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TReND in Africa: Towards a truly global (neuro)science community

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Abstract

TReND is a volunteer-scientist run charity dedicated to promoting research and education on the African continent. Focussing on neuroscience, we discuss approaches to address some of the factors that currently stifle Africa’s scientific development, and our experience in implementing them.

Keywords. Africa, Neuroscience, Education, Capacity Building

MAIN

The case for a more global scientific community. If Ebola, Zika or Covid-19 have taught us anything, it might be that in modern life sciences there is no such thing as a local problem. Accordingly, now more than ever, we need to increase global research capacity and expand scientific literacy, with a focus on those parts of the world that have traditionally been left behind the most. This notably includes large stretches of the African continent, which is home to one in seven people worldwide, but contributes less than 2% to the global research output (Thelwall, 2017). Here, we urgently need to reach critical mass of well-trained and internationally connected scientists, supported by scientifically literate citizens and governments, who can tackle problems before these enter the world stage.
Access to higher education and current scientific progress remains a scarce resource across large parts of the African continent. Capacity building projects have classically focused on primary and secondary education, with comparatively little attention directed towards the critical roles of the tertiary tier, although this trend has steadily changed in recent decades (Riddell and Niño-Zarazúa, 2016). Top-level science education and primary research are pivotal to the ability to innovate, move forward and meaningfully integrate with the global society. Moreover, better positioned universities train better teachers and boost scientific literacy in the population. A flourishing research landscape also promises to increase the willingness of governments to formulate evidence-based policy.

Though small when compared to its total population, Africa boasts a substantial university and research landscape, with countries including South Africa, Egypt, Kenya, Tanzania, Uganda, Nigeria, Ghana or The Gambia hosting some of the world’s leading research institutes in various fields (https://research.webometrics.info/en/Africa). Several African universities, led by the University of Cape Town in South Africa, are ranked in world university league tables. Clearly, the continent hosts an ever-growing number of scientists with potentially game-changing ideas. These factors form a solid base upon which educational and research development initiatives can operate.

The problem, however, is that examples of leading African research institutes are sparse when considering the continent as a whole. This is compounded with a series of challenges that many African-based researchers and educators endure. Beside obvious factors such as poor funding, unreliable power grids and difficulties in
importing specialised equipment and reagents, one pressing issue is a disconnect from the global scientific community.

Researchers in the Global North typically learn about scientific advances long before these are formally published by attending conferences and by maintaining close personal dialogue with colleagues. In contrast, attendance to international conferences by African-based researchers is routinely obstructed by funding or visa issues, or a crushing overload in administrative duties. This hampers the development of important personal contacts with researchers abroad and thus a lack of information about the field’s current state-of-the-art. Journal pay-walls are a further complication, although initiatives like the HINARI programme (https://www.who.int/hinari), the rise of open access outlets, increased adoption of preprint servers, and the formulation of Plan-S (https://www.coalition-s.org/) have made progress towards addressing this problem.

These access issues compound with another prevalent problem at many African Universities: The dramatic shortage of teaching personnel. Besides administration, senior academics usually face a crushing teaching overload, often having to run multiple repeats of crowded seminars for hundreds of students at a time in sometimes woefully inadequate teaching spaces (Marais, 2016). To fill this teaching gap, universities routinely employ junior academics (often MSc level) to teach. This practice has led to a vicious cycle of low teaching quality where even theoretical aspects of many topics are only superficially covered. This is finally worsened by a near complete absence of practical training in modern research approaches in university science curricula (Ozor et al., 2016).
Neuroscience research capacity in Africa. Per million inhabitants, most African countries have fewer than 100 researchers – compared to a global average of currently 1080, and more than 4,000 in scientific powerhouses like the UK, USA or Japan (http://chartsbin.com/view/1124). Similarly, on average 3 neurologists serve 10 million people in Africa, compared to nearly 500 in Europe (Mateen et al., 2016). These numbers contrast forecasts that by 2050, 71% of people living with dementia or related neurological conditions will be from low-to middle income countries, which currently includes most African countries (Prince et al., 2013). Ultimately, long-term solutions to problems such as these must come from within Africa, with concerted actions from governments and African-based philanthropists supporting a thriving African research sector. However, in parallel it will be critical to better integrate African neuroscientists into the global scientific community.

In 2011, to catalyse these efforts and to contribute to the development of a truly global scientific community, with an initial focus on neuroscience, we founded the non-profit organisation TReND in Africa (www.TReNDinAfrica.org). Here we summarise our actions (Fig. 1) in the context of other programmes with closely aligned goals, focusing on:

1. (Neuro)science capacity building
2. Promoting scientific exchange
3. Public outreach and policy engagement

(Neuro)science capacity building
A plethora of advanced, hands-on neuroscience courses are offered across the Global North, including those by Woods Hole Marine laboratories, Cold Spring Harbor, FENS,
or the CAJAL programme. Many of today’s most influential neuroscientists were once
students at courses such as these, and for some they remain instrumental to their
careers even years later. And yet, despite the international nature of these courses,
few participants come from Africa. Instead, African-based students are rarely selected
in view of their often comparatively limited research experience, an absence of glowing
recommendation letters from well-known scientists, and/or the applications’ formatting
to different cultural expectations. Even when selected, attending the course is routinely
hampered by lack of funding even when partial scholarships are provided, or by visa
requirements. Finally, if all these hurdles are overcome, attendees often realise that
much of the training received may be difficult to apply when faced with the realities of
the research infrastructure back at home. This can have a counterproductive effect,
with some applicants leaving these courses more discouraged to pursue research
than when they first applied.

Realising these limitations, international organisations such as the International Brain
Research Organization (IBRO) and the International Society for Neurochemistry (ISN)
have invested into funding neuroscience training courses in Africa. Building on these
efforts, and with help from a wide range of additional funders (see acknowledgments),
TReND organises top-level and hands-on training courses in collaboration with African
universities and research institutions (Fig. 1A-D). We have to date trained ~500 African
young scientists through more than twenty intensive and multi-week research schools.
We cover diverse disciplines including neurogenetics, neurophysiology, molecular
biology, genome editing, bioinformatics, open hardware, general lab- and research
skills, and scientific writing (Fig. 1A,B). To ensure equal opportunity, all courses are
free of charge, and usually cover travel costs and board. Ensuring gender balance as
much as possible (Fig. 1B), typically 15-20 participants per course from late undergraduate to faculty level are selected amongst candidates applying from all over Africa, with an acceptance rate of usually <10%. TReND courses are delivered by worldwide leading researchers and have a strong emphasis on hands-on training, with at least half of the course spent in lab-based practicals.

All TReND courses take place in Africa, and we complement existing resources with donated scientific hardware and reagents to ensure that the taught state-of-the-art techniques can be replicated in a typical African university setting. We therefore combine our courses with an equipment donation programme (Fig. 1E), available to our alumni and partner universities. The need for research grade equipment in emerging economies has long been recognised, for example by the WHO equipment funding programmes and non-profit organisations such as Seeding Labs (www.seedinglabs.org). Industry and well-funded laboratories often discard or store fully functioning equipment and reagents that have become superfluous to current requirements, yet they present a vast resource for underfunded labs around the world. Our equipment donation programme aims to activate these resources for African universities. Importantly, African countries should not be the end point of e-waste, nor should shipped equipment end up unused. For this reason, we thoroughly test all donated equipment prior shipping, and link donations with courses or volunteer visits (see below), to make sure that there is expertise on site to efficiently make use of the donated equipment.

Another defining feature of our courses is a strong focus on open science, including the promotion of free and open source software and do-it-yourself (DIY)-equipment based on open source hardware designs (Baden et al., 2015; Tsanni, 2020) (Fig. 1F). We also teach how to build or repair equipment based on off the shelf electronics and
3D printed parts - either as part of an introductory week, or as dedicated courses in their own right. These activities reinforce a mentality of innovation and frugality, and dispel the commonly held misconception that that state-of-the-art research categorically requires expensive equipment.

In general, we adapt all aspects of taught materials to local realities, including local budget constraints. This includes discussions on the most appropriate model organism to each research question. Therefore, many courses focus on the use of genetically accessible invertebrate model systems such as fruit flies or nematodes, as these are not only powerful but also affordable and easy to maintain. For the same reasons, where vertebrates are used, we aim to promote the use of small and comparatively cost-effective models (e.g. zebrafish or medaka). We also encourage the use of local resources, such as investigations on local animal and plant species. Altogether, these measures increase the chances that students can meaningfully implement what they learnt once they return to their home institutions.

**Promoting scientific exchange**

Global exchange of information is key to scientific progress, but interactions between African researchers remain sparse, both within Africa and beyond (Maina et al., 2020). Several initiatives are aimed at reducing this gap. While targeted courses like those mentioned above can go a long way in fostering important international links, they can be expensive and difficult to scale to the required levels. Therefore, we complement our courses with a volunteering programme (Fig. 1G). Scientist-volunteers from around the world register interest to organise on-site training or provide focused advice in their specific area of expertise. From here, our
African partners periodically receive a curated list of available volunteers and can submit specific requests based on their local needs. Once mutual interest is established, details for the visit are discussed directly between the volunteer and the hosting institution, with guidance from TReND members as required. In some cases, limited funding may be available, for example when volunteers are based at institutions that offer scholarships towards this programme (e.g. The Francis Crick Institute, or The Max Planck Society). In other cases, costs can be flexibly shared between the volunteer and the host institution. This programme enables personal international collaborations to form and is both nimbler and more scalable than the abovementioned research courses.

Another model taken by many organisations is to provide fellowships for African scientists to spend time at Western institutions, such as the Crick Africa Network, the Graduate Programme for Science and Development (PGCD) of the Gulbenkian Institute in Portugal or the Spanish Women For Africa Foundation. Like our volunteering programme, these initiatives can go a long way in developing personal links among researchers worldwide.

While the most popular approach to scientific exchange may be through conferences, these have largely remained geographically segregated. For example, the meetings of the Society for Neuroscience (SfN) in the USA, or of the Federation of European Neuroscience Societies (FENS) both attract impressive international crowds, but typically few participants are African-based. In contrast, the meeting of the Society of African Neuroscientists (SONA) concentrates an impressive line-up of African labs but attracts comparatively few non-African scientists. TReND aims to link these societies (e.g. SONA and FENS) to increase international representation at these meetings, for instance through travel-fellowships. Eventually, transforming neuroscience
conferences into a mix of in-person and online forums promises to go a long way in making these events more globally accessible. The current situation generated by Covid-19 has shown us that online meetings are not only possible but also effective. In response, FENS 2020 conference has gone online, and worldwide participation will be facilitated through the provision of large numbers of fee-waiver scholarships. Other conferences, such as the Genetics Society of America (GSA) 2020, have waived fees altogether. In parallel, many online seminar series are springing out of the ground. Community-generated online conferences like Neuromatch.io or seminar platforms like worldwideneuro.com (WWN) (Bozelos and Vogels, 2020) rapidly emerged, routinely attracting thousands of hits worldwide, including a growing African participation. In fact, SONA joined WWN early on, hosting both African and non-African speakers. Indeed, some African scientists have been hosting online talks long before Covid-19 hit the world stage. To facilitate these efforts, TReND has worked with the Sudanese Researchers Foundation (SRF) since 2016, and with SONA since 2019. Going forward, it will be important to continue providing broad online access to conference talks in the future. It may be as simple as online streaming departmental seminars or international conferences, with one person on-site curating questions and comments for the speaker.

Public outreach and African science policy

Ultimately, a strong African research sector can only emerge from within, supported by scientifically engaged governments and a general public that supports research and development (R&D) spending. Accordingly, promoting scientific literacy and evidence-based thinking is pivotal. To this end, TReND runs a sizable outreach and policy engagement programme broadly focused on school-children as well as the
general public including decision makers. This branch of TReND is African-led, and to a large extent comprised of our course alumni (Fig. 1H). These African-based TReND members form a tight, pan-African community of scientists that continue to engage with each other long after courses are finished. Importantly, while engaging in outreach activities, they can serve as believable role models, and can communicate in local languages if needed. To date, TReND has run several dozens of targeted outreach activities (Fig. 1A), engaging with schools, universities, and the general public through a variety of formats. Activities can range from school visits for an afternoon, via organised hands-on experiments for children, to multi-day science festivals that involve schools, parents, teachers, and local government representatives. Many outreach events are coordinated with equipment and reagent donations, for example by providing light-microscopes to primary schools where outreach activities are held. These activities are supported by a wide range of funders (see acknowledgments). Moreover, since they are always organised by researchers who understand the local realities of their community, including local prices, they can achieve great impact with minimal funding.

Conclusion

Africa’s scientific landscape is extremely heterogeneous, including both world-leading research centres and institutes of higher education where local circumstances make research all but impossible. Accordingly, the promotion of science education and research requires strategies that are adapted to local realities: a “think globally act locally” approach. The Sustainable Development Goals 4 (SDG4) of the 2030 agenda focuses on high quality education and has two central pillars, which focus on improving learning outcomes and those who are excluded. Across the continent, there are many
organisations engaged in the promotion of research, science education and policy (e.g. https://en.wikipedia.org/wiki/List_of_organizations_engaged_in_STEM_education_across_Africa). Many focus on specific geographical regions, fields of science, or types of support. Jointly, these grassroots organisations are key players in making inroads in the long run. They tend to be cost effective and highly sensitive to local realities, which are difficult to accurately judge for major funders. Accordingly, the most impactful initiatives are likely to be those that intimately involve African-based researchers. As part of this, it will be critical to support them to facilitate engagement with the global scientific community. Only in this way can they gain the visibility and support for leading the way in Africa’s scientific future.

Figure Legends

Figure 1 | TReND in Africa activities 2011-2020. A, impact map, summarising course alumni (brown), courses (purple), volunteer visits (pink), outreach activities (green) and policy actions (yellow). B, Alumni and gender ratio by course types. C-H, impressions from TReND activities, including courses (C, D), equipment donations (E), building your own lab equipment (F), volunteering programme (G) and outreach (H).

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