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Probing a space exploration awareness in a Swedish secondary school

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Abstract. The advancement of space exploration is an important socio-scientific and political issue in Sweden. This study attempts to understand secondary school students' awareness about this national "space ethos" and roles of space technology in their everyday life. Methodologically, this research draws on a sociocultural framework and examines the reflections of 69 grade 9 students in a questionnaire about space exploration consisting of a total of nine multiple choice, short answers and open questions. Students shared awareness and high expectations about space contribution to monitoring climate and environmental problems, providing satnav and telecommunication services, but showed limited understanding about satellite technology.

Introduction

Sweden is steadily advancing its space science and technical capacity. In January 2023, a new launch complex was inaugurated at the Spaceport Esrange, located in the very north of the country, above the Arctic Circle, capable of launching rockets, including human space missions, to orbit. This is the mainland EU's first orbital launch complex offering an independent European gateway to space. Recently the selection of a new Swedish astronaut for ESA manned space missions was announced. These events were closely covered by the media.

The study explores how national space ethos is reflected in fifteen years old students' understandings and expectations about space technology and human space exploration.

Theoretical framework

Sociocultural theoretical perspective was found useful in making deliberations on the pedagogical framing of work with "space exploration issues" in science education. This interdisciplinary area has a solid physics foundation but is also characterised by a variety of epistemic, scientific, and educational uncertainties. For example, science does not provide solid evidence about long-term health effects of exposing humans to microgravity or the long-lasting polluting effects of space launches on different layers of the atmosphere. Teaching about space exploration includes not only conveying a broad array of physics principles, but also pedagogically approaching issues of risk taking, disputed values, uncertain facts and strong national political and economic interests. Focusing on cultural and socio-scientific aspects is important to understand human actions in complex and uncertain contexts and prepare teachers to work with them [1].

Research focus and research questions

This study was guided by the following research questions:

- What do Swedish secondary school students expect to learn about the role of space technologies in addressing everyday life problems?
- How do students' answers on a questionnaire reflect their sensemaking about socio-scientific issues of space exploration?

Methods and findings

The background information for development of the research instrument was collected through analysis of Swedish science/physics curriculum documents and educational resources provided by the national and non-governmental organisations working with space education (e.g. rymdstyrelsen.se; esero.se). The constructed questionnaire consisted of a total of nine multiple choice, short answers and open questions. A small quantitative study with a sample of 69 grade nine students was conducted in northern Sweden.

The paper discusses findings related to students' attitudes and understandings of space explorations. The results show that students are moderately knowledgeable and enthusiastic about national achievements in space. They are aware about the general importance of space technology for communication and satnav, but did not know, for example, how specifically telecom works (signals spread) when they use Wi-Fi on the airplanes. Students show great expectations that space technologies can contribute to solving climate and environmental problems (54%), but also concern about space debris and that rocket launches can pollute the atmosphere (40%). They formulate insightful questions that they would like to pose to astronauts/space researchers if they would have a chance to meet them. For example: "How expensive are rocket launches to go up into space?", "Is space infinite or do you think there is an end?", "How much do you know that you are not telling the public?"

Our particular interest has also been on what attitudes learners reveal towards risks related to scientific space explorations. "Risk refers to uncertainty about and severity of the events and consequences (of outcomes) of an activity with respect to something that humans value." [2] Students were much concerned about risks related to space travel and potential threats that come from space. Over two thirds of the respondents would like to learn more about these issues.

Conclusions

The study identifies specific context-bound areas of inquiry that can be targeted by further physics curriculum development in the field of space education. We found that the students' revealed knowledge and attitudes in responding to a questionnaire can be productively taken into account in developing space education materials for secondary schools. Relevant parts of physics courses can be enriched by introduction of visuals/virtual reality/augmented reality to show how space technologies work in our life and facilitate teaching of physical phenomena. For example, explanations of weightlessness and gravity can be illustrated by experiences of astronauts dealing with varied micro/hypergravity, and data available from the space industry. We need to work systematically in developing space education culture in science classes. An argument is provided for overt training of science teachers in approaching complex space exploration issues with associated risks and uncertainties in order to find personally and socially valued pedagogical solutions and reach expected educational outcomes. The author of this paper is engaged in developing teaching-learning multimodal material including artistic visual production on space related matters that will be also exemplified in the presentation.

References

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