

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



**PROMOTING INCLUSIVE ASTRONOMY AND SPACE SCIENCE
EDUCATION THROUGH ADVANCED TECHNOLOGIES: A DIGITAL
TRANSFORMATION AND ACCESSIBILITY ASSESSMENT BASED ON THE
11-YEAR EXPERIENCE OF THE ASTROPARK IN MONGOLIA**

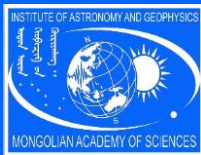
B. Gantuya^{1 *}, N. Chantsaldulam², B. Banzragch¹, U. Tuguldur¹,
T. Turtogtokh², D. Erdenebaatar^{1,2}

gantuya@iag.ac.mn corresponding author*

¹*Institute of Astronomy and Geophysics, MAS*

²*Nanosatellite Development Laboratory, NUM*

ULAANBAATAR
2025.08.11



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

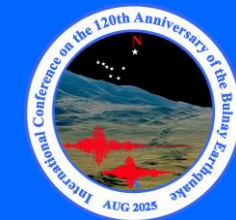


Outline of presentation

- Introduction
- Technological Evolution: From MS-8 to Sky Explorer
- Research Methodology
- Conclusion and Future Goals



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



Introduction

- Globally, planetariums attract over 140 million visitors annually and play an essential role in public science education. International bodies such as UNESCO and the International Planetarium Society (IPS) highlight their value in making science more equitable and engaging.
- In Mongolia, the Astropark was founded in 2014 to fulfill a similar mission: to inspire and educate the public, particularly youth, through immersive astronomy experiences. Initially operating with a mechanical Minolta MS-8 opto-mechanical projector, the Astropark underwent a major digital transformation in 2024 with the adoption of the RSA Cosmos Sky Explorer system. This upgrade aligns with global trends in digital education and expands both content delivery and user interactivity.
- This study aims to assess how this transition has affected accessibility, learning outcomes, and public engagement.



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



Technological Evolution:
Minolta MS-8 (2014–2024)

The MS-8, developed by Minolta Camera Co. (Japan), was a robust analog system capable of projecting 3,500–4,000 stars.

It featured:

- Accurate celestial simulations
- Long operational life (25–30 years)
- Mechanical reliability

Yet, it had notable limitations:

- Static, non-interactive content
- Dependence on auxiliary devices (slide projector, FX system)
- Lack of modern visual capabilities
- Difficulty in acquiring spare parts

Specification	Details
System	Minolta MS-8 optical-mechanical system
Country of Manufacture	Japan
Production Year	Initially 1960s (serial production in the 1970s)
Number of Stars Displayed	3,500–4,000
Device Type	Mechanical, based on optical lenses
Modeling	Depicts realistic motion of the Sun, Moon, and planets
Operational Lifespan	Up to 25–30 years (with proper maintenance)

Table 1. Key Features of the Minolta MS-8 Device.



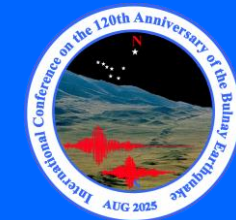
Image 1. Konica Minolta "MS-8" analog specialized device, control unit of the equipment.



Image 2. 2014–2024 In Mongolia used Minolta MS-8 mechanical system.



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



Despite these, it reached over 118,000 visitors in Mongolia and played a critical role in foundational public education.

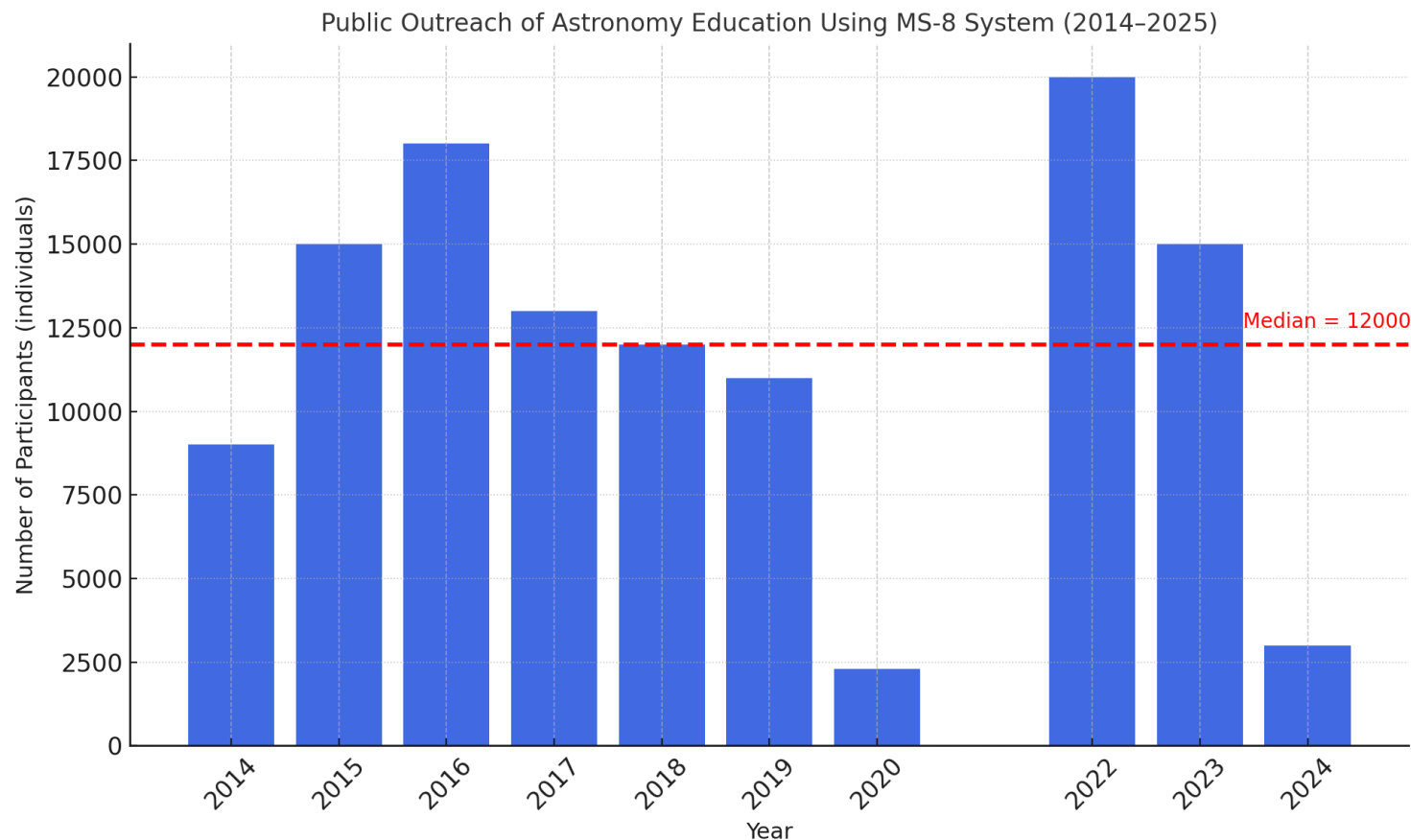
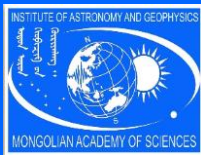
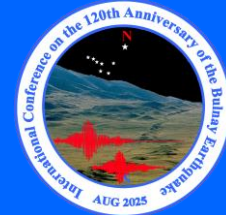


Image 3. Minolta MS-8 mechanical device era (2014–2024).



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



Technological Evolution: Sky Explorer (from 2024)

Developed by RSA Cosmos (France), Sky Explorer is a state-of-the-art digital planetarium system that offers:

- 360° full dome projections
- Real-time data integration from NASA, IAU, and ESA
- High-resolution simulations
- Smart Zoom and HiPS imagery
- Interactive 3D environments
- Alignment with STEAM and "Data to Dome" frameworks



Image 4. Sky Explorer digital system (RSA Cosmos, France).

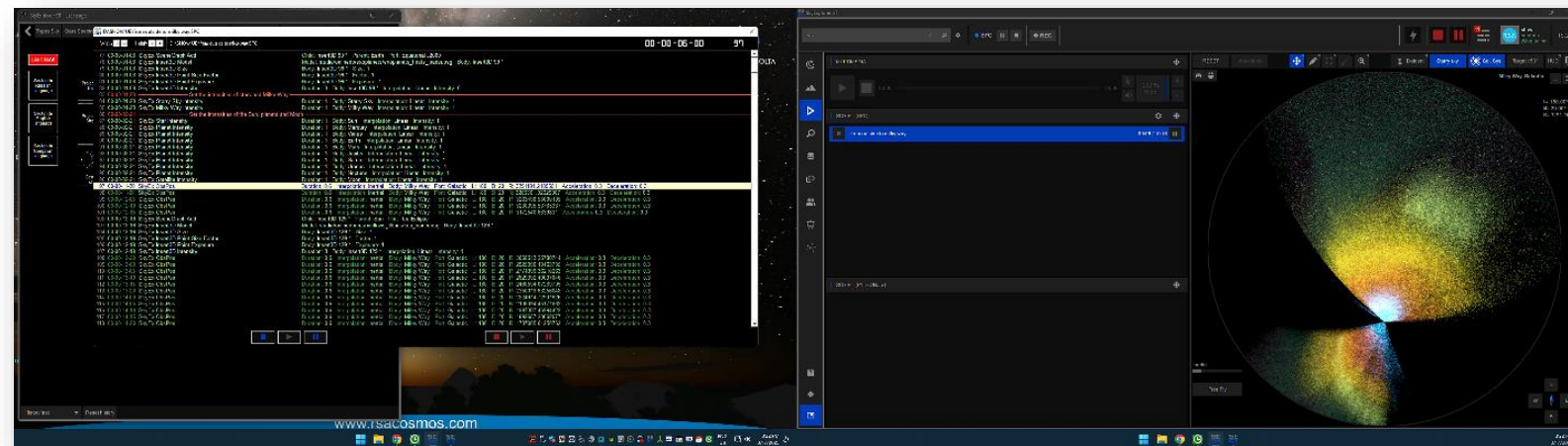
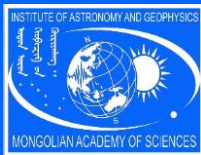
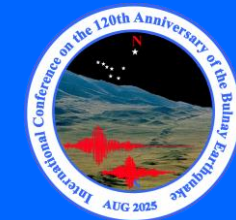


Image 5. Content on the Solar System prepared by Astropark researchers.



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



- Between September 2024 and May 2025, over 16,900 visitors experienced Sky Explorer programs.
- Monthly attendance ranged from 1,400 to 3,400.

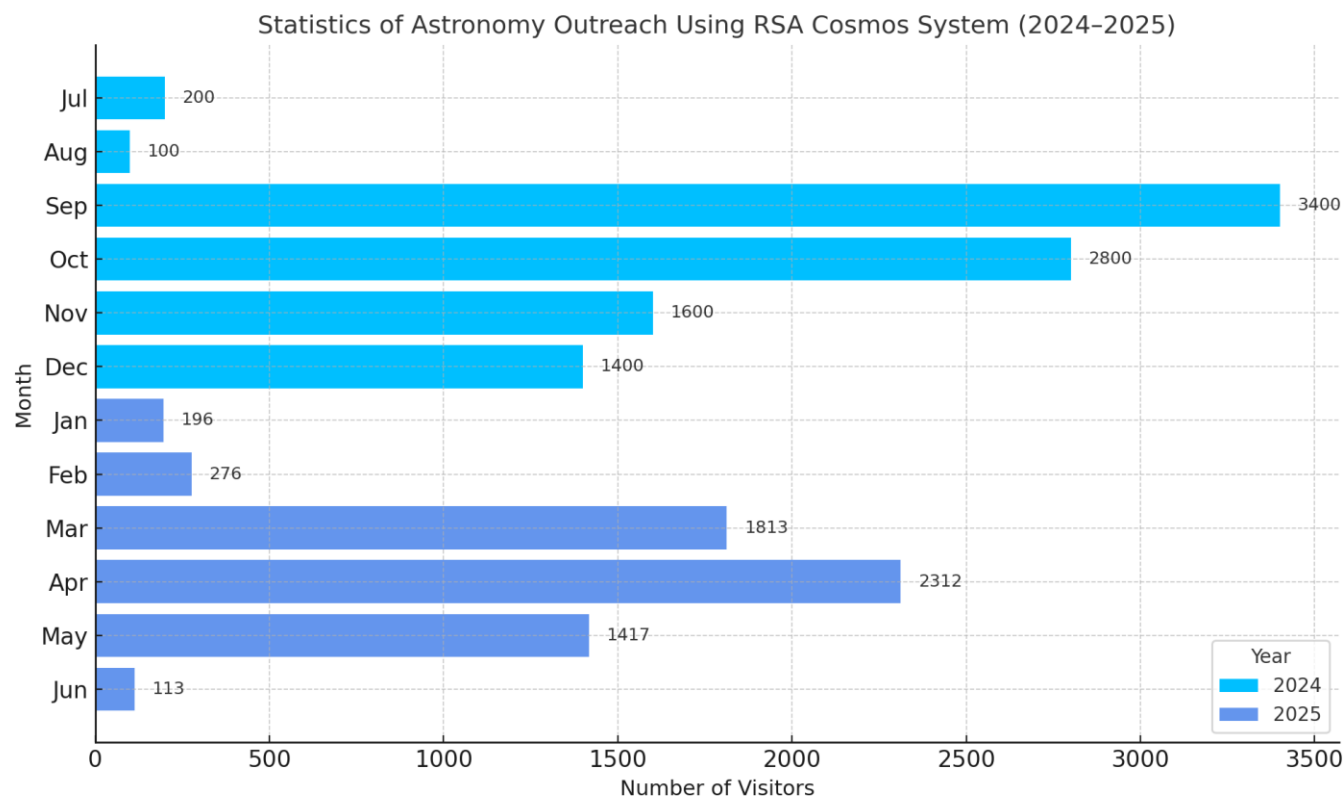
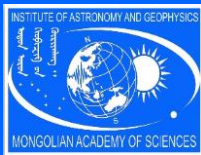


Image 6. Sky Explorer digital system era (2024–2025).



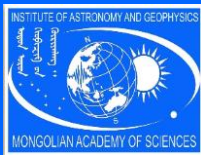
THE INTERNATIONAL CONFERENCE ON THE 120TH ANNIVERSARY
OF THE BULNAY EARTHQUAKE:
ADVANCES IN ASTRONOMY AND GEOPHYSICS



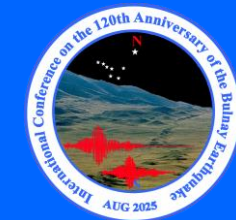
Technology Comparison of Minolta MS-8 vs Sky Explorer

Specification	Minolta MS-8	Sky Explorer Digital System
Visualization Resolution	High (optical lenses)	Very high (3D graphics, HD/4K resolution)
Content Flexibility	Limited (stars, planets, basic motion)	Extensive (planets, galaxies, videos, interactive)
Lifespan	25–30 years (rarely fails)	7–10 years (more susceptible)
Technological Flexibility	Mechanical, non-digital	Python-based with development capabilities
Educational Impact	Helps understand realistic motion	Supports interface, simulation, and interaction
Maintenance	Limited availability of spare parts	Regularly updated via digital system

Table 2. Comparison of Minolta MS-8 and Sky Explorer Digital System



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



Methodology

We adopted a mixed-methods approach:

Quantitative: Visitor numbers, operational hours (2014–2025)

Qualitative: Feedback from teachers, students, and parents; structured surveys; interviews

On average, the Astropark operated 280 days per year, totaling over 10,200 hours of public education.

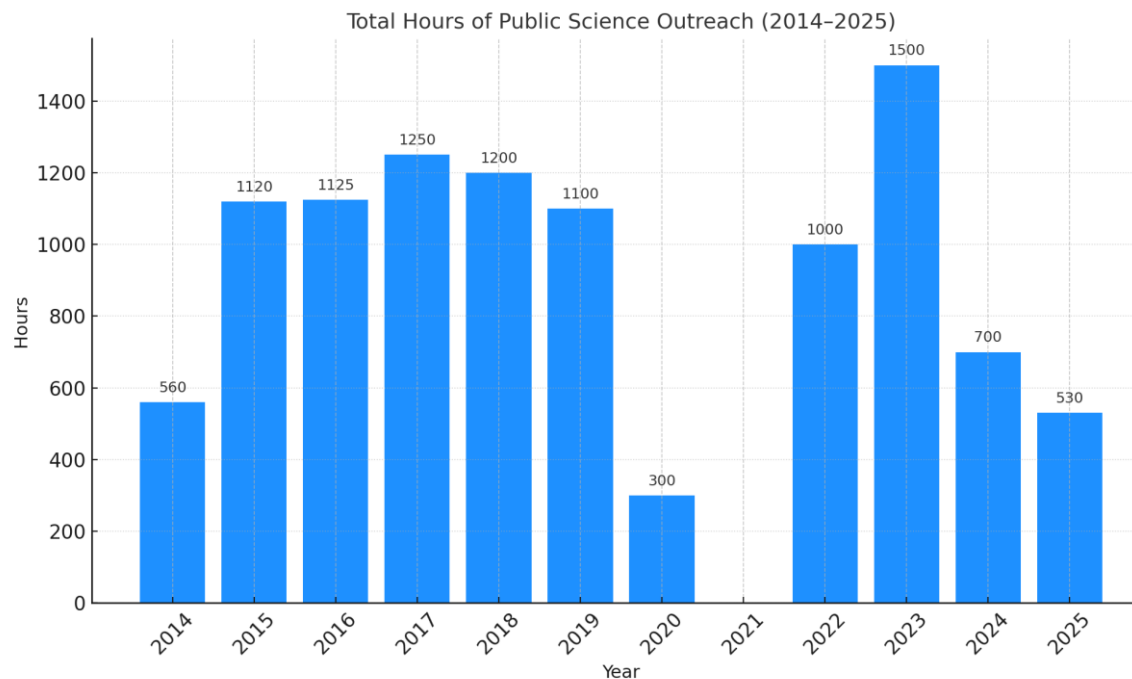
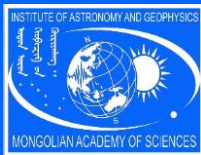
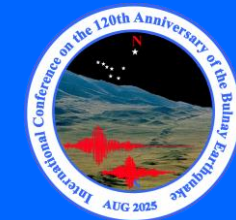


Image 7. Total exhibition hours of science knowledge dissemination through Astropark from 2014 to 2025.



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



Visitor Trends

- From 2014 to 2019, visitor numbers grew by 20–30% annually. Despite a temporary decline during the COVID-19 pandemic (2020–2021), attendance rebounded from 2022 onward, reaching 15,000–20,000 annual visitors.
- As of mid-2025, over 135,000 individuals have engaged with Astropark's programming.

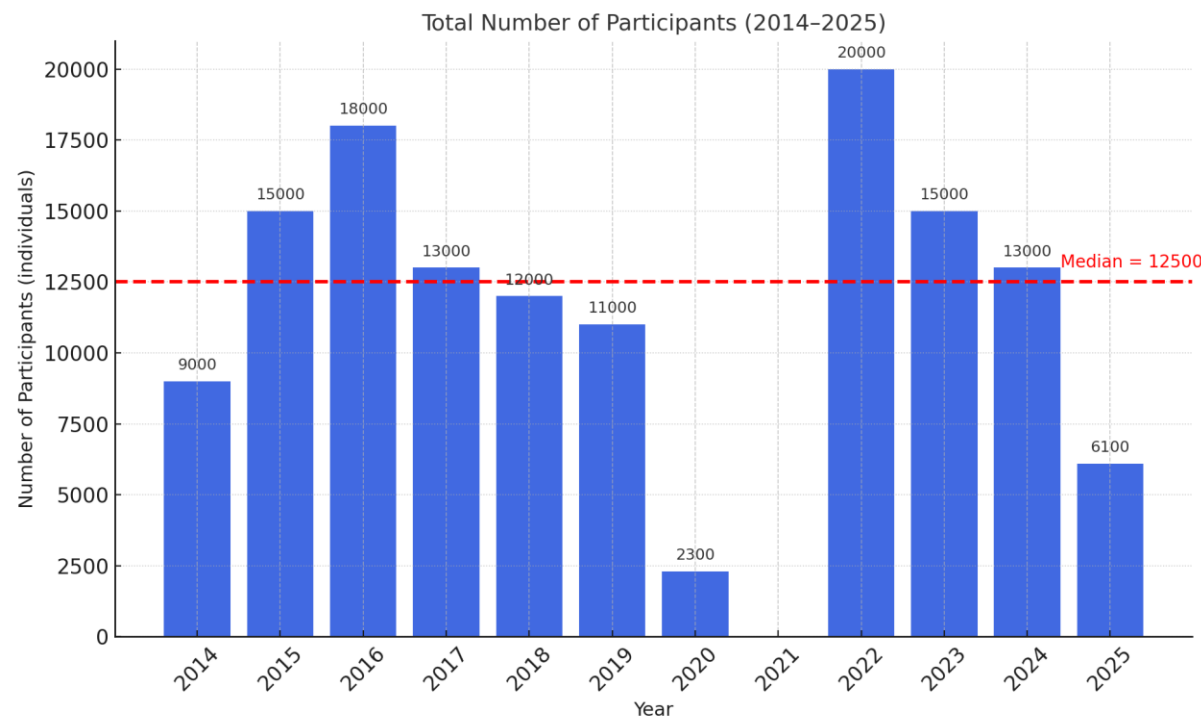
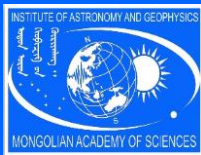
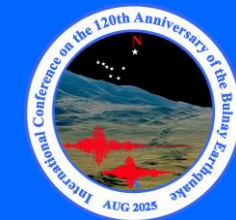


Image 8. Total number of visitors served by Astropark from 2014 to 2025.



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



Accessibility Data

72% of visitors were aged 5–24:

Kindergarten: 15%

School children: 36%

University students: 21%

However, only 2% of all visitors were individuals with disabilities.
This highlights a significant gap in inclusive access and the need
for adaptive learning environments.

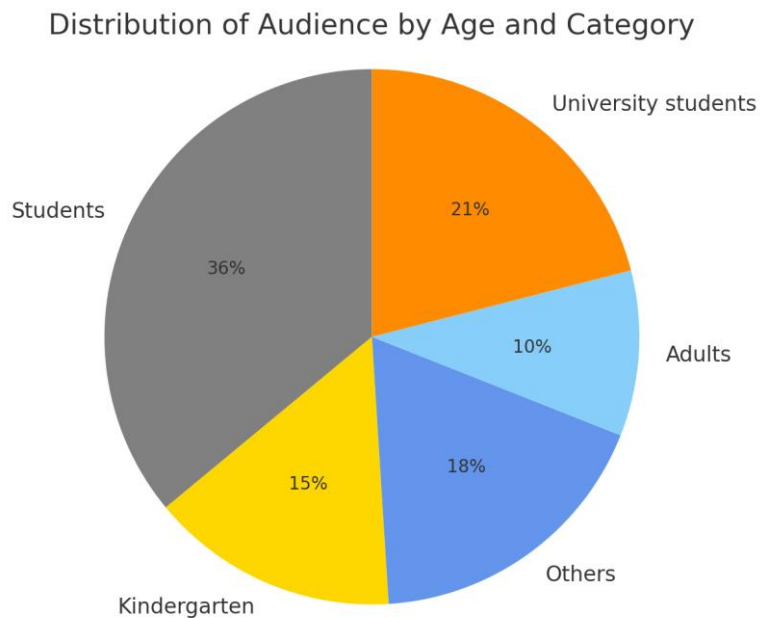


Image 9. Age distribution of visitors (2014–2025)

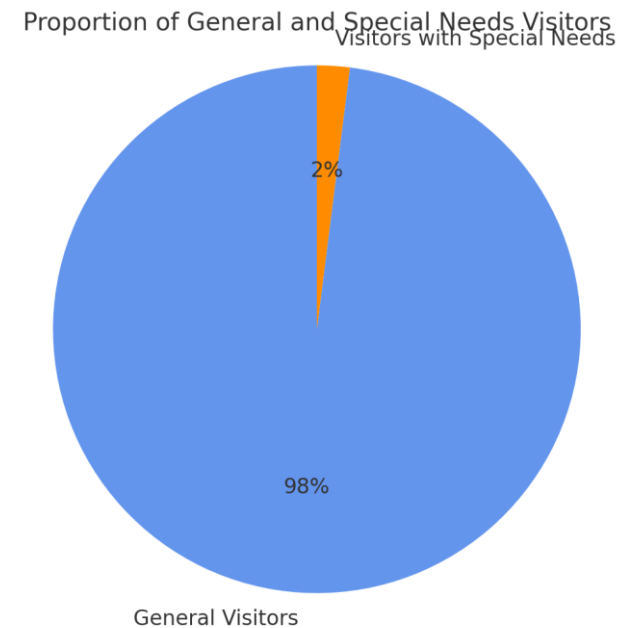
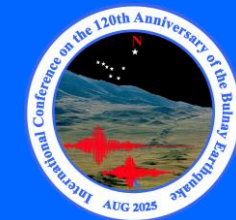


Image 10. Accessibility Assessment (2014–2025)



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



Quality Assessment

Based on 2024–2025 surveys:

- 92% of students reported increased interest in astronomy
- 95% expressed a desire to revisit
- 97% said they would recommend the experience to peers

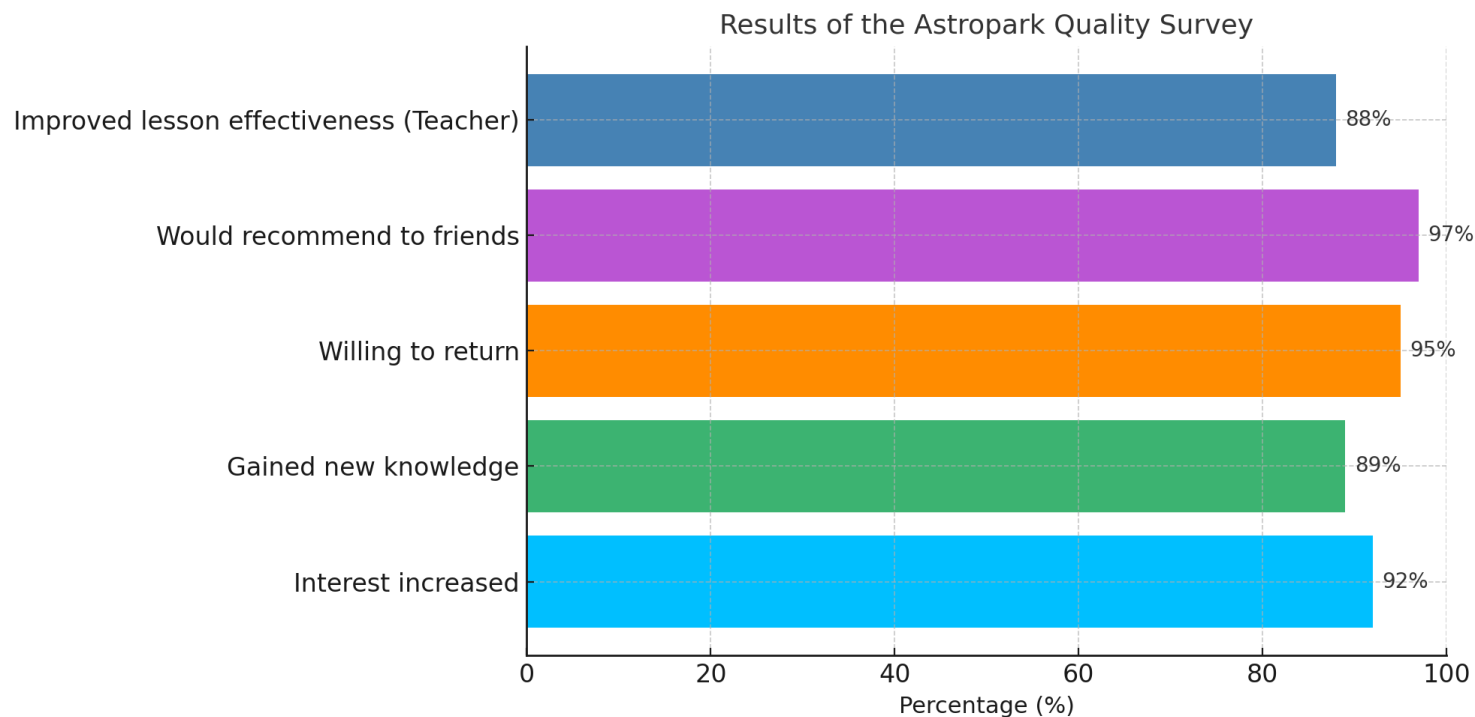
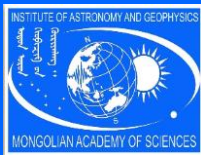
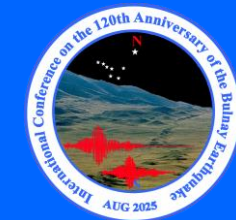


Image 11. Results of the Quality Survey Among Astropark Visitors



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

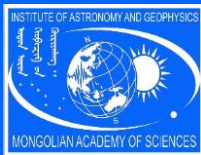


Conclusion

The Astropark has successfully transitioned from traditional mechanical systems to an advanced digital environment. This transformation has elevated both content quality and accessibility. However, inclusive participation remains limited. Future goals include:

- Expanding outreach to rural regions
- Localizing content in Mongolian
- Developing adaptive programs for individuals with disabilities

These steps align with IPS and UNESCO's call for equitable, student-centered science education.

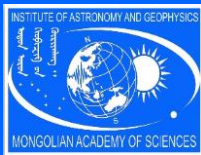


THE INTERNATIONAL CONFERENCE ON THE 120TH ANNIVERSARY OF THE BULNAY EARTHQUAKE: ADVANCES IN ASTRONOMY AND GEOPHYSICS



Acknowledgments:

- Institute of Astronomy and Geophysics
- Astropark personnels
- Teachers, students, and parents who participated in surveys



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



References:

1. Petersen, M.C. (1983). Tallying The World's Planetarium Attendance. *PLANETARIAN*, 12(1).
2. RSA Cosmos. (2024). Sky Explorer 2024. <https://www.rsacosmos.com>.
3. UNESCO. (2020).
4. Planetarium Education Report. Gantuya, B. (2024). Astropark's 10-Year Report.



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



THANK YOU FOR YOUR ATTENTION