage: 4 points—78% and 3 points—55% correct answers, respectively (Fig. 1).

Fig. 1. First stage of the testing competition

Thus, at the conclusion of the first stage of the regional vocational education Olympiad among students in the Arkhangelsk region, students in the GM department achieved 78% correct answers, while students in the N department achieved 54% (Fig. 2).

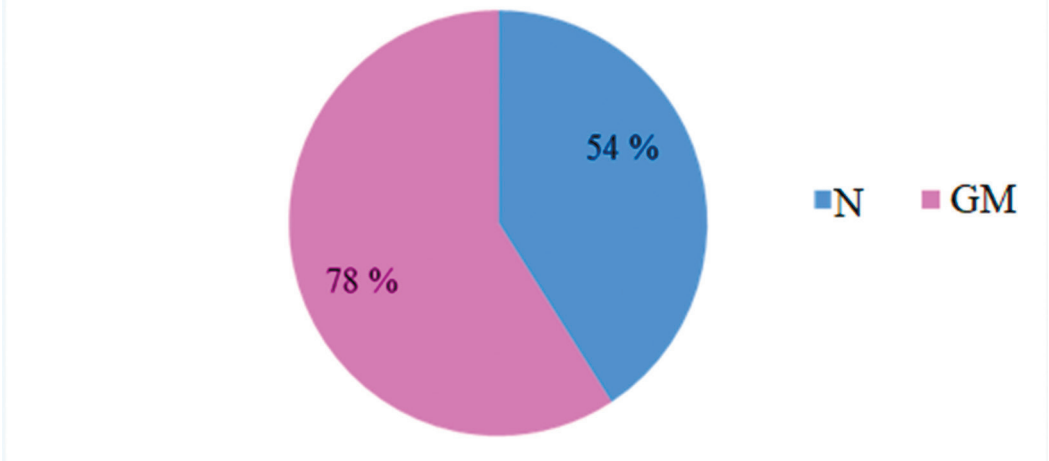

Fig. 2. Test results (%)

At the conclusion of the second stage of the regional academic competition—the intellectual quiz "Our Game"—students from the GM department also scored higher: 8 points and 4 points, respectively, compared to participants from the N department. The average score for students in the GM department was 75%, while for those in the N department it was 50% (Fig. 3).

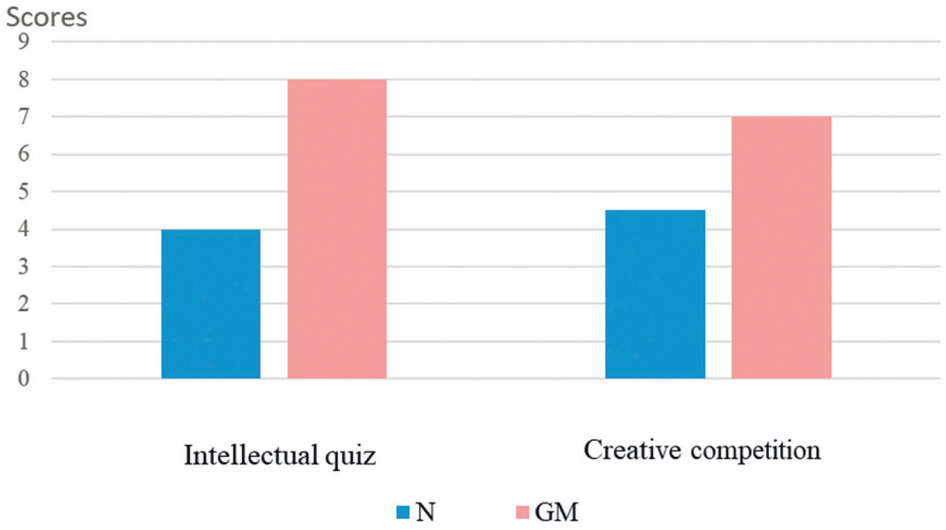

Fig. 3. Students' scores in the 2nd and 3rd stages of the regional competition (points)

Students from the N department provided incomplete answers to the regional Olympiad questions; there were quite a few errors on topics related to the cardiovascular system, as well as on tasks involving the correspondence and sequence of anatomical structures and physiological processes. It should be noted that in the creative competition, participants from the GM group also achieved the highest score, earning 7 points (87.5%) compared to the N group's 4.5 points (56.3%). A total of 11 points were available for the creative competition. The two teams of Olympiad participants were assigned optional tasks. Each task was worth 1 point, with an additional 1 point awarded for the situational task.

The creative competition is the final stage of the regional Olympiad in the completion of tasks on human anatomy and physiology. At this stage, students' cognitive activity and its application in learning are analyzed (Fig. 4).

The final tally of points shows that the maximum score for the test was 50 points, for the intellectual quiz — 25 points, and for the creative task — 8 points. The total maximum score for the regional competition among vocational school students in the Arkhangelsk Region is 83 points, encompassing all three stages of the competition.

Fig. 4. Students completing the creative competition tasks

Students in the graduating classes demonstrated the best knowledge in the areas of the structure and function of the endocrine system, the gastrointestinal tract, and the reproductive, urinary, and immune systems. In addition, the contest participants had difficulty with questions regarding the cardiovascular system, the nervous system, and the musculoskeletal system.

Students from the GM department achieved the best results, as the curriculum at Arkhangelsk Medical College included both traditional and interactive teaching methods, compared to students from the N department. This pattern is due to the fact that students at other educational institutions in the Arkhangelsk region do not have access to practical training using the "Pirogov" interactive anatomical complex. Interactive learning was conducted through theoretical foundations, which is ineffective in education.

Analysis of the questionnaire revealed that students showed the greatest interest in a model combining traditional and interactive teaching methods (N — 67% and GM — 100%). Students justified their answers by stating that the use of interactive information when preparing a topic facilitates the understanding of theoretical material, which is reinforced by the instructor's comments and demonstrations on a touchscreen display. It was noted that knowledge assessments are consistently conducted after practical sessions (100% — N, GM). The survey results revealed that 83% of students in the GM department possess theoretical and practical knowledge of anatomy. However, among students in the N department, this figure was 1.6 times lower — 50%.

A survey revealed that the satisfaction rate with practical training among GM students was 100%, while among N students it was 83%. These figures indicate that nursing students at other secondary vocational education institutions in the Arkhangelsk region do not have classes using the "Pirogov" interactive anatomical system. The difficulties in learning to use the interactive equipment stem from the need to master a large volume of theoretical knowledge and practical skills within a short training period. A small proportion of vocational education students experience difficulties with the interactive anatomical system, attributing this to the lack of network solutions and compatibility with mobile platforms.

Conclusion

The results obtained underscore the importance of holding a regional subject competition among vocational school students and the need for further improvement of educational programs aimed at developing practical skills based on theoretical knowledge. Interactive equipment allows for the active engagement of students in the learning process and the implementation of various educational technologies. The combined use of various digital technologies and interactive equipment enhances the effectiveness of the educational process and enables the assessment of knowledge acquired by students in graduating classes.

Conclusions

Thus, the implementation of virtual reality tools expands the boundaries of the principles of clarity and accessibility, resolving many traditional challenges. Working with the anatomical atlas already demonstrates improved student perception and understanding of anatomy, fostering clinical spatial thinking. Students showed great interest in the illustrated interactive educational material. Interactive learning increases participants' motivation to solve the problems under discussion, which provides an emotional impetus for subsequent research activity and encourages them to take concrete actions. The interactive approach stimulates students' cognitive activity, fosters professional interest, develops spatial thinking, and prepares specialists capable of both independently solving assigned tasks and engaging in collaborative interaction with fellow students.

At the same time, the use of interactive equipment allows for the individualization of the learning process, stimulates interest in completing tasks, and enhances motivation and cognitive activity. Through the use of interactive learning in education, the goals of aesthetic education are achieved, along with the development of communication skills, the formation of the ability to make optimal decisions or propose alternative solutions in complex situations, and the ability to process information. Interactive teaching methods create the necessary conditions for developing the ability to think independently, navigate new situations, and find one's own approaches to problem-solving.

Contributions of the authors

Menshikova E. A. collected the material and analyzed and interpreted the data for this publication.
Mardarovskaya T. A. participated in the discussion of the research results and finalized the article.
Lyubov A. S. developed the concept and design of the study.
All authors participated in drafting the manuscript and approved the final version of the article.

REFERENCES

1. Voitenko E. V., Gumbina A. V., Deychuli I. P., Zhivotova E. Yu. Experience in using interactive teaching methods in the study of the discipline "Topographic Anatomy" // Ways to Improve Organizational and Pedagogical Work at Universities During the Pandemic: Experience and Prospects. Proceedings of the Interregional Pedagogical Conference of Higher Education Faculty. Khabarovsk: Far Eastern State Medical University Press, 2023. Pp. 39–41.
2. Dvulichanskaya, N. N. Interactive teaching methods as a means of developing key competencies [Electronic resource] // Science and Education: Electronic Scientific and Technical Journal. 2011. No. 4.
3. Menshikova, E. A. The use of interactive equipment in the study of human anatomy and physiology at a medical college // Master's Bulletin. 2024. No. 22 (149). Pp. 75–77.

Appendix 1

Student Survey on the Use of the Pirogov Anatomical Complex

1. Indicate your status at Arkhangelsk Medical College and at other educational institutions:
   Year _____
   department _____
2. How often have you taken courses in the simulation center on the subject of «Human Anatomy and Physiology»?
   constantly _____
   Sometimes (rarely) _____
3. Which teaching methods do you find useful and helpful for learning?
   Traditional format _____
   Interactive format _____
   Both options _____
4. What sources did you use to acquire theoretical knowledge of human anatomy and physiology?
   Lectures by instructors _____
   course materials _____
   Information from the Internet _____
5. What practical skills do you practice in anatomy classes using the Pirogov interactive system?
   create an anatomical scene _____
   remove or isolate an organ _____
   describing an anatomical object _____
   Other _____
6. What knowledge of human anatomy and physiology do you possess?
   topography of organs _____
   structure of organs _____
   Functions of organs _____
7. Were there any assessments of knowledge after the topics covered in the practical sessions?
   Yes _____
   No _____
8. How well do you know human anatomy and physiology?
   sufficient _____
   Insufficient _____
9. Are you satisfied with the level of practical training in this discipline?
   Yes _____
   Partially _____
   No _____
10. What difficulties do you experience when using interactive anatomical equipment?

_____

_____