The UNAM/AMT Mobile Planetarium: Lessons learnt on how to run a student-driven mobile planetarium project in Africa

Case Study

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The UNAM/AMT Mobile Planetarium travels to Namibian schools and presents live astronomy shows, introducing school children to astronomy and science in general. Mobile planetariums face a host of specific challenges, especially logistical ones. Moreover, very few planetariums are situated in the Global South (*International Planetarium Society, n.d.*), where documentation (e.g., *Carlson, 2020; Olivier, 2014*) on them is limited, mainly focusing only on stationary planetariums in Africa and, in most cases, are not easily accessible. Here, we detail the challenges faced and share our lessons learnt in an African context, particularly revolving around the use of student volunteers as the backbone of the project. We will also contribute insights into how to deal with vastly different school environments. The logistical issues and lessons discussed here span the mobile planetarium's electricity requirements, how to manage heat build-up in the dome, and how to deal with the lack of large indoor spaces that our mobile planetarium usually requires. We additionally discuss the challenges around funding for the project. The work presented here was adopted and adapted as a scaled version of the successful NOVA Mobile Planetarium Project in the Netherlands (e.g., *Holt, 2022; NOVA, 2023*), noting that Namibia provides a very different outreach setting. In summary, a solid logistical and organisational basis is invaluable, as well as seamless teamwork and the right approach to secure future sponsors for the mobile planetarium project.

Introduction

The UNAM/AMT Mobile Planetarium project was created as part of the more comprehensive Africa Millimetre Telescope (AMT) project (*Backes et al., 2017*). The AMT is an upcoming radio telescope that will serve as part of the global Event Horizon Telescope array (*La Bella et al., 2023*) as well as monitor Active Galactic Nuclei as a standalone telescope (*Backes et al., 2019*).

Since the AMT project is a joint project between Namibia and international partners, it is important for Namibia to stand on equal ground with its partners. Inequity between partners from the Global North and the Global South is a general problem in North-South research partnerships (*Flint et al., 2022*). It is also an issue in astronomical collaborations (*Dalgleish, 2021*). Efforts are underway to solve this ongoing, multi-

faceted issue (*Perivoli Africa Research Centre, n.d.*). Having sufficient, well-educated Namibian astronomers is part of the journey towards more equity. Also, more generally, the development of local astronomy in Africa helps to drive socioeconomic development (*McBride et al., 2018*) and would put Africa in a position to challenge and add to existing science, as Backes argues (*Brits, 2022*).

In 2014, the Namibian Government reaffirmed its commitment to positioning Africa as an emerging hub for astronomical sciences and facilities (*South African Government, 2014*). In 2021, it launched the Namibia Space Science and Technology Policy. As per the mission of this policy, the Namibian Government is "to create platforms and an enabling environment for the development, promotion, coordination and optimisation of space science and technologies for the Namibian nation" (*MHETI, 2021, p. 10*).

Despite the progress in developing astronomy in Africa in recent years (e.g., *Backes et al., 2018; Pović et al., 2018*), Africa still lacks sufficient astronomers. This is exemplified in Ghana (*Sapah, 2023*) and Namibia, as Backes laments (*Woodall, 2022*). The mobile planetarium project, initiated by the University of Namibia, Radboud University (RU), and the Netherlands Research School for Astronomy (NOVA), serves to remedy this, amongst other goals.

Namibia is a vast country with very clear and dark skies, so the goal of the planetarium is not necessarily to show the night sky as one would see it in a dark sky region but to alert children that the field of astronomy exists via a fun, easy, and memorable experience, and therefore kindle the next generation of Namibian astronomers (*Radboud University, 2019; Radboud University, n.d.a*). More generally, astronomy is a "Gateway Science" (*Salimpour et al., 2021*), and planetariums are valuable tools for education and outreach towards young children because of their interactive and engaging nature (e.g., *Plummer, 2008; Sumners et al., 2008*). Sparking enthusiasm for astronomy in schoolchildren is especially important since astronomy is only briefly covered in the Namibian school curriculum when the Solar System is introduced. It is also worth noting that the goal of this planetarium project is not science education but outreach. As *Pössel and Liefke (2022)* note, education and outreach, though complementary, have fundamentally different goals.

As an additional motivation for the schoolchildren, the presenters of the planetarium are Namibian students in physics or astronomy and serve as role models for the possibilities of an astronomy career. A discussion on the project's success is not yet possible but will be included in future research. Aside from this broader goal, the mobile planetarium also raises awareness of Namibian youth and the general public about the AMT project (*Radboud University, 2019; Radboud University, n.d.a*).

The UNAM/AMT Mobile Planetarium Project

Pilot Phase

In April 2019, NOVA conducted a pilot project using one of their mobile planetariums. This programme, operated by NOVA and supported by the Rössing Foundation, RU, and UNAM, toured through Northern and Eastern Namibia and hosted two events in Windhoek (*Holt, 2020*). During this time, the inflatable dome visited ten schools and one university and reached 1,588 students in total (*Rössing Foundation, n.d.*). The project was deemed a great success and has since been adopted as a central element of the AMT Social Impact Plan (e.g., *Dalgleish et al., 2022; Holt, 2022*). This initial pilot phase of the mobile planetarium project did not yet have a set project structure or event structure, and the AMT was also not mentioned when talking to the learners.

Main Phase of the Project

A planetarium dome explicitly bought for the AMT has been in Namibia since 2019. The project's main phase was supposed to start in 2020 but was postponed due to the Covid-19 pandemic and related travel restrictions. Thus, only in May of 2022 were the first Namibian students trained in the operation of the mobile planetarium by a NOVA expert. In addition to lectures and technical training, trainees gained practical experience by presenting shows to learners. Since the inaugural show in May 2022, presented by the Namibian students themselves, the mobile planetarium project has visited schools, universities and corporations regularly; the common frequency is one or two events per week. Recently, we welcomed the 5,000th visitor to the planetarium. As of April 2023, 9,816 individuals[1] have attended the mobile planetarium, with over 5,000 attendees counted in 2023 alone.

The Mobile Planetarium Team

Currently, the mobile planetarium is coordinated with the help of two UNAM and RU staff members and operated by nine voluntary students from the University of Namibia. Of the nine students, two are undergraduates in physics, five are master's students in astrophysics, and one is a PhD student in physics, specialising in radio astronomy. For an extended period of the project, the students organised the school events themselves, a task now taken over by a staff member. The students run the planetarium shows and all associated tasks independently and autonomously. This is a great learning experience for the learners and the student volunteers who learn through project-based learning (*Buck Institute for Education, n.d.*).

It is also worth noting that the team consists of six students who identify as women and three students who identify as men; for example, in the USA (*Porter & Ivie, 2019*) and Africa (*Pović et al., 2021*), the fraction of women-identifying astronomers is small. In the USA, 21% of physics Bachelor's degrees were obtained by persons who identify as women (*Porter & Ivie, 2019*). In contrast, the corresponding figure in our team is 43%, while 100% of current physics undergraduates identify as women.

Organisational structure

When speaking about organisational structure, we do not refer to hierarchical structures but rather a more horizontal structure with lateral leadership. We have defined the following roles: presenters, pre-talkers, post-talkers, organisers, tally clerks, media and marketing, spokespersons, correspondents, and educators, with the latter three roles being more overarching and not strictly required for any single event. Every person can and should fill more than one of these roles, depending on what is relevant to the event.

This structure ensures two things simultaneously:

- Everyone has a clear role, and team members do not enter into conflict over assigned duties at a given event.

- If the roles are well-defined, then there is always a team member who is individually responsible for every task that needs to be completed.

The above is a well-known management practice (e.g., *Flint & Hearn, n.d.*).

Roles are allocated according to skills (with team members trained to fulfil particular tasks) and preferences. This approach allows the volunteers to assign themselves according to their likes and dislikes and allows them to fluidly take on new roles as they learn and develop new skills. This way, the team structure arose organically; volunteers were not forced into a predetermined structure. This structure is crucial because the project relies on a large team of student volunteers, as preference alignment is tied to improved performance (*Willems & Walk, 2013; O'Keefe & Linnenbrink-Garcia, 2014*). This also highlights our use of project-based learning as a pedagogical approach to improve their skills and prepare them for the workforce. This fluid team structure does not seem to be a common practice among other established mobile planetarium projects that often have a team of contractual workers operating the planetarium (e.g., *The Travelling Telescope, 2015*), but we have found this to be most successful.

The Planetarium Logistics & Events

The mobile planetarium fits nicely into the back of a large pickup truck while still leaving space for the driver and four potential passengers, such as the students who run the planetarium shows. Currently, most of our planetarium events are conducted in Windhoek, our base of operations. The challenges associated with expanding the visits to sites outside Windhoek are discussed in the Challenges Section.

The UNAM/AMT Mobile Planetarium project primarily focuses on bringing the planetarium to schools and running shows for learners (and preferably their teachers). The planetarium is large enough to accommodate 30 children or around 20 adults. Each school event with the planetarium can reach up to 300 attendees; we typically reach 260 learners during a single event. Typical visits conducted at schools in Windhoek are around five to seven hours. Included in this time frame is one hour on either end of the event that is used for setup and disassembly of the planetarium. The planetarium is also used for public and corporate events, essential for networking and opening avenues for potential future sponsorships.

Initially modelled after the three NOVA mobile planetariums in the Netherlands, the shows are live, interactive and individually customisable (*NOVA, 2023*). *Holt (2022)* notes that these shows' success is due to their live and interactive nature rather than running pre-made films. At one event with the planetarium, multiple consecutive shows can take place inside the planetarium.

With experience, the structure of our shows evolved into what it is today; all talks are realised without any technical aids like slides or blackboards. The typical sequence is as follows:

(1) We give a pre-talk; *Okwei et al. (2022)* note that this introduction enhances learners' understanding of the astronomy concepts presented. The content of this pre-talk differs depending on the age group.

- Younger children (aged 12-13): 10-15 minutes maximum. There is a brief introduction to the AMT project without explaining its scientific purpose. Instead, this pre-talk piques the children's interest and gets them excited about astronomy. Usually, we ask the learners basic questions about the Solar System. We explain the rules of the planetarium extensively to ensure that the learners do not damage the equipment. Figure 1 shows a team member giving a pre-talk to a group of preschoolers.
- Older children and adults (aged 13 years and above): 20-25 minutes. The AMT project is introduced in detail, its impact on Namibian society, and why Namibia is an ideal location for this observatory.

(2) After explaining the safety instructions, we invite the learners into the planetarium for a session inside the dome, modelled after those from NOVA (*Holt et al., 2023*).

- Younger children: 20-40 minutes maximum. In our experience, content for this age group that revolves around the Solar System works best, as this is a topic with which Namibian schoolchildren are usually already familiar. In the presentation, the learners observe the Earth from above, and the presenter discusses one or two planets in the Solar System in detail. Other topics are only covered if one of the attendees of the planetarium asks. Local links to telescopes in Namibia, like the High Energy Stereoscopic System telescopes (H.E.S.S.; *de Naurois, 2018*), are frequently mentioned.

Figure 1: *A team member giving a group of children a pre-talk before they enter the planetarium. Image Credit: Barbara Kerkhof*

- Older children and adults: 30-60 minutes maximum. The Milky Way is projected as a visible light image as seen from Earth in clear areas with no light pollution. Different invisible emissions, such as gamma rays and hydrogen emissions, are displayed and explained, along with satellites, space junk, and different space telescopes. The Earth and the rest of the Solar System are seen from above, later zooming out to the rest of the galaxy, travelling to the supermassive black hole in the centre of the Milky Way (a natural link to the local AMT project) and then zooming out to the entire visible Universe.

(3) Structured post-talks are only offered to younger children. We ask learners to share their experiences with the planetarium team, which serves to better gauge their interests and adjust the content of the show. We also emphasise that the AMT needs supporting staff in addition to astronomers. For older children and adults, interested learners often independently approach team members for more input on astronomy.

The Role of School Teachers

School teachers play a crucial role in the project; they often learn about the planetarium by attending networking events and experiencing the planetarium shows themselves. Teachers usually establish the first contact with the team and request a school event. Teachers also help raise awareness of the project in the community, as educators from different schools frequently communicate and recommend the mobile planetarium experience to other schools.

Further, teachers have a fundamental role in engaging their pupils in astronomy in the long term, beyond short planetarium visits. To support this, we recommend interactive and easily accessible smartphone applications teachers can use to teach astronomy concepts. Follow-up communication with teachers a few weeks after the planetarium visit has revealed that when teachers cover astronomy topics in school, they frequently mention the planetarium visit to illustrate a concept that they are currently teaching. The teachers also better understand the value of smartphone applications as a learning resource after seeing learners' enthusiasm in the interactive planetarium environment. However, it is important to note that the planetarium experience does not directly influence the content that teachers cover in the classroom. Rather, teachers refer back to the learners' past planetarium experience as a convenient illustration when teaching an astronomy concept that is already in the curriculum, such as planetary motion.

Challenges

Since we are based in Africa, our mobile planetarium faces many specific challenges that might not be present to such a degree outside Africa. These are project-specific challenges but also structural issues.

The project-specific challenges include but are not limited to the need for seamless teamwork, significant logistical efforts (e.g., the need for electricity and a vehicle to transport team members and the mobile planetarium), training the student presenters extensively, and developing effective show-running techniques.

A Science Outreach Project in Africa

Besides project-specific challenges, there are also broad structural challenges in Africa that must be considered. Countries in the Global North, where most planetariums are based, have, in general, much higher Gross Domestic Products than countries in Africa (*The World Bank, n.d.a*). In addition, countries in the Global North allocate a much higher fraction of their annual budgets to science projects (*The World Bank, n.d.b*).

Since there is monetary support for science projects in the Global North, it is evident that implementation structures, such as established partnerships with other research institutions and governments, the recruitment of qualified staff, scholarships for PhD students, supply chains for specialised equipment, and project management policies are also present. In Namibia and Africa as a whole, these implementation structures, though present, need to be more sophisticated, largely due to the lack of funding. This issue is exemplified by the state of the Namibian National Commission on Research, Science and Technology, which has faced "numerous budget cuts" by the Namibian government in the past, according to Keramen (David, 2020) and therefore struggles to uphold its mission.

Additionally, the Global North has a large pool of educated and specialised staff for any such project. This disparity is largely due to the difficult and unequal access to universal and comprehensive education in Africa, as illustrated by the state of education in Sub-Saharan Africa (*Lewin, 2009*). Further, "brain drain" – the phenomenon where well-educated persons emigrate from a country – continues to be a problem in Africa (*Tebeje, 2005*).

Thus, management of these challenges needs to be considered. In this section, we will primarily focus on the project-specific challenges of our planetarium, but we will also discuss funding issues as part of broader structural challenges. Discussing the inadequate or lacking implementation structures in Africa in detail is out of the scope of the article and partly inherent since this is exactly the issue that the AMT and the associated planetarium project seek to alleviate.

Team & Training

In similar European projects, such as the *Astronomy-to-go* mobile planetarium project operated by the University of Vienna, mobile planetarium members can perform all tasks necessary to keep the show running (*A. Caldú, personal communication, April 14, 2023*). In our project, only one-third of the team members have received full training in running the actual planetarium show. Our experience shows that operations are possible even with only a partially trained team, though this does come with challenges. We handle this by ensuring multiple team members can do any particular task. If only a single person can do one such task, then this person becomes a limiting factor in the availability of the whole planetarium. This point is crucial as most team members are full-time students or work full-time (e.g., tutors or high school teachers) and might not always be available for the events. Hence, clear, consistent, and advanced communication is vital.

We have also adopted the strategy in which team members mentor and train their teammates in the hopes that, eventually, all team members should have the knowledge and skills needed to perform all necessary tasks. This ensures the team's maximum efficiency in running the shows.

Logistics

Locations

As discussed above, much of our operations lie within Windhoek; visits within city limits are typically about half a day. However, the trip can extend over several days when reaching out to schools outside Windhoek. Additional considerations include accommodations for the team members, funding to support the visit, coordinating team members' schedules over extended periods, and maximising efficiency by visiting multiple schools in one trip.

Another layer of difficulty is the transport of the planetarium and the team members. Not only does our planetarium project not have a dedicated vehicle of its own, but none of the student team members have a driver's licence, as this is typically out of financial reach for students in Namibia. As a result, non-student team members must accompany the student volunteers to every event. Due to these reasons, for now, the planetarium events have been largely restricted to Windhoek.

Heat mitigation

Heat build-up is a common issue in mobile planetariums, especially in Africa, where solar irradiance is much higher (see Figure 2, left, for a temperature schematic). Other planetarium projects manage this heat build-up with an air-conditioning unit inside the planetarium itself (*A. Caldú, personal communication, April 14, 2023*; *J. Holt, personal communication, April 19, 2023*). We do not have such an air-conditioning unit at our disposal, and thus, other strategies are needed. The first strategy is to place the planetarium in a large indoor space, shielded from direct sunlight, and, in the best case, in a room with good insulation. In addition, we mitigate the heat within the dome by deflating the planetarium completely in between one session and the next. This effectively fills the planetarium with ambient air again. If operating the planetarium in exposed environments, we schedule shows during cooler months to operate in an outside environment.

Space requirements

Since the mobile planetarium is a large, hemispherical dome, we need to find venues that can accommodate the dome's size and leave sufficient space to move around the outside of the dome. In addition, scraping damage to the dome by the ceiling must be prevented. See Figure 2 for more information on the dimensions of the planetarium used in the UNAM/AMT Mobile Planetarium project.

Contrary to Europe, in Namibia and Africa in general, large indoor spaces are rare. We have adopted site pre-visits by team members as an integral part of our organisational strategy to avoid potential misjudgement of the space requirements by the school. In the case of remote locations, where additional site visits are logistically prohibitive, extra emphasis is placed on accurately communicating the spatial requirements.

Electricity requirements

The mobile planetarium requires electricity to run with its air compressor, laptop, and digital projector. This may be unavailable in some rural areas – for the planetarium or the school. Though we have a diesel generator at our disposal, this has not been used as grid electricity has thus far always been available. In addition, the generator creates noise, is not environmentally sustainable, and runs on expensive fuel. As technology improves and becomes more efficient, using devices like portable solar cells may be a useful alternative. The Outlook and Future Development Section details the future development of the project in this regard.

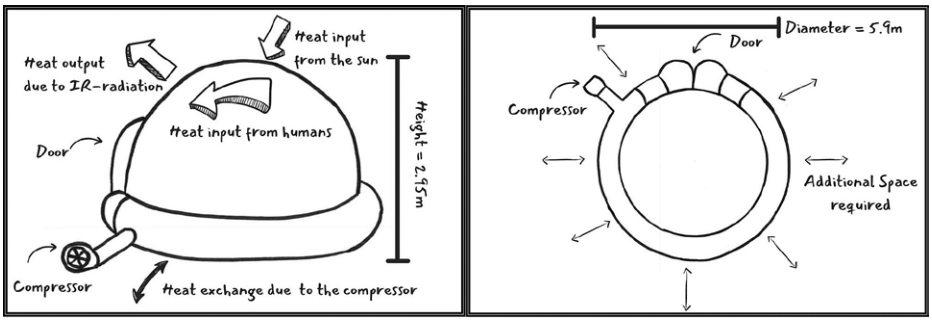

Figure 2: Left*: A rough sketch of the planetarium system indicating most of the various heat loss mechanisms and heat sources in the planetarium. The arrows indicate the effective heat flow. Note that the arrows are not proportional to their contribution to the planetarium's actual temperature development.* Right*: A bird's eye view sketch of the planetarium with the diameter of the planetarium shown and the additional space required showcased through arrows that are pointing radially out. Image Credit: Queen "Delight" Namene*

Staffing at events

We have found that two team members are always needed as a bare minimum. Otherwise – particularly during pre-and post-talks – team members become overwhelmed with the volume of tasks. On the other hand, we found that a maximum of five team members should be present at any event. With more volunteers present, their time may not be used efficiently, or they may compete for tasks. These minimum and maximum values will vary depending on the specific school environment. However, utilising more team members for one event on a shift basis can be beneficial, particularly if the event is long and team members need breaks.

Managing School Relationships

Regardless of the school environment, we have learnt that having a direct connection within the school is invaluable. Since, in Europe, schools pay for the planetarium to visit them, they have a vested interest in making those events a success and willingly provide organisational support in the form of a school contact (*A. Caldú, personal communication, April 14, 2023*). Since we do not charge the schools for the visit, we have to put a much stronger emphasis on ensuring the school's organisational support. This school contact could be any staff member from the school and usually is the one that requests a planetarium visit; a science teacher might be an obvious candidate, but not a mandatory one.

Finances

Necessity of sponsorships

The inflatable dome of the planetarium and the rest of the equipment, such as the laptop and the projector, were sponsored by Radboud University. However, one challenge for the planetarium is the long-term financing of the project. The Namibian schools are not charged for the visits, unlike in some other mobile planetarium projects (e.g., *NOVA, 2023*; *University of Vienna, n.d.*), due to our aim of equity in access to STEM outreach, and the planetarium does not receive direct university funding aside from

in-kind staff support. Though some non-educational events have brought in some revenue, these funds are insufficient to cover the project's operational costs. Additionally, a crowdfunding campaign by Radboud University for the project only raised about 35% of the initial funding target of €25,000 (*Radboud University, n.d.b*).

Securing sponsorships

It is important to align sponsorship proposals with the organisation's mission, vision and overall strategy. Implicit choices are made when approaching sponsors, and any offers of sponsorships we receive are carefully considered. Support and sponsorships do not necessarily have to be monetary. For example, one sponsor has offered project management support, while another has offered to accommodate the team members in their lodges during longer trips outside Windhoek at a subsidised rate.

It is helpful to leverage pre-existing connections to establish a connection to the potential sponsor of the project. For example, the AMT hosted a networking event in May 2022, featuring representatives from most major banks in Namibia, all of whom experienced a planetarium show, including a Corporate Social Responsibility Manager. During a meeting in November 2022, the manager's bank expressed further interest and recently confirmed their commitment to monetarily sponsor the planetarium for three years.

Finding the right approach to securing sponsors can be difficult; there is no simple, one-size-fits-all solution. This task requires a significant amount of time, which is untenable for the team members who are full-time students or work full-time elsewhere. For that reason, a person in our team has adopted this task as part of their responsibilities. As a qualitative comparison between the success of the crowdfunding and sponsorship campaign, crowdfunding, as a short-term solution, allowed the planetarium to start operations, whereas sponsorships allow for long-term financial stability.

Outlook and Future Development

The UNAM/AMT Mobile Planetarium project is on the road to further growth. The planetarium project plans to organise events outside of Windhoek in 2023 and 2024 – we are aiming for roughly one event per week, with the ambition to visit every school in Namibia within the upcoming years (constituting nearly 865,000 learners in total; *Namibia Ministry of Education, Arts and Culture, 2023*). The more comprehensive AMT project is currently funded through 2029, so we are confident that the planetarium will operate until then at a minimum, given the condition that funding targets for the planetarium project are met.

In addition, there are many ways that we can improve the project, including:

(1) Given the growth expectation above, the project needs to recruit more students from the University of Namibia, including students in physics or astronomy and one or two students with a social science or science education background, per the planned impact assessments outlined below.

(2) Similarly, there needs to be additional considerations on how to run the planetarium events cost-effectively and time-efficiently. For this, we will build on the expertise of the NOVA project in the Netherlands, detailed in *Holt et al. (2023)*.

(3) There have been discussions within the planetarium team on how to make the planetarium interventions more effective in the long term:

- For this, it was proposed that we create educational materials for classrooms and students' communities, such as posters and handouts, following the experiences of *Arcand & Watzke (2010)*, using visually engaging astronomy images accompanied by information texts.
- It will also become necessary to increase our engagement of teachers through regional planetarium events and more.
- In the future, offering follow-up opportunities to interested learners might be possible, for example, pairing them with a student volunteer.

(4) To better understand our impact and effectiveness, we have begun an all-encompassing impact study of the AMT project – including the mobile planetarium as part of its social impact plan. The study will touch on topics including:

- What is the most effective way to gauge a learner's interest in astronomy? For example, we might ask the learners via a questionnaire before, immediately after, and some weeks after the planetarium event. In addition, we will investigate the differences between learners' experiences in cities (where there is some light pollution) and learners in rural areas.
- How could we restructure our planetarium events to allow for evaluation? This might have direct implications for the staffing at events as the current volunteers do not have the capacity to conduct in-depth evaluations.

(5) Our efforts to mitigate the heat in the dome have been partially successful. However, we find that, at times, our mitigation is not sufficient. We must find a more effective solution for this problem to reduce our dependence on ambient environments.

(6) The planetarium team is looking into alternative electricity sources to visit rural schools, such as supplementary photovoltaic equipment and a UPS-type set-up run on renewable energy, such as solar energy. This would serve as an energy source for the dome and demonstrate to the attendees the viability and advantages of renewable energy. A system design study is underway with the Renewable Energy group in the Department of Physics, Chemistry and Material Science at UNAM.

(7) To streamline the organisation of the planetarium events, we envision an application process for schools. The UNAM/AMT Mobile Planetarium project has gained substantial media attention (e.g., *Nel, 2022*; *Van der Schyff, 2023*; *Windhoek Express, 2023*), increasing our requests for school events. This approach requires additional consideration regarding equity, as the best-resourced schools will likely be the ones best informed about these (and similar) opportunities.

(8) The mobile planetarium project already has some social media activity[2], but we plan to introduce a more comprehensive social media strategy in the future.

Conclusions

One year since the inception of the UNAM/AMT Mobile Planetarium project, we have successfully implemented a student-driven planetarium programme in which, under the framework of project-based learning, students have been able to learn how to organise school events with the planetarium, navigate the social aspects of teamwork, to manage the finances and budgets, and to use science communication techniques effectively.

The initial model and support of the NOVA planetariums have been instrumental. Based on the vastly and constantly increasing number of requests for school events, we infer that we have successfully adapted the planetarium project to the Namibian environment.

In 2023, the planetarium project has picked up momentum, and we expect that trend to continue. Our engagement with the learners has been overwhelmingly positive, with many learners stating that they had great enthusiasm for astronomy after our shows, which is also exemplified in Figure 3. Scholarly assessment of this observation is beyond the scope of this article and will be covered in future research, detailed considerations on which can be found in the previous section. This indicates that our current methods are working well for us. This is especially meaningful to the project as our broader goal is to increase astronomy awareness in Namibian children. If engagement happens in a fun, easy, and memorable experience, that is even more beneficial to the project: it means that this experience in the planetarium might open Namibian schoolchildren's minds to considering a career in STEM or astronomy in particular. We conclude that we shall continue to operate the UNAM/AMT Mobile Planetarium project, confident that the project will continue to bear fruit.

Notes

[1] When quoting the number of planetarium attendees, we think of the numbers as "individual planetarium experiences" rather than individual persons, as some enter the planetarium multiple times.

[2] Examples of social media activity of the mobile planetarium and the AMT: @blackholehunters on Instagram, @africa_mm_tel on X and https://www.blackholehunters.space/

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Figure 3: *Enthusiastic children in front of the planetarium after a successful show with a team member in the background. Image Credit: Queen "Delight" Namene*

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