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Commentary

Developing Science Research by Recognizing the Human Capacity for Inquiry

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Introduction

Amid the anxiety of evolving coronavirus variants, the discovery of the Omicron variant of COVID-19 in South Africa was interpreted as it having originated there, resulting in immediate travel bans imposed on South African nations, only to be realized soon after that Omicron was already present around the world (Lencucha and Neupane, 2022). Such a policy reaction, one might argue, is the result of epistemic hierarchy in scientific knowledge production. Conversations with scientists, however, reveal their awareness of epistemic injustices and their desire to not only understand the world but also to improve it, often with innovative methodologies (Sinha, 2016; Quirk, 2019). Why is there incoherency in our micro-level thoughts and macro-level policies?

A testament to the growing concern of scientists to build a more just society is apparent in the increasing effort of science departments trying to improve diversity and inclusion in training and recruitment. Yet the places that would most benefit from science still have limited access to research and training. Despite technological progress, with extreme poverty at a steady decline (World Bank, 2022), the freedom to inquire and the means to exercise the richness of human potential remain highly unequal. Why is this the case and how can scientists play an active role in the betterment of the world?

As there is no singular diagnosis or a prescription for society's ills, so complex in nature, multiple approaches and their corresponding stories of successes and failures must be taken into account with an attitude of learning so that we can make collective progress that benefits all. In this spirit, we share our experience of an ongoing effort to develop neuroscience research infrastructure in Kathmandu, Nepal and reflect on our assumptions and outcomes.

Premise

Even a cursory look at the history of international development shows that the old convention that development is "something handed over by the developed to the underdeveloped" is untenable (Arbab, 2000). For development to happen from within, active involvement of the community members to study local issues and generate locally relevant knowledge is a desideratum (Chambers, 1983). The participatory approach offers multiple benefits at the outset: it creates ownership in those who are the beneficiaries of the development process, motivates appropriate research topics, and includes a diversity of backgrounds in investigating those topics. Diversity is a valuable element in any inquiry as the degree of objectivity, a lofty goal of science, is determined by the diversity of ideas put on the table, open for debate (Oreskes, 2019). Therefore, our first task was to find Nepalese individuals, communities, and institutions open for collaboration as active protagonists in developing Nepal's science infrastructure.

As we reflected on the prospective scientific work to be pursued in our future collaboration, we ran into a dilemma early on: Is it feasible for a low-income country, such as Nepal, to invest its resources in fundamental research before addressing basic needs, such as access to education and health? The pursuits of fundamental research are in many ways independent of any given social context. Most research operates under the premise that there is an underlying order in the universe, and researchers are searching for universal laws governing that order. How can we incentivize and promote fundamental research while the prevailing focus of our discourse revolves around localized concerns that might necessitate advances in applied sciences? We could never conceive a reasonable theoretical answer to this question. As we will see, despite not having an answer initially, a resolution presented itself to us as we started our work.

Finally, we reasoned that viewing the world through the lens of income disparity may lead to an inaccurate assumption about human capacity. For example, income classification in the past has perpetuated a perceived inability to pursue scientific research by residents of low-income countries despite many counter-examples (Lencucha and Neupane, 2022). Instead, we assumed that the thirst for knowledge and the attraction to truth and beauty are inherent human qualities that can be nurtured to develop a capacity for inquiry (Farid-Arbab, 2016). We view these qualities not as characteristics that define a scientist but instead as features that are latent in every individual, imbuing her with the potential to flourish as a scientist.

Action

Initial attempts to find collaborators for neuroscience research in Nepal included conversations with the founders of the Nepal Neuroscience Society and grant officers at Nepal's University Grants Commission. Although everyone seemed to agree that the development of basic science is essential for Nepalese society, no one could pinpoint why society should invest in it. This conclusion aligned with

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our inability to motivate fundamental research in light of local issues, such as weak health care infrastructures.

A possible resolution to the abovementioned dilemma emerged during a neuroscience symposium at the Tilganga Institute of Ophthalmology in Kathmandu in October 2017. The symposium was part of our ongoing effort to find collaborators. During the symposium, Keepa Vaidya, a neuro-ophthalmologist at the Tilganga Institute, shared MR brain scans of her pediatric patients who get referred there from all over the country. The scans showed occipital lesions of patients with partial blindness, which were often congenital. She asked whether vision neuroscience offered any solution to this clinical problem. It turned out that the pediatric population with stroke-related vision loss is disproportionately high in communities with poor perinatal care; the case was no different in Nepal. Around the same time, a feature of brain plasticity had been recently discovered in Chris Pack's laboratory at McGill: perceptual behavior could flexibly rely on select parts of the brain depending on the behavioral training history (Liu and Pack, 2017). The implication was that partial blindness, a perceptual deficit caused by an occipital lesion, could be restored by training subjects to rely on intact parts of their brain. Although the idea itself was not new, the context in Nepal provided ground to not only use this idea to find a solution to a local problem but also to pursue fundamental research on the rules of perceptual learning in young populations.

With a broad goal to address cortical blindness, we planned a collaboration between the Tilganga Institute and McGill University. This effort was funded by Canada's International Development Research Center (IDRC) grant. The IDRC grant was unique as it required plans to address a scientific problem via international collaboration involving at least one country listed as low or middle income. The grant was complemented by Tilganga Institute's commitment to research space, logistic support, and access to the patient database. Our project aimed to restore visual function in patients who suffered damage in their visual brain areas at birth or early childhood using a newly innovated perceptual learning paradigm for the visual rehabilitation of patients with partial vision loss (Awada et al., 2022).

In the spring of 2019, we hired an engineer and a clinician as research trainees in Kathmandu. They first spent 3 months familiarizing themselves with the neuroscience literature under remote mentorship. They then spent 4 months as visiting scholars in Christopher Pack's research group at McGill University.

The short-term laboratory visit proved highly beneficial in growing as a scientist and demystifying ideas of what science practice looks like. The immersion in a science laboratory culture and conversations with students, postdocs, and professors were formative. The experience gave a sense of affirmation that scientists are normal human beings doing human things — being curious about nature and exploring ways to look for answers.

"...usually students like us have this idea that scientists are extra smart people, and we feel like we are not up to the mark to start doing science ourselves, but the lab visit in Canada helped demystify this." — Ashim Pandey.

The scientific growth of the trainees after a laboratory visit was apparent. The trainees learned the nuts and bolts of running psychology experiments on healthy humans and patients. When they returned to Nepal, they built a vision psychophysics laboratory and began experiments. Crucially, after this visit, the trainees started asking questions, forming hypotheses, and suggesting experimental designs driven by their own thought processes.

"The early days of mentorship were challenging. What helped was my joyful memory of learning the basics of visual neuroscience. As we learned the basics together, I kept thinking there was so much more to learn for someone just entering the field. After the lab visit, however, the level of maturity in their scientific thinking had significantly grown. Discussions became much easier." — Sujaya Neupane.

The scientific work proved promising in restoring visual function through behavioral training, even many years after brain damage. One trainee published this finding (Pandey et al., 2022) and secured admission to multiple doctoral programs across North American universities. The second trainee obtained a permanent position at Tilganga Institute as a clinician-researcher.

"In 2019, something that just started as a job for me opened a universe of opportunities. The lack of emphasis on research-based training during undergraduate studies in Nepal creates a major obstacle for students like me who aim to secure spots in competitive doctoral programs. The mentorship, guidance, and hands-on research experience at Tilganga paved the way for me to receive multiple Ph.D. offers from prestigious universities. Additionally, I got offers to attend fully funded summer schools, which I never knew existed and was available for students in Nepal." — Ashim Pandey.

"Attending the European Summer School of Sensory Neuroscience has shown me that science is all about exploring the unknown, and it takes time to do good science. Maybe we are not as far behind as we think. With proper guidance, I believe we can catch up quickly." — Suraj Prasai.

During our work, we faced several opportunities to learn, some of which we expected and others we did not.

The ethics approval process to conduct experiments on humans was smooth, similar to what one might expect at institutions with established protocols, and consistent with similar experiences in the past (Neupane and Sinha, 2019). Our ethics application was first reviewed and approved by the institutional review board of Tilganga and subsequently by the Nepal Health Research Council (NHRC). Additionally, we were invited to present our ethics application at NHRC. We learned that the nature of the fundamental research we were proposing in the pediatric stroke population had generated interest at NHRC, thus setting a precedent at the governmental institute.

Grant administration was a hurdle we faced early on. We found that the administrators in Nepal were overly wary of spending the grant money as dictated by the progress of our science project. There were concerns for even slight variations from the originally proposed expenditures, and significant delays ensued from stringent purchase rules. While caution over spending is not necessarily a hurdle, we learned that the source of this caution was unhealthy but understandable. Since international development grants have historically been hyper-prescriptive, administrators were accustomed to the close scrutiny of donor agencies. In contrast, science grants, a rarity in Nepal, offer relatively more freedom to pursue proposed projects. We resolved this issue through multiple consultations, including IDRC's grant officer.

Purchasing research equipment was another unexpected hurdle we faced. The Nepalese government does not have clear guidelines for importing research equipment. As a result, the import tax imposed on some of the equipment purchased outside the country seemed arbitrary and unjustified.

One specific and obvious challenge for doing research in a low-income country is a lack of sustained funding mechanisms nationally or internationally. The IDRC grant was a unique opportunity that allowed us to build a foundation for neuroscience research. However, similar international grants for basic research are scarce, making the sustainability of our effort challenging.

Obtaining a visa for travel has always been a challenge to international students, depending on which passport one holds. For our trainee, after the initial visit to Canada, both Spanish and Canadian embassies denied their student visa to attend a fully funded summer school and a Ph.D. program. After a year-long wait and reapplication, the Canadian student visa was finally granted, causing an unwarranted waste of time and money. The issue of obtaining a travel permit is something that citizens of certain countries face regularly, while the same issue is far removed from the reality of other citizens.

As a final point, we end this section with a realization we have made through our experience. In a fast-paced academic world where time holds such high value, one virtue we must develop if we are to attain true diversity and inclusion in academia is patience. Our work in Nepal during the last 4 years demanded patience from all involved parties. There is no shortcut to solving the world's challenging problems; therefore, exercising patience will bring us a long way.

Future outlook

We have now streamlined our training program into a bridge program in which trainees with undergraduate degrees will conduct research to prepare for a doctoral program outside their home country (we use the term home country to refer to any country, such as Nepal, with a history of limited science research). They will be co-mentored by two scientists: one based in the home country and one in a region with advanced science infrastructure. Students will participate in journal club discussions, identify research topics of interest, and travel on 4 month placements to active and relevant research laboratories as visiting scholars. They will first undertake a replication project followed by a novel research project. They will also mentor the new cohort of trainees by sharing relevant skills and their experience in conducting and communicating research. While the early part of the bridge program will focus on developing the trainees' capacity, the trainees will later serve and accompany others in their capacity building. This two-fold empowerment approach will help build the bridge program organically and with the participation of all parties involved.

Our long-term goal is to build a collaborative team of scientists who will perform independent research based in the home country. A functioning research unit like the one envisioned here will play a vital role in upholding the research aspiration of newly established universities in the home country. We recognize that this goal is only attainable if trainees return to their home country to run their research program. While there is no guarantee, we reason that, if trainees share the ownership of the ideas being conceived by actively participating in the development process, they will take the role of a protagonist from the outset (Chambers, 1983; Arbab, 2000). As such, in all our endeavors, trainees exercise equal participation with mentors in writing proposals and developing ideas.

Although we have built relationships with scientists in and outside Nepal to collaborate, we do not have a sustained funding source available from within Nepal. We believe that developing a culture of research is a prerequisite for a strong funding structure to form, either in the government or the private sector. Our focus is, therefore, to develop research with minimal resources and let the science funding structure grow organically.

Reflection

Overall, we find confidence and more clarity in our premise. With consistent mentorship, students can canalize their inherent curiosity to develop formal hypotheses and gain confidence in pursuing a career in science. If the nature of the research question matches the social need, the buy-in from stakeholders is only natural, as our experience with the Tilganga Institute testifies.

Grounding our action on the assumption that human beings are inherently capable of inquiry was consistent with what we observed in the growing capacity of our trainees. However, simply holding that assumption would be insufficient to bring about change. If it were so, we asked, why isn't rich scientific inquiry spontaneously happening in all countries? This question led us to ask what social conditions would allow for human capacities to be expressed in their most creative forms.

Two points stood out when we reflected on the social context in which science has developed historically. First, many innovations and discoveries emerged from a concerted effort to solve a social problem: the Internet at CERN, engineering advancement during the great wars, and medical advancement during a pandemic. Therefore, in addition to the GDP of a particular country, other social forces play a significant role in the progress of science. Second, although a social condition of fulfilled basic needs engenders free thinking and productive scientific activity, a strong social need transcends the fixation on immediate basic needs. It seems, then, that the chicken and egg problem of investment in basic needs versus that in science can be resolved by identifying those needs of society that justify research. It then became clear to us that a participatory and consultative approach to reading the social reality is a necessary first step to developing science infrastructure.

Participation can only become meaningful if diverse views are being presented and discussed. As we proceed with our cycles of action and reflection to develop science, diversity will play a key role in constructively interrogating underlying assumptions not readily apparent in homogeneous communities.

Diversity, in and on itself, however, is not enough for a healthy development of science infrastructure. We imagine a future of science where individuals (scientists and trainees), communities (scientific societies), and institutions (universities, governments) play active roles as protagonists to work toward a shared vision of universal participation in the generation of knowledge. What would be the conditions necessary to achieve such a vision? We highlight two here and let our readers conceive more; we must muster up the courage to take action and go beyond our ability to theorize frameworks of change. Instead of viewing courageous actions as risky or too idealistic, we must find joy in our endeavors, whose ultimate goal is to learn to build a more equitable and better world. Indeed, the feeling of courage and joy is familiar to us scientists when we are engaged in designing or running an experiment. Second, we must remain aware and immune from the ills of elitism. The elitist tendency is fundamentally exclusionary. This is not an attack on the culture of celebrating merit; we must give credit wherever it is due. Nevertheless, we must be aware that unchecked elitism will cloud our ability to investigate reality independently. As we march toward a future where diversity and inclusion are increasingly becoming priorities of our social institutions, we must strive for our shared principle of justice to become, instead of a yardstick for competition, a yardstick for the oneness of humanity.

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