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Astronomy and inclusive development: access to astronomy for people with disabilities

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1. Introduction: Astronomy and inclusive development

Globally, the institutions of astronomy have prioritized inclusive development within their strategic visions. The International Astronomical Union (IAU), and its Office of Astronomy for Development (OAD), have a clearly articulated strategy for social inclusion in the domain of astronomy.

In order to achieve the goals of the IAUs strategy, it will be necessary to enhance access to astronomy knowledge for people with disabilities (PWD). However, there is a paucity of knowledge in this particular domain. This proposed pilot study aims to develop new knowledge to contribute towards filling this gap. In particular, we propose to undertake a small-scale study focusing on access to astronomy knowledge for the visually impaired. The study will test the efficacy of a software tool designed to translate astronomical data into audio signals that can be interpreted by people with visual impairment. By using baseline data (prior to the intervention) and post-intervention data, we will assess the manner and extent to which the software package, and the attendant didactic techniques and classroom activities, facilitate changes in knowledge about astronomy, interest in astronomy, attitudes towards astronomy, and aspirations towards astronomy careers.

The longer-term objective of the study is to develop a knowledge base upon which the intervention can be scaled up, both geographically and to other modalities of disability. At the same time, PWD have great potential to contribute towards astronomy as a discipline, and greater access for this group will therefore increase the global pool of available talent for astronomy.

2. Astronomy as a gateway to science for people with disabilities

Astronomical topics such as weightlessness, black holes, and asteroid impacts have been identified as the most interesting topics among physics students. Astronomy also integrates chemistry, mathematics, biology, computational thinking with multiple STEM disciplines. Science has been considered one of the most valuable subjects taught to students with disabilities, and teachers identify science as the subject most suited for mainstreaming special needs students.

The World Report on Disability (2011) by the World Health Organisation and the World Bank estimates that more than a billion people across the world, or approximately 15% of the worlds population, live with some form of disability. However, in the sciences, professionals and students who are classified as disabled are considered to be a significantly under-represented population. This may be because mathematics and science often rely on one modality of learning to convey key aspects of the content. While

computers can make the world more accessible to the disabled community, the visual nature of computing as it is usually implemented, a lack of resources, and a lack of role models, make it difficult for students with disabilities to participate in science courses and to see themselves as potential. Among the main reasons why disabled learners do not participate in sciences and mathematics is the absence of appropriate access technologies, and the attitudes of teachers and lecturers.

3. Methodology

A *literature review* will assess the state of knowledge with respect to: access to science knowledge for the visually impaired; the use of specialized software to facilitate learning for the visually impaired; and the mechanisms and dynamics of science learning for the visually impaired. The literature review will provide an informed basis on which to develop appropriate final research instruments, and guide the development of a detailed analytical framework.

Research instruments will include baseline measurements (pre-intervention), intervention observations, and post-intervention measurements. Instrument development will also include the development of a fieldwork plan for the deployment of the software package. The *location of the study* will be the Athlone School for the Blind, located in Cape Town, South Africa. *Baseline measurements* will capture demographic data. *Pre-intervention interviews* will include questions to elicit participants perceptions of their capabilities as a result of their academic preparation and access to information. The *intervention* will take the form of the didactic deployment of a specialized software package 'SoundOne'. This sonification (text-to-sound translation) tool has been designed to present astronomy telemetry from text files. *Post-interview questions* will consist of a series of scripted open-ended questions. *Analysis* will draw on the collective research data, both quantitative and qualitative, in order to: assess changes in perceptions of astronomy and science in terms of interest, access, and potential career paths; theorise mechanisms to explain changes in perceptions; identify changes in astronomy knowledge as a consequence of the intervention; identify mechanisms to explain changes in knowledge; reflect on the efficacy of the software package, and the efficacy of the didactic methods used to apply the software in the classroom setting; analyse demographic variables in relation to changes in knowledge and perceptions; and identify lessons for future application and scaling up.