

Survey on Space Education in Japanese High Schools and Possibility of Space Education Programs with a 3D-VR Software

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Introduction

The Basic Plan for Space Policy (2013) published by the Office of National Space Policy in Japan emphasized importance of fostering human resources for space development and utilization and promotion of space education [1]. It mentioned the high potential of space as a means to promote the education of science and technology as well as the importance of developing space technology and industry.

We conducted a survey on space education in Japanese junior and senior high schools to grasp the current situation and issues that teachers face. Here, we report major results that became clear from the survey. One of the problems for teachers is that hands-on activities or experiments are difficult in the field of space education. We thought that the 3D virtual reality (VR) technology could give a solution to this problem and started an attempt to develop educational programs with a 3D-VR software.

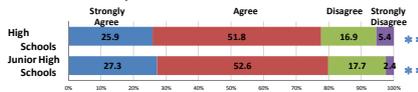
Survey on Space Education in Japanese High Schools

The survey was conducted by mail-in questionnaire in 2015. The questionnaires for teachers who have experiences of teaching fields of science related to space including astronomy were sent to randomly selected 500 junior high schools and 500 senior high schools, and 389 answers were obtained.

Major results from the survey

- (1) Majority of the teachers (about 80%) think that students have high interest in the space-related topics in both junior and senior high school. The interest is higher in the fields of astronomy than in the fields of space technology.
- (2) In the case of junior high school, the largest number of answers to the question asking about difficulty in teaching space-related topics were that large fraction of the students are not good at spatial thinking. The second largest was the difficulty of observations. The third largest was the difficulty of hands-on activities or experiments.
- (3) In the case of high school, the largest number of answers were insufficient knowledge of teachers. The second and third largest were the difficulty of observations and experiments.
- (4) Most demanded support for space education at schools was for the data base of images and videos.
- (5) Most of the teachers are aware that space agencies such as NASA and JAXA (Japan Aerospace Exploration Agency) as well as the publishing companies of the textbooks provide materials to support teaching including images and videos. However, the ratio of the people using the material in the class is not large (about 20%).

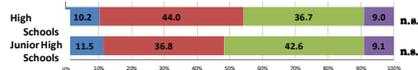
Q. Do you think that your students are highly interested in the field of space ?



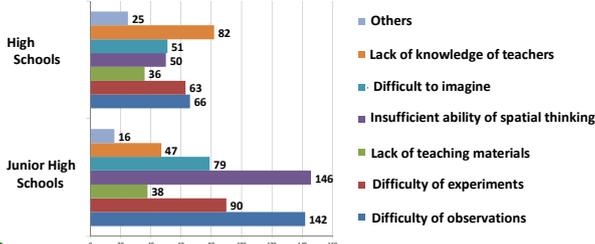
Q. Do you think that your students are highly interested in the field of astronomy?



Q. Do you think that your students are highly interested in the field of space technology (observational technology, artificial satellites, rockets, etc.)?



Q. What do you think makes it difficult for you to teach topics in the field of space science and technology?



Space Education Program with Mitaka for VR, a 3D-VR Software

Advancement and Spread of 3D-VR technology

In 2016, equipment and software contents for 3D VR were released with moderate prices in the market, which made the technology accessible to wider range of users. The 3D-VR technology and contents have the potential to solve some of the major problems that became clear from the survey.

Mitaka for VR

Mitaka is a software developed by the Four-dimensional Digital Universe (4D2U) project of National Astronomical Observatory of Japan (NAOJ) [2]. Purpose of the software is to visualize the structure of the universe and various celestial objects based on the observational data and theoretical models in modern astronomy. In its "space mode", users can navigate freely in the space. It also has planetarium mode. Mitaka was originally developed for 3D visualizations at the 4D2U theater of NAOJ. Versions for 2D screen for personal PC's are also available for free on the internet and have been widely used for education of astronomy and space science. In 2016, 3D-VR version of the software, Mitaka for VR, was developed.

Prototype education program and a trial experiment

We designed a prototype educational program and had a trial at a junior high school in January, 2017. In the program, students form a team of three and explore the solar system in collaboration. The team consists of the captain, an operator, and a recorder. Assigned some tasks, they are expected to learn the structure of the solar system, characteristics of planets, satellites, or asteroids which they selected through the exploration in the virtual universe. The Galaxy is another suitable object for the virtual exploration to study the structure.

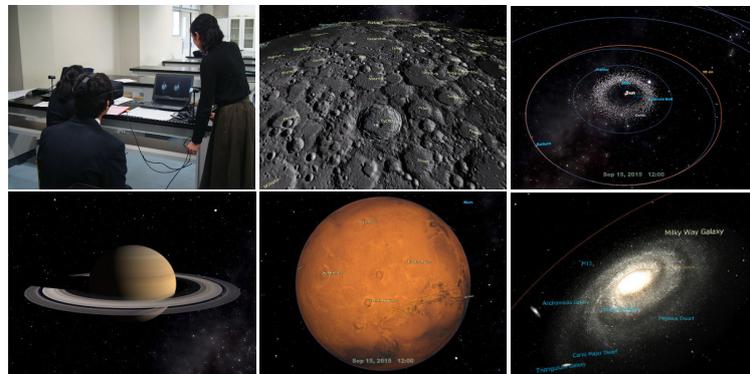


Fig. 1 Trial experiment of the education program (upper left) and some screenshots from Mitaka (Copyright: 2005-2017 Tsunehiko Kato, 4D2U Project, NAOJ).

From the trial, we found that the teacher needs some proficiency to cope with possible hardware trouble. Cost of the hardware settings necessary for the program is still high for general schools at present. We hope reduction of the cost in the future will make the usage of 3D-VR technology available to wider field of space education.

References

- [1] Office of National Space Policy (2013) *Basic Plan for Space Policy* (in Japanese).
- [2] 4D2U project, National Astronomical Observatory of Japan, *Mitaka* web page, http://4d2u.nao.ac.jp/html/program/mitaka/index_E.html.