THE INTERNATIONAL CONFERENCE ON THE 120TH ANNIVERSARY OF THE BULNAY EARTHQUAKE: ADVANCES IN ASTRONOMY AND GEOPHYSICS

An Evaluation of the Quality of Astronomy Content in the General Education Curriculum

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Abstract: Modern astronomy is a rapidly evolving interdisciplinary field closely linked to physics, mathematics, engineering, chemistry, biology, and space science. This integration has increasingly drawn interest from both the scientific community and the public. In Mongolia, the establishment of the Astropark in 2014 under the Institute of Astronomy and Geophysics, initiated by national hero and cosmonaut J. Gurragchaa, marked a major step in raising public awareness of astronomy and showcasing scientific achievements and future directions. As scientific and technological demands grow, innovative methods of science communication are becoming essential. High-tech astronomical planetariums, for instance, serve as versatile educational platforms that support astronomy education and promote integrated STEM learning, sparking wider interest in these fields. This study evaluates the quality and accessibility of astronomy content in Mongolia's general education curriculum. It is the first systematic assessment of its kind and aims to support evidence-based educational policy reform. Content analysis was used to examine the number, scope, and depth of astronomy-related topics in the national curriculum.

Keywords: Astronomy, secondary school, knowledge

Introduction

Astronomy, based on observation and analysis, fosters scientific thinking and inspires youth. However, in Mongolia, it has been removed from the general education curriculum, and modern textbooks are scarce, leading to a decline in astronomical knowledge among students. This study aims to address this gap by promoting astronomy education through the activities of the Astropark and evaluating the quality and accessibility of astronomy content in the national curriculum. As the first systematic assessment of its kind in Mongolia, the study seeks to support evidence-based reforms in science education policy.

Figure 1. Exhibition Hall of the Astropark

Figure 2. Astronomy Hall at the Astropark (SkyExplorer: RSA Cosmos software)

Background

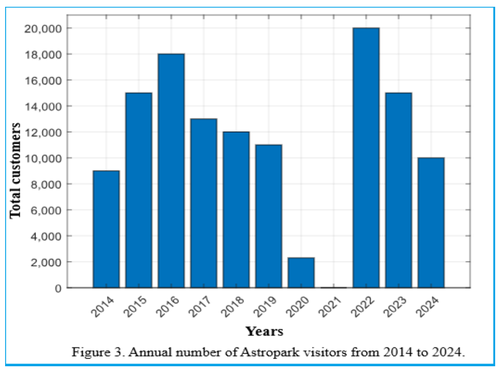

Figure 3. Annual number of Astropark visitors from 2014 to 2024.

Between 2014 and 2024, Astropark engaged over 122,000 visitors in astronomy and space science. As shown in Figure 3, visitor numbers dropped sharply in 2021 due to COVID-19 lockdowns, suspending outreach activities. Operations resumed in February 2022, with annual visitors rebounding to around 20,000.

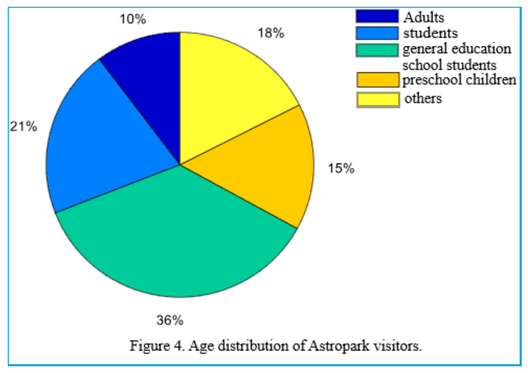

Figure 4. Age distribution of Astropark visitors.

Figure 4 shows that most Astropark visitors were general education and university students, reflecting strong youth interest in astronomy. To improve access to astronomy education, this study examined where students currently gain astronomy knowledge, starting with an analysis of the national curriculum content.

Research Methodology

Grade	Subject Area	Topic	Content Summary	Skills Developed	Suggested Teaching Methods
1	Human and Environment	Our Earth	Observe and describe the sun (sunrise, sunset), and different types of weather (sunny, cloudy, cold). Recognize natural changes in the environment.	Observation, questioning, classification, comparison	Exploratory learning
2	Human and Environment	Planet Earth	Identify Earth's rotation, heat, and seasonal changes. Recognize the four seasons and their environmental impacts.	Observation, prediction, recording, expressing ideas	Exploratory learning
5	Human and Nature	Planet Earth	Understand the causes of day and night. Describe the Earth's rotation. Explain phases of the Moon and its influence on nature.	Time-based observation, pattern recognition, reasoning	Exploratory learning
5	Human and Nature	The Moon	Observe and describe the Moon (phases, appearance, and motion). Explain the difference between the Moon and the Sun.	Visual analysis, simple explanations	Exploratory learning
7	Physics	Outer Space	Understand the motion of the Sun, Moon, and stars. Model the Earth's rotation and revolution.	Scientific modeling, logical reasoning, experimentation	Inquiry-based learning
8	Physics	Outer Space	Understand the solar system and the position of planets. Construct models of planetary motion.	Formulating hypotheses, conducting experiments	Inquiry-based learning
9	Geography	Earth in Space	Explain the Earth's movement in space, including rotation and revolution. Understand the geographic grid system.	Model construction, data interpretation, drawing conclusions	Experimental and group work
10	Geography	Universe and the Solar System	Understand the solar system, galaxy, and universe. Explain how Earth's position and motion affect seasons and eclipses.	Problem-solving, critical thinking, drawing evidence-based conclusions	Research-based learning

Source: Ministry of Education and Science of Mongolia. (n.d.). E-content platform for general education. *https://econtent.edu.mn/book/*

Textbook Review and Curriculum Gaps

In 2021, Mongolia's Ministry of Education and Science launched a comprehensive review of general education textbooks (Order No. A/134). The study evaluated 174 textbooks across 35 subjects, including 34 in Kazakh, to assess the presence and quality of astronomy content.

The analysis revealed that astronomy is inconsistently covered and largely absent at the upper secondary level due to the elective-based curriculum, where astronomy is rarely chosen. Compared to international standards, Mongolian textbooks show significant gaps in the depth, integration, and continuity of astronomy education.

The review also examined how well textbooks support academic learning, life skills, and values through tasks, experiments, and case studies using a range of analytical and scientific methods.

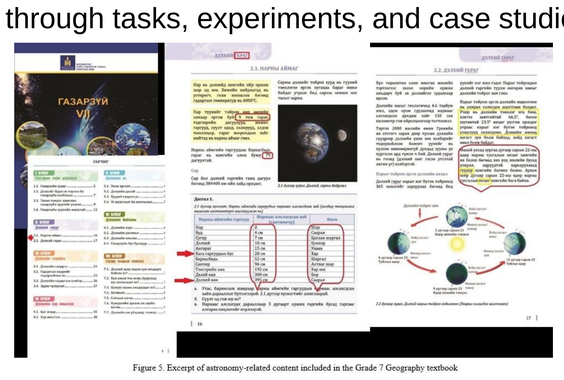

Figure 5. Excerpt of astronomy-related content included in the Grade 7 Geography textbook

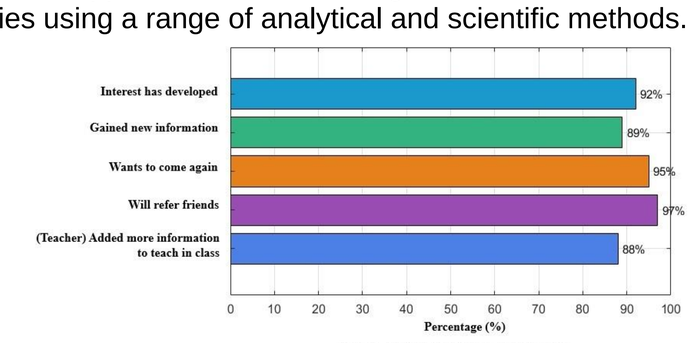

Figure 6. Astropark's quality assurance survey

Discussion

Curriculum Status

In many countries, including Mongolia, astronomy is only partially integrated into school curricula. Basic topics like day and night, seasons, lunar phases, and planetary motion are introduced in grades 5-9. However, there is strong potential to expand these into advanced topics at the upper secondary level.

Challenges in Teaching Practice

Many primary-level teachers lack astronomy training. Students hold common misconceptions (e.g., lunar phases, seasons). Some topics exceed age-appropriate cognitive levels. Theory-heavy approaches limit learning; hands-on activities are more effective. Engagement improves with night sky observation, telescopes, planetariums, and AR/VR tools.

Age-Appropriate Pedagogical Strategies

- Primary level: Use simple, activity-based and observational methods to boost participation.
- Middle school: Students are eager to learn advanced topics (e.g., black holes, space exploration), which are often missing from the curriculum.
- Adults/enthusiasts: Interactive, experience-based learning is more impactful than lectures.

Improving Astronomy Education

To enhance astronomy education quality, the following strategies are essential:

- Promote astronomy across all education levels
- Establish a unified national strategy
- Use evidence-based teaching methods
- Strengthen collaboration among stakeholders
- Ensure continuous evaluation and improvement

Conclusion

Astronomy content in the national curriculum is too general and lacks depth. A structured, age-appropriate introduction from early grades is needed. Well-designed content and diverse teaching methods can boost student interest in science and improve understanding of natural phenomena. Integrating astronomy into the national education system is essential for strengthening scientific literacy and aligning education with technological progress.