



## FUNDAMENTAL CONCEPTS IN TEACHING ASTRONOMY IN SPECIALIZED SCHOOLS

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### ABSTRACT

The article examines actual issues of advanced teaching of astronomy in specialized schools within the education system of Uzbekistan, as well as the theoretical and practical aspects of effective use of electronic educational resources. The features of the educational process are highlighted based on the example of the Mirzo Ulugbek Specialized School. The study substantiates the opportunities for developing students' scientific worldview, spatial thinking, independent thinking, and research skills through the application of modern pedagogical technologies, virtual programs, and 3D models in astronomy education.

**Keywords.** astronomy education, specialized schools, electronic educational resources, 3D models, virtual programs, scientific worldview, spatial thinking, research activity, integrated learning, modern pedagogical technologies.

### INTRODUCTION

One of the specialized institutions aimed at in-depth teaching of astronomy in the education system of Uzbekistan is the Mirzo Ulugbek Specialized School, established on September 14, 2017, by a presidential decree. The school is located in Tashkent and specializes in teaching physics, mathematics, astronomy, and computer science at an advanced level.

The concept of "specialized schools" is an important element of the education system, aimed at providing in-depth knowledge to gifted students in specific fields. These schools are general secondary education institutions specialized in particular subject areas such as physics and mathematics, natural sciences, information technologies, foreign languages, arts, and sports. Their main goal is to identify talented students, develop their potential, and provide advanced subject-oriented education.

Such schools focus on developing students' scientific potential and creating a strong foundation for training future scientists, engineers, educators, and researchers. Additionally, fostering students' interest in research activities is one of their key objectives. In these institutions, subjects such as physics, mathematics, biology, and astronomy are taught in greater depth and with increased instructional hours. This approach strengthens students' knowledge, enhances their scientific thinking, and enables them to actively participate in research projects, academic competitions, and innovative initiatives.

### MAIN PART

Currently, the number of specialized schools in the public education system has reached 790. Among them, 135 are fully specialized schools with boarding facilities, while in the remaining 655 schools only certain classes are specialized, accounting for approximately 25% of all classes. However, in some cases, the curriculum, teaching methodology, and extracurricular activities in these schools do not differ significantly from those in general education schools. For example, in classes specialized in mathematics or foreign languages, only about two additional hours per week are allocated to these subjects.



As of January 2022, specialized schools in Uzbekistan operate in various fields: 207 schools focus on foreign languages, 126 on mathematics and physics, 99 on information technology, and 87 on chemistry and biology. This reflects systematic efforts to identify and support talented students across different disciplines.

International experience shows that specialized schools focusing on astronomy and natural sciences play a crucial role not only in advanced subject teaching but also in engaging students in research activities at an early stage. For instance, the A.N. Kolmogorov Specialized Educational and Scientific Center in Russia, founded in 1965 by the renowned mathematician Andrey Kolmogorov, operates under Moscow State University and provides in-depth education in mathematics and physics. The involvement of university professors in the teaching process allows students to engage in research activities during their school years.

Similar models exist in other developed countries. In the United States, STEM-oriented schools involve students in scientific projects and research activities. In South Korea, science-focused lyceums provide advanced education in mathematics, physics, and space sciences. In Germany, academic gymnasium systems emphasize the development of students' scientific potential.

These examples demonstrate that the effectiveness of specialized schools depends on advanced curricula, research-oriented teaching, and close collaboration with higher education institutions. Therefore, studying and adapting international experience to the national education system is of great importance for Uzbekistan.

### **Fundamental Concepts in Teaching Astronomy**

The mastery of fundamental concepts in astronomy plays a crucial role in increasing students' interest in science and guiding them toward scientific and technical professions. The following key concepts should be acquired by students:

1. The Universe and Its Structure

Students learn about the concept of the universe, its infinity, composition, and stages of development. Fundamental knowledge about galaxies, star systems, and the place of the Solar System in the universe is formed.

2. The Solar System and Celestial Bodies

Students gain in-depth knowledge about the Sun, planets, their satellites, asteroids, comets, and meteorites, including their physical properties and motion.

3. Astrophysical Foundations and Laws of Motion

Students study Newton's law of gravitation, Kepler's laws, orbital motion, and their interconnection with physics and mathematics.

4. Stars and Their Evolution

The internal structure of stars, energy sources, and stellar evolution are studied, including the Hertzsprung–Russell diagram.

5. Cosmic Evolution and Modern Theories

Students learn about the Big Bang theory, expansion of the universe, black holes, neutron stars, dark matter, and dark energy.

6. Observation Tools and Space Technologies

Students study telescopes, satellites, observatories, and modern observation techniques, including software such as Stellarium, Celestia, and NASA Eyes.

7. Practical Skills and Scientific Methods

Students develop practical and research skills in accordance with national educational standards.



Due to the lack of sufficient astronomical observation equipment in schools, integrating electronic educational resources into astronomy teaching is essential. Virtual tools significantly enhance students' imagination and understanding.

### CONCLUSION

In conclusion, specialized schools in Uzbekistan, particularly the Mirzo Ulugbek Specialized School, play an important role in identifying gifted students and developing their scientific potential. Teaching astronomy at an advanced level contributes to the development of scientific thinking, logical reasoning, and research skills.

However, despite the increasing number of such schools, there is still a need to improve the quality of education, teaching methodologies, and technical resources. International experience shows that effectiveness depends on research-oriented education, modern pedagogical technologies, and collaboration with universities.

The integration of electronic educational resources and virtual models into astronomy education enhances students' imagination, increases their interest in science, and strengthens practical skills. Overall, advanced teaching of astronomy is a key factor in preparing highly qualified specialists for the future.

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