ANALOG PLANETARY RESEARCH

AS A TOOL FOR EFFECTIVE SPACE EDUCATION

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ABSTRACT

Nowadays there are many more players, including many commercial and private companies and organizations. With a more open space sector, many more people are involved in space research and especially in **Analogue Planetary Research** (APR). APR, **the testing of space hardware, software, procedures and operations on Earth under space-like conditions** has been important for spaceflight since the early days of space exploration. Analogues are also used for **conducting human factor studies** and training. Space exploration has been inspiring students to study science and engineering for generations, motivating them to become researchers and extend the borders of human knowledge. These space missions not only delivered important scientific data, but have been used to bring science to life for students showing how it can be used. **With the advent of a variety of voluntary organizations for students and young professionals we are now able to move from studying previous missions in the classroom to providing hands-on experience.**

This paper presents **the potential for APR, and especially space analogue missions, to contribute to current space research and provide an opportunity for involving students in research**, both in and out of the classroom. Analogue missions can be used **as case studies** to teach students about science and space exploration and can offer an opportunity for students from a range of disciplines (such as engineering, science and medicine) to **get actively involved** and gain hands-on experience in missions.

ANALOG PLANETARY RESEARCH

Analog Planetary Research (APR) is **the development and testing of scientific, technical, operational, social and medical procedures in simulated space or planetary environments for application to crewed and robotic space exploration missions** [1]. APR aims to serve as a low-cost, low risk basis to prepare all kinds of applicable strategies for future planetary missions [1]. Also it provides **opportunities for volunteers and especially students to get hands-on experience in space science and space technologies**.

Although, space agencies only provide limited access to students getting hands-on experience, volunteer organizations such as Mars Without Borders (MWOB), the Mars Society, and the Space Generation Advisory Council (SGAC) work to advance science and engineering, to raise public awareness and engagement in space exploration, and to educate students and young people with involving them from beginning to end regardless of past experience. These efforts have the goal of advancing space exploration toward settlement of the Moon, Mars, and other worlds.

A prominent location for analog studies and space education outreach is the Mars Desert Research Station in Utah, which is used by research groups, professionals as well as volunteers, to simulate human Mars exploration in a terrestrial analog.

Analog astronaut performing EVA

Astronaut taking samples

Interior of the habitat

MDRS at night

ANALOG PLANETARY MISSIONS

Analog Planetary Missions are an **excellent tool for space education providing opportunities for volunteers, especially students, hands-on experience in space science and technologies**. Analog missions contribute in space education in passive and active way, which active education makes difference via allowing students getting full hands-on experience during the mission.

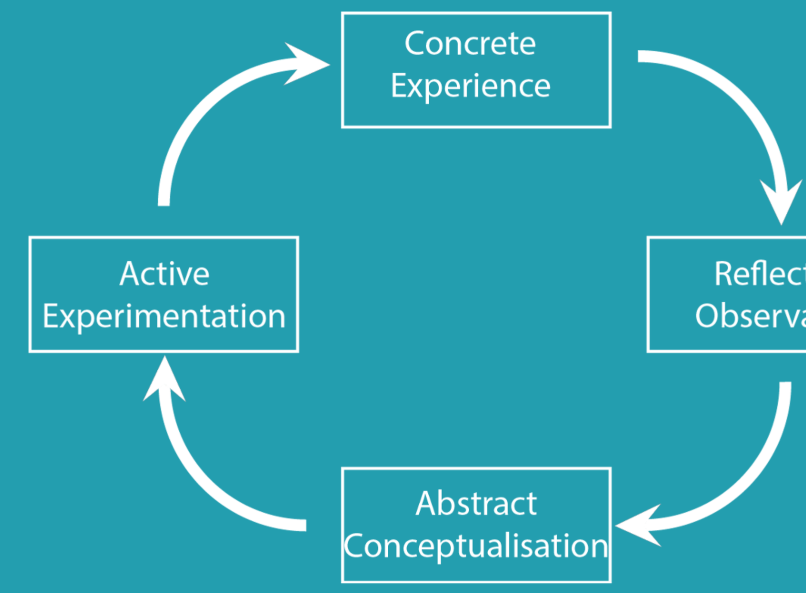
Analog Planetary Missions are the simulation of parts of or the entire human, robotic or human-robotic space missions in terrestrial environments that are an analog to the real space environment. An analog mission starts with **identifying the scientific objectives**, then the **mission framework** is decided on. The third step is the **selection of experiments**, next, in a human mission, analog **astronauts need to be selected and trained**. Another major aspect in the preparation of an analog mission is gathering the **necessary funding**. All in all, even if the mission takes usually up to a few weeks, the proper preparation time is around one year.

In volunteer organizations such as the Space Generation Advisory Council (SGAC) for example, young people can come together to work on space-related topics [2]. Within the SGAC, the Space Exploration Project Group (SEPG) / Analog Planetary Operations Group (APO-G) conducts analog research in line with the General Exploration Roadmap (GER) [3]. It **offers students and young professionals of various professions interested in space exploration the opportunity to gain hands-on experience in a Mars analog mission, to take place in autumn 2016** [4]. The Mission Control Center (MCC) will be crewed up with wide variety of personnel from multidisciplinary background, which provides a high rate of success for the mission due to having a wide spectrum of specialists [5]. **They learn about all aspects of space missions, carrying part of the responsibility for leading the whole mission to success. This is effective 'learning by doing', or 'experiential learning'** [6].

EXPERIENTIAL LEARNING

The theory behind this hands-on experience which is so-called Experiential Learning Theory describes **learning as a process of creating knowledge by transforming experience gathered through the interaction of individuals with the environment** [7].

According to the D. Kolb's cycle, the process of learning starts from experiencing certain situations that are then reviewed and evaluated in the phase called Reflective Observation. The output conclusions lead to planning and modifying future experiences, which increases knowledge by adding analyzed conclusions from past experience[7].



CONCLUSIONS

Decades of education research show that the learning effect is higher when the student not only hears and sees, but also gets some real hands-on experience. **Volunteer organizations such as the SGAC provide easy and free access to these experiences**, complementing and adding to space agencies' limited student programs. Analog planetary missions, for example SGAC's proposed Mars mission simulation, can bring together a multitude of participants from different professional and cultural backgrounds, learning from each other and moreover **learning by performing tasks themselves that in the end contribute to a scientific purpose. These programs not only add valuable knowledge to the scientific questions that motivate these missions; they also effectively trigger a deep learning experience and create in participants the motivation to continue contributing to space science and space technology, fostering the space explorers of tomorrow.**

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SPACE GENERATION ADVISORY COUNCIL

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APO-G
Analog Planetary Operations Group