Community Observatories: Going Beyond the Dome to Bring Science Education to Rural Communities

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I have walked that long road to freedom. I have tried not to falter; I have made missteps along the way. But I have discovered the secret that after climbing a great hill, one only finds that there are many more hills to climb. I have taken a moment to rest, to steal a view of the glorious vista that surrounds me, to look back on the distance I have come. I can only rest for a moment, for with freedom comes responsibilities, and I dare not linger, for my long walk is not ended.

- Nelson Mandela
BIOGRAPHY

Jonathan Padavatan is Presenter and Senior Technician at Wits Planetarium, University of the Witwatersrand, Johannesburg. Besides maintaining the world’s oldest working star projector, he presents shows to school children, university students and the general public. Jonathan has a BSc (Honours) Physics degree and is completing his MSc in Computer Science.

ABSTRACT

Rural South Africa possesses one of the most inspirational forms of natural beauty: the night sky. This paper explores the possibility of establishing community observatories at suitable locations in South Africa, using astronomy as tool to improve science and maths education for school children in under-resourced rural areas. Communities around the observatory would hopefully be encouraged to regard the clear night sky as a natural resource worth preserving and protecting. Africa can reunite with her ancient wisdom by exploring her ancient skies.

INTRODUCTION

Astronomy has an unparalleled power to make maths and science accessible to school children. At Wits Planetarium in Johannesburg, South Africa, presenters use this power on a daily basis to spark an interest in science and show learners that they can master mathematical concepts that they perceive as abstract and very difficult.

In South Africa, the country’s Apartheid legacy is starkly evident in our education system. Private schools and government schools in affluent areas provide quality education, while the majority of government schools struggle with overcrowded classrooms, overwhelmed teachers, and a lack resources and infrastructure. Schools in rural areas are often the most disadvantaged, and many lack computers, science labs, libraries or even a reliable electricity supply. However, the lack of light and air pollution in rural areas means these learners do have access to the greatest and most inspiring natural laboratory of all: the night sky.

The Wits Planetarium is one of the University of the Witwatersrand’s main vehicles for science outreach. Over 60 000 school children visit the Planetarium each year, usually as part of school field trips. Besides schools from the cities of Johannesburg and Pretoria, we also receive visits from schools based in the primarily rural provinces of Limpopo, North West and Mpumalanga. One day, while contemplating the irony of children being brought from rural areas to the city to be shown the beauty of the night sky, I asked myself how we could motivate these children to see their natural dark skies as an asset, rather than an unfortunate side effect of underdevelopment? There are probably many answers to this question, but the one that I hit upon was the concept of a community observatory.

I. WHY A COMMUNITY OBSERVATORY?

Children are natural scientists. They explore their environment, study the world around them, conduct experiments (what happens when I bite the ocean?) and draw conclusions from these experiments (sea water is salty and not good to eat). Yet day after day, I encounter groups of school children who find science boring or intimidating. They tell me that science and mathematics are “scary”, they lack confidence in their own abilities in these subjects. Many are so disengaged that they have completely given up on learning anything from these subjects, and cannot see the relevance of maths and science to their lives.

In recent years, a growing body of research in neuroscience and psychology has identified weaknesses in traditional teaching methods contribute to the pervasive myth that maths and science are dry, abstract and difficult. Internationally, educators are moving towards teaching methods that focus on an experiential, project-based approaches, which build upon children’s natural ability to learn by engaging with problems in the real world, rather than by reading about them in text books. Experiential learning, where learners explore information in practical and creative ways, helps children who are already engaged with a subject to excel, and those children who have lost interest to re-engage and begin learning.

The Planetarium is an ideal venue for exploring maths and science in exciting, creative ways. Space travel, like dinosaurs, is one of those branches of science that grips young minds and ignites a passion for science. In almost every field of science, you will find eminent professors who owe their initial interest in scientific matters to either Carl Sagan or T Rex. But for children who have lost all faith in their own abilities, and who worried that they will not be able to get a job at all because they cannot pass even the most basic maths test, the Planetarium is also the ideal place build new confidence, because learners can relax and immerse themselves in wonder and beauty.

For example, I use this very simple exercise during shows: after enjoying the star field for a few minutes, I point out the summer triangle of southern skies, comprising the bright stars Sirius, Betelgeuse and Procyon (see figure 1). I then ask the
learners to identify the isosceles triangle, and lead them in a discussion on which two sides are equal. I then inform the
learners (who 10 minutes before complained that maths was a terrifying subject) that they are actually doing maths.

![Isosceles Triangle](image)

**Figure 1 – The summer triangle as a geometry exercise**

Techniques that are effective under the dome can also be taken outside under the stars, and the Wits Planetarium has a long
history of outreach and community engagement. In the late 2000’s, the Planetarium (then known as Johannesburg
Planetarium) ran a project called the Astro Hit Squad, which involved mentoring a group of high school learners, many of
whom came from disadvantaged backgrounds. They participated in astronomy events, did science projects, and took
telescopes into the streets of the inner city and townships around Johannesburg, to engage passers-by in impromptu star-
watching sessions. Several Astro Hit Squad members went on to study at Wits University and embarked on careers in science,
including Dr Sheldon Rameez Herbst, who maintains that the mentoring and inspiration he received in the Astro Hit Squad as
a teenager was a key motivating factor that led him to a career in computational astrophysics. In a testimonial in support of the
community observatory project, Dr Herbst said, “As an applied mathematician doing research in computational astrophysics I
am still fueled by the same sense of intrigue that was fostered in the Astro Hit Squad…. It is without doubt that the
Planetarium’s Astro Hit Squad has contributed significantly to the scientist I am today and that the creation of such initiatives
is fundamental for the scientific development of young children.”

The Astro Hit Squad programme showed the power of extra-curricular science projects to improve school maths and science
results and to make further study and careers in science accessible to young people who might otherwise not have had this
opportunity. By taking similar programmes to rural areas, disadvantaged children in these areas could be given similar
opportunities. In addition, the growth of the astro-tourism industry in South Africa provides an opportunity for direct job
creation, by training community members to act as “sky guides” at the many holiday resorts, luxury game lodges and wild life
reserves that are now offering star watching as a tourist activity. Tourism is perhaps the only industry which has the potential
to create jobs and economic opportunities in rural areas, at a time when the large employers in these areas, mining and
agriculture, are shedding jobs. The community observatory would therefore be an asset to the entire community, not just to
schools.

After staring at the Africa at Night images from space for a while, I saw the potential for expanding the horizons of nature
conservation by linking local eco-tourism with the international dark skies movement. Rural communities would have a
tangible reason to become guardians and protectors of their dark skies. They could also promote indigenous knowledge
systems and traditional star lore.

With this as very strong motivation, I then set out to identify a suitable site for a community observatory pilot project.

**II. A BUMPY RIDE ON THE ROAD LESS TRAVELED**

As our Planetarium is based at Wits University, the obvious first choice of site was the Wits Rural Facility (WRF), a nature
reserve and research facility owned by the university. Situated in Acromhoek, near to the Kruger National Park, WRF seemed
to be an ideal site. It has clear, dark skies, is located in a low rainfall area, and is accessible to a large number of nearby
village, farm and township schools. It also has existing accommodation, conference and teaching facilities. In April 2017 I
visited WRF to assess the site, and make contact with stakeholders. I subsequently drew up a concept note for a small
observatory to accommodate both the public and school groups, consisting of an 8 inch to 12 inch telescope, and a structure to
house the telescope. The observatory was envisaged as a joint project between Wits University and the local community, with
activities such as school visits; school holiday programmes; training programmes for teachers on how to use the night sky as a
natural laboratory; star-watching evenings for tourists; training programmes for sky guides in the astro-tourism industry; and
corporate team-building events combing astronomy with a bushveld experience. Teachers at local schools expressed a great deal of enthusiasm for the project.

However, it soon became clear that obtaining funding was going to be formidable challenge. The project did not fit neatly into any one category, and did not seem to meet anyone’s funding criteria. I applied to Astronomy for Development, who declined to fund it on the basis that they were not sure of the educational value of the project.

I then approached Wits University, and was referred to the Global Change Institute (GCI), which runs climate change and sustainable development projects at the WRF. They could see the value of the community observatory as a science outreach project, but it did not fall within their mandate. (On the bright side, I formed a friendship with Professor Barend Erasmus of the GCI, who recognized the link between my dark sky agenda and more efficient lighting to lower energy consumption. I was subsequently invited to join Wits sustainable development on campus forum created by the GCI).

I also approached various private sector stakeholders, and everybody loved the idea and saw great potential for income generation, but nobody was willing to provide the start-up capital.

In the interim I had also been discussion with the Square Kilometer Array (SKA) telescope project, South Africa’s premier astronomy project. They are currently considering potential science outreach projects, but are engaged in their own project selection process. A community observatory was one of the ideas under consideration, however they are focused on the SKA telescope site in the Northern Cape, whereas the Wits Rural Facility is quite literally at the other side of the country.

It therefore appears that despite the great potential, there is not much chance of establishing a community observatory at the WRF, at least in the short term. The lessons I have taken away from this process are the difficulty of fund-raising for a project that cuts across the different areas of education, science outreach, job-creation and nature conservation; and pit-falls of conceptualizing a project in isolation and then trying to sell it to others. Projects such as this, which involve many different stakeholders, should preferably start out as partnerships with local champions, who share a passion for science education, and all stakeholders should co-create the shape and content of the project.

III. BUT... WHERE THERE’S DARKNESS, THERE’S HOPE

In 2018, Wits Planetarium was accosted by the chairperson of a passionate group of nature enthusiasts, the Friends of Suikerbosrand. Suikerbosrand is a nature reserve situated approximately 50 km from Johannesburg, and is one of the few nature conservation areas in the largely urban and industrial Gauteng Province. The Friends of Suikerbosrand are a group of volunteers who are committed to preserving this piece of wilderness. They are interested in astronomy, see the value of promoting dark skies as part of nature conservation, and it was clear that I had no other choice but to haul a telescope up a mountain and provide them with a star-watching evening.

Omega Centaurus is one of the most spectacular features of the Southern Skies. That cold night (it was around 2 degrees Celsius) we could easily see that wispy smudge almost the size of full moon hanging in the sky near the Southern Cross. The black-backed jackals were calling in the distance, almost mockingly at our search for meaning in the darkness. We were a mere 40 minutes drive from the Johannesburg City centre but we were mesmerized by the 1 million star cluster that filled the field of view of the telescope. Not only were we transported to another time, a time of our far ancestors, but we were transported through our 8inch telescope, to a world that could exist in Omega Centaurus. We imagined the night sky of that world, that frigid night. A spotted eagle owl huu-hooed in acknowledgement. Later on, as we warmed around the fireside, sharing our various states of awe for the cluster, we found a moment of reverence for the darkness. A group of strangers a few hours ago, now a community of observers.

I wonder what effect this experience would have on a young mind from an under-resourced school with little chance of passing her next mathematics test?

The Suikerbosrand reserve is managed by the Gauteng Provincial Government, and the reserve management are interested in exploring astro-tourism at the reserve. The proximity of the reserve to Johannesburg means that it is considerably easier and cheaper for the Planetarium to conduct outreach there, and there are many schools in the surrounding farming and peri-urban areas. I am therefore hopeful that the dream of a community observatory remains alive, but the form it takes will depend on a collaboration between the Reserve Management, local communities, the Planetarium and the Friends of Suikerbosrand.
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