



RESEARCH ARTICLE

The importance of mentorship and collaboration for scientific capacity-building and capacity-sharing: perspectives of African scientists [version 1; peer review: 1 approved with reservations]

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Abstract

Long-term goals for capacity-building in Africa centres around building a self-sufficient scientific community, however there is a lack of research on the interactions that are needed to make up a thriving academic community or the steps needed to realise such a goal. Through interviews with researchers supported by a capacity-building initiative, we have characterised their interactions with other scientists and the impact that these have on capacity-building. This has revealed a wide range of interactions that have not been captured by traditional bibliometric studies of collaboration and shown that a substantial amount of intra-African collaboration is taking place. This collaboration allowed the researchers to share capacity with their colleagues and this could provide an alternative to, or supplement, traditional North-South capacity-building. We have shown that this capacity-sharing can enable capacity to spill over from capacity-building programmes to the broader scientific community. Furthermore, researchers are deliberately hastening this capacity-sharing through training or mentoring others outside of their capacity-building initiative, including those from more resource-poor groups. To understand how capacity-building initiatives can harness the power of these interactions, we investigated how interactions between researchers originated, and found that collaborations tended to be formed around pre-existing networks, with researchers collaborating with previous colleagues, or contacts formed through their mentors or consortium activities. Capacity-building organisations could capitalise on this through actions such as expanding mentorship schemes but should also ensure that researchers are not limited to pre-established networks but have exposure to a changing and growing pool of expertise. As interactions continue to move online since the appearance of COVID-19 this will present

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opportunities for new interaction patterns to develop. This study highlights the need to develop new metrics for collaboration that will take into account these new modes of interaction and the full range of interactions that make up a scientific community.

Keywords

Collaboration, Health research, Capacity-building, Mentorship



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Introduction

Building scientific capacity in Africa is a key aspect of development plans for the continent, and there are a large number of international and African organisations working towards this goal (Chataway & Ochieng, 2017). Traditionally this capacity-building has been carried out by pairing African research groups with groups in more scientifically-advanced countries, termed ‘North-South’ collaborations. These collaborations can allow the African research group to access capacity in the form of resources, equipment, and expertise (Cochrane et al., 2017). However, there is a growing recognition that such collaborations can be imbalanced and misaligned with African needs (Walsh et al., 2016). Capacity-building organisations are beginning to encourage more intra-African collaboration. For example, the African Academy of Sciences’ Coalition for African Research and Innovation (CARI) (The African Academy of Sciences, n.d.) aims to build systematic scientific collaboration on the continent. Through intra-African collaboration, organisations hope to build a more self-sufficient scientific community, working to solve local challenges through more equitable collaborations (Marjanovic et al., 2017). This involves not only formal collaborations, but building a scientific community that can share ideas, hold meetings and be a part of the broader international research community. However, there is a lack of research on the interactions that are needed to make up a thriving academic community.

Most work on collaborations has used just one metric for collaboration, shared publications, however this only captures a small proportion of scientific interactions, those formal collaborations that result in a publication and has a long lag with many projects taking years until they reach publication, if at all. It fails to capture a whole range of informal and pre-publication collaborations and does not reveal insights into how the collaborations were formed (Tijssen and Kraemer-Mbula, 2017). Previous attempts to characterise these broader interactions have included two large-scale surveys of researchers in the US (Boardman & Corley, 2008; Bozeman & Corley, 2004) and UK (Abreu et al., 2009). The UK study showed that 50% of scientists engage in collaborative research with researchers from other organisations and that many engage in activities that allow them to share ideas and expertise; 90% attend conferences and 65% give lectures at other institutions and participate in networks (Abreu et al., 2009). The US study, The Research Value Mapping Project, used a survey to measure the amount of time scientists spent interacting with other researchers (Boardman & Corley, 2008; Bozeman & Corley, 2004). This identified that researchers spent the bulk of their time working by themselves or with researchers at their university and around 6% with international researchers.

However, more work is needed to fully characterise the collaborations and interactions that researchers engage in, particularly in the context of capacity-building where collaborations may be most valuable. In a developed country context, it has been shown that research collaborations are associated with higher productivity (Abramo et al., 2009; Lee & Bozeman, 2005), but collaborations may be even more important as part of capacity-building projects, where they can allow researchers to build their capacity by accessing the expertise and equipment of others. There have been a number of studies of collaborations in Africa, but these have largely used bibliometrics measures. These studies have revealed that most co-authored papers in Africa are the result of North-South collaborations, with less than 10% being produced by collaborations between authors in more than one African country (De Vré, RM Rial Verde, E & Santos da Silva, 2010; E Fonesca et al., 2016; Owusu-Nimo & Boshoff, 2017). Studies that have looked at the impact of these collaborations on capacity building have focused predominantly on formal North-South collaborations (Burgess, unpublished report) at the expense of informal and broader research interactions, particularly intra-African ones.

Only a small proportion of these studies have sought the perspectives of African researchers on collaborations. These found that researchers particularly value international collaborations for the visibility and funding provided (Franzen et al., 2013, 2017a; Zdravkovic et al., 2016). However local and, in particular, institutional (Zdravkovic et al., 2016) collaboration was also valued, particularly as it provides more opportunity to work on problems of local relevance (Zdravkovic et al., 2016). Researchers also placed a high importance on other research interactions such as mentoring (Franzen et al., 2013, 2017a; Tijssen & Kraemer-Mbula, 2017, 2018; Zdravkovic et al., 2016), with researchers stating that involvement in mentoring and training the next generation of researchers is a vital part of research excellence (Tijssen & Kraemer-Mbula, 2017). There were also found to be many barriers to intra-African interactions, and like intra-African co-authorship, informal collaborations and networking were found to be rare (Franzen et al., 2013, 2017a), with researchers often feeling isolated from the regional research community (Franzen et al., 2013). Researchers attributed this to a lack of networking opportunities (Franzen et al., 2013, 2017b), poor communications infrastructure (Marjanovic et al., 2013), the need to prioritise international partners and their institution’s focus on teaching (Franzen et al., 2013, 2017a; Muriithi et al., 2018; Owusu-Nimo & Boshoff, 2017; Zdravkovic et al., 2016). Three recent studies examined whether capacity-building initiatives could ease these barriers. A study of an effort to increase local research interactions in the field of reproductive health by bringing together five research centres into a network, found that the network instead ended up being dominated by North-South interactions (van der Veken et al., 2017). However, the other studies, evaluations of major health capacity-building initiatives, found that they did facilitate interactions, such as conferences, between members of an initiative (Marjanovic et al., 2017) or shared publications (Uwizeye et al., 2020), including after researchers have left the programme. However as highlighted by a recent review of evaluations of capacity-building

initiatives (Pulford et al., 2020), in order to effectively study the impact of these initiatives on informal collaborations requires better quality metrics for collaboration in capacity building.

Through interviews with African researchers supported by a capacity-building initiative, this study aims to characterise the collaborations of these researchers, in particular the interactions that have not been effectively captured in previous studies: intra-African collaborations, and informal and pre-publication collaborations, and other interactions such as mentoring and attending meetings. Through this, we gain insight into the researchers' patterns of collaborations and how they are formed. This allows us firstly to identify areas in which it is important that better quality metrics are developed, secondly to determine the impact that collaborations have on capacity-building, and thirdly to highlight the ways in which capacity-building organisations can harness the power of these interactions.

Methods

This work arose out of two literature reviews we conducted in 2018 and 2020 (Burgess, unpublished report) on perspectives to South-South collaboration within Africa in the literature on capacity-building and collaboration in health research. This found that references to South-South intra-African collaboration were relatively rare, with most of the literature focusing on North-South collaborations. Furthermore, these reviews showed that only a very small portion of the literature took into account the views of the scientists themselves on these collaborations. Consequently, we set out to carry out interviews with African researchers with the aim of characterising their collaborations, in particular intra-African ones, and gaining their perspectives on these. We were particularly interested to study these collaborations in the context of a capacity-building initiative to determine the impact of these collaborations on capacity building, so we contacted researchers working under the DELTAS¹ capacity-building initiative, one of the largest capacity-building programmes operating on the continent and one that has as one of its stated aims to encourage scientific mentorship and collaboration. DELTAS funds 11 programmes across the continent and we interviewed researchers from six of these: MARCAD, Afrique-One Aspire, Kemri-IDeAl, WACCBIP, MUII plus and Santhe², providing perspectives from a range of different contexts. Researchers from the programmes who focused primarily on laboratory rather than clinical research were identified from the programme websites and contacted via email. 15 scientists were interviewed, comprising four principal investigators, five postdoctoral researchers and six PhD students. This was to some extent a selective sample, as those who agreed to participate may be those who are more likely to have an interest in collaboration, thus we might expect that they might experience more collaboration than average.

Prior to the interview, researchers were asked to complete a short questionnaire on the frequency with which they experience different interactions such as meetings, training, mentorship and collaborations. This was used to structure the interview, allowing us to ask the researchers follow-ups on these interaction patterns, such as how the collaborations were formed, any barriers and their perspectives on these interactions. 13 of the 15 researchers completed this survey. In the interview, researchers occasionally recalled collaborations that they had not at the time of the questionnaire, thus the interview appeared to give more complete information. Interviews were conducted via Skype and lasted between 32 and 70 minutes. The study was approved through the University of Sussex Business School ethical review process (ER/HEB35/1) and consent was obtained via email and verbally at the start of the interview. Interviews were recorded and transcribed. Qualitative analysis of the interview data was carried out using a deductive approach. Responses were split by type of interaction and information collated on the different modes, attitudes, facilitators, and barriers for each type of interaction. This is a small exploratory study aiming to highlight areas where new metrics should be developed and identify areas where capacity-building organisations might wish to focus their efforts in building a scientific community. As the number of participants was low, we have not attempted to provide full quantitative analysis of the data but have presented summary statistics of the survey data and the number of responses in a particular category, where appropriate. It should be born in mind that these proportions cannot be extrapolated to the general population of researchers due to the small and selective sample, but give an overview of the interactions experienced by this particular group of researchers.

Results

Collaborations allow not only capacity-building from outside Africa but also intra-African "capacity-sharing"

From our questionnaire we find that researchers spend a substantial amount of time on collaborative research, spending on average 33% (range 7-60%) of their research-related work time working with researchers outside their own work

¹DELTA: Developing Excellence in Leadership, Training and Science Initiative.

²MARCAD: Malaria Research Capacity Development, IDeAL: The Initiative to Develop African Research Leaders at the KEMRI-Wellcome Trust Research Programme, Afrique One-Aspire African Science Partnership for Intervention Research Excellence, WACCBIP: West African Centre for Cell Biology of Infectious Pathogens, MUII plus: Makerere University/UVRI Infection and Immunity Research Training Programme, SANTHE: Sub-Saharan African Network for TB/HIV Research Excellence.

group. As discussed, previous bibliometric studies have found that most of African scientists' collaborations are North-South (De Vré, RM Rial Verde, E & Santos da Silva, 2010; E Fonseca et al., 2016; Ettarh, 2016; Ogachi, 2018; Onyancha & Maluleka, 2011; Owusu-Nimo & Boshoff, 2017). However, our interviews reveal that researchers are participating in a broad array of intra-African collaborations and according to the responses to the questionnaire, the average proportion of a researcher's time spent on intra-African collaboration outstrips collaboration outside the continent by 4:1. Six of the 13 researchers reported having no current collaborations at all outside of Africa (although on follow up in the interview two of these had at least some current international collaboration), whereas all of the researchers experienced intra-African collaboration at a minimum level of 7% of total research time.

The large disparity between the amount of intra-African collaboration from bibliometric studies and the amount captured in this study, highlights the need to build more comprehensive and real-time measures of collaboration. This study captures informal and pre-publication collaborations that are not captured in publication metrics, both in the questionnaire and in examples detailed in the interviews. These include collaborations where a publication is currently in preparation, collaborations with students where a publication may not be an endpoint and informal assistance between researchers.

Researchers mentioned a wide range of benefits of both intra-African and international collaborations, including building more complex projects, involvement in the publications and grants of other researchers and personal benefits to their careers such as finding a new position or career mentorship. A major benefit cited by all researchers was capacity-building; developing collaborations to gain expertise or access resources, funding or equipment. Traditionally capacity-building has been focused on building North-South collaborations and indeed researchers described in the interviews many examples of this, including training placements in laboratories outside of Africa (8/15 researchers) and training from visiting researchers (mentioned by three researchers). However, as we have seen from the questionnaire data there appears to be a large amount of intra-African collaboration taking place which raised the question of whether this is also playing a role in capacity-development.

Indeed, the researchers all gave examples of intra-African collaborations that had provided them with access to the expertise, equipment or resources of other groups within Africa or in which they provided this to others. For example, one researcher in a new research group carried out part of her project in a more established laboratory that provided access to expertise, equipment and reagents. All scientists had also given or received training or mentoring from groups of researchers inside Africa. One particularly common way to share capacity between two groups appeared to be via the exchange or co-supervision of students (all four principal investigators experienced this).

Thus, intra-African collaborations can allow African researchers to develop new expertise and access other resources through sharing of capacities within the continent rather than by import. This 'capacity-sharing' was valued by researchers. All of the researchers were either in the process of, planning to or hoping to build more intra-African collaborations and more than half of the researchers (eight) specified specifically that these would play a capacity-building role. Thus "capacity-sharing" could provide an alternative mode of capacity-building that allows researchers to develop their capacities in ways that are more equitable and more self-sustaining than external capacity-building. We will next describe how these intra-African collaborations can also work *with* traditional capacity building schemes to amplify their effects by spreading the imported capacity to an expanding circle of other institutes and researchers.

Collaborations and mentorship allow positive spillovers from capacity-building to the wider scientific community

Researchers interviewed were current or recent members of one of six different consortia under the DELTAS umbrella. Researchers spoke positively about the effect being a part of this network had on their research capacity. They also described a wide range of interactions they participate in that have the potential to diffuse this capacity. These interactions can be classed into two groups. Firstly, the sharing of capacity in the course of mutually beneficial intra-African project collaborations as we have described above. Secondly, deliberate sharing of the capacity to resource-poor groups through collaboration, training and mentorship. Researchers were questioned on the interactions that they have with more resource-poor groups and this revealed that many researchers (five) were part of research groups or institutes that welcomed visiting researchers from more resource poor groups for training or access to their better equipment and facilities. Five researchers also shared their expertise with less research-intensive universities and institutes though providing training, teaching or co-supervising of students. This includes a researcher who had an unpaid placement to provide training at a local university and another who provided training to lecturers at a lower-capacity university. Another two fellows were also actively involved in training the non-DELTAS members at their institute. As well as these ad hoc interactions, capacity-sharing also occurred officially through the DELTAS programmes; for example researchers on the MUII plus programme described how some meetings and equipment were open to non-MUII members of the local scientific community.

A further important way in which researchers are deliberately trying to share the capacity is by mentoring researchers outside their programme. All researchers were involved in supervising students, and all but one also mentored researchers that were not directly under their supervision. For five of these researchers, this was as part of official mentoring schemes that had been established by themselves or by researchers in their programmes. This included a scheme at one consortium to match mentors with students and a programme at another to provide career development training to postdoctoral researchers, which were both open to researchers outside of DELTAS. Researchers involved in supervising and mentoring mentioned the positives for their own work, but also the motivation to give back, the satisfaction of helping others and the need to pass on and build on the mentoring they themselves had received. By mentoring others they could help to pass on the capacity they have gained from the schemes and this is something that appears to be recognised by senior researchers in these capacity-building programmes as members from two consortia described how they had participated in or organised training programmes on how to mentor others and members of two others described how the mentoring schemes established by researchers were then supported by their consortia. Thus, it appears that the organisations recognise the importance of good mentorship in building up research capacity. Further, by opening up mentorship schemes to external researchers, this ensures that the training and experience built up through capacity-building programmes can be amplified by passing it to the broader scientific community.

Collaboration patterns are shaped by pre-existing networks

We have outlined how the extensive collaboration, training and mentorship activities that these researchers take part in can allow both traditional capacity-building and capacity-sharing, developing and amplifying capacity. However, for capacity-building organisations to be able to harness this, requires an understanding of how these collaborations are formed and what can be done to facilitate or to remove barriers to these interactions.

Within their institute researchers describe one of the facilitating factors for forming collaborations being a positive culture that facilitates interactions, with an informal structure where other researchers and supervisors are approachable and where students and fellows help each other. For all but three researchers these interactions were facilitated by researchers getting together at an active schedule of meetings, including departmental or institute meetings at least once a month.

For collaborations beyond the researchers' own institutes the most common modes by which collaborations were established were through consortia or through their current or past colleagues, supervisors and mentors. All researchers described collaborations established through consortia activities and all but two, through their current or previous supervisors, mentors or colleagues. This is compared to just four through non-consortia meetings and workshops and two by getting in contact through phone or email.

Researchers outlined a number of avenues by which consortia such as DELTAS, or others such as H3ABioNet, were able to facilitate collaborations. Firstly, they provide networking opportunities, for example three quarters of researchers were attending the AGMs of DELTAS or their sub-programme. These bring together scientists from different institutes and enable researchers to meet and identify potential collaborators and to raise their profiles. Secondly, consortia would bring in external speakers (this was described for three different consortia), particularly from abroad, through which the researchers describing this, had identified potential collaborators. Thirdly, it created a ready-made community of peers who could provide mentoring to each other. Fellows also interacted with each other at consortia training sessions and fellows from three consortia were interacting with each other via email and instant messaging and at workshops. Finally, consortia also provide travel opportunities enabling travel to conferences or training workshops which allow researchers to expand their networks, gain exposure to more research, raise their profile and identify more collaborators. Furthermore, the PhD training schemes of consortia such as Kemri-IDeAL enable researchers to spend a six-month training placement abroad which facilitates long-term collaborations.

Mentorship also appeared to play a crucial role in shaping collaboration. Seven of the nine postdoctoral researchers and Principal Investigators interviewed continued to have ongoing collaboration with prior supervisors or mentors. In addition, researchers (12/15) were also often introduced to new collaborators via their supervisors or mentors or through co-supervising or mentoring students themselves. Also particular to extra-continental collaborations, researchers with the highest levels of international collaboration (10-30%) had previously worked abroad with the international researchers in previous positions or training placements.

Several researchers (four) mentioned the importance of having a profile and establishing trust in forming collaborations. Consortia or links with mentors likely provide the researchers with credibility and establish trust, reducing the risk to potential collaborators. Furthermore, as mentioned by one researcher, potential collaborators are likely to place more trust in a potential collaborator once they have met face to face, for example at consortia meetings. Seven researchers mentioned that they experienced some difficulty forming collaborations without a profile, network or contacts in a

particular region or field. Two researchers mentioned that their consortia maintaining relationships with alumni would enhance their networks. Thus, membership of a consortium and introductions through previous collaborators and mentors might enhance the network of researchers, unlocking access to project collaborations through which they can enhance their capacities and build bigger projects. However, these facilitators may also act to constrain collaborations by restricting them to pre-existing patterns based around the networks of their previous collaborators and networks. This lock-in could limit their exposure to new collaborations and ideas and also act as a barrier to researchers who lack these contacts. Indeed, there is some evidence that researchers felt constrained in their collaborations; a francophone researcher mentioned that the default is to look to France for collaborations, another that the UK is the default for DELTAS interactions and a third that they were experiencing a poor response to their enquiries about potential collaborations in the EU due to their mentor not having contacts there.

We have described how consortia and mentorship can act as facilitators to collaborations, we will next describe the factors that researchers cited as barriers to collaboration.

A move towards online modes of interaction may remove barriers to intra-African collaboration

Researchers indicated that they had experienced barriers to forming an even higher level of intra-African collaboration. Whilst collaboration was high in the researchers' own institute at 12% of total working time, it was low in their local area and country at a total of 5% compared to elsewhere in Africa at 10%. Over half (eight) of the researchers cited the lack of capacity within Africa. This was expressed as the lack of African researchers in their field or that it was difficult to identify them, or that the labs that do exist face the same challenges in their lack of facilities or resources. Researchers mentioned that it was easier to find the funding and capacities needed outside of the continent. Six researchers also cite a lack of openness from other researchers, that individuals or consortia are not open to new collaborations or that people will sign up for collaborations but lack the time or interest to fully engage with them. Two of these researchers mentioned that due to a lack of local meetings and collaborations they would often only meet local researchers at international conferences.

Although many areas seemed to lack local meetings, there were positive examples described, such as the local area around where the MUII consortium is based at the Uganda Virus Institute in Entebbe, Uganda. All of the MUII researchers we interviewed mentioned the good links between MUII and the other programmes based at UVRI as well as with other research institutes and private universities in the area. Particularly strong links were formed with the University of Makerere.

Researchers believed more meetings could help overcome the barriers to local collaborations including a lack of engagement (four researchers) and difficulties in identifying potential collaborators (five researchers). From our questionnaire data and interviews, 10/13 researchers were attending both frequent lab and institutional meetings and all but one were attending international conferences, inside or outside of Africa, although they experienced some barriers to these such as insufficient funding and difficulties getting visas. However, researchers identified a lack of local and regional African meetings as a problem and all but one researcher attended local and regional meetings six or fewer times a year. However, there is a lack of evidence from our interviews that increased meetings would lead to increased collaborations because, as we described earlier, there were few collaborations described that were formed at meetings without the further facilitator of consortium activities or introduction by mentors. More work is needed to determine whether meetings are an important factor in collaborations, particularly at the intermediate geographic levels between institute and international collaborations.

A further area for urgent study is the impact of new technologies on research collaborations. We found that researchers are increasingly using Zoom and other platforms to keep in touch with collaborators. A particularly striking new opportunity for researchers to interact has arisen through WhatsApp, with six researchers using this to keep in touch with other fellows, providing peer-to-peer mentoring and sharing opportunities. One project collaboration described was also taking place over WhatsApp, allowing video meetings and sharing of documents more instantly and conveniently via phone, than via email and other video-calling platforms. Use of these technologies by the researchers has increased since the beginning of the COVID-19 pandemic, with even whole conferences being conducted virtually and researchers attending online training workshops and webinars. There is an opportunity for these to open up new opportunities to researchers from Africa, allowing capacity-building via webinars and removing the barriers of limited travel funding, travel time and visa issues thereby creating a more level playing field for participation in meetings and conferences. However, researchers also cited the importance of meetings in providing face-to-face interactions in forming collaborations and it is worthy of investigation whether this same benefit can be derived from virtual meetings.

Discussion

In this study we aimed to characterise the interactions of researchers being supported by a capacity-building initiative, how these interactions are formed and how they can impact upon capacity-building. We hoped to capture the full range of

interactions that make up a scientific community, from formal and informal collaborations to meetings, training and mentorship. By capturing a wide-range of interactions, including those that might not be covered by publication metrics, such as collaborations with students and training, and by asking researchers about both their previous and current interactions, we are able to reveal extensive interactions taking place between researchers within the continent that have been hidden from previous bibliometric studies. Some of this increased intra-African collaboration that we have shown may reflect an increase in these collaborations over time that has not yet come through in the publication metrics which are subject to a large lag-time between research and publication.

The researchers valued these intra-African collaborations and detailed many ways in which these are allowing them to share capacity. This capacity-sharing could be an alternative to, or supplement traditional capacity-building, allowing positive spillovers to the broader scientific community. Strikingly researchers are also deliberately spreading the capacity they are provided with through being part of a capacity building initiative, to less well-resourced researchers. Through collaborations and interactions, capacity could become amplified, spreading out and contributing to the development of a self-sustaining scientific community.

To understand more about how these collaborations can be harnessed by capacity-building initiatives we sought to examine how they are formed and what might facilitate or hinder them. We identified that collaborations are most commonly formed along the lines of prior networks and relationships. Researchers were introduced to potential collaborators through consortia networks or worked with former colleagues and mentors, or the collaborators of those former colleagues. These introductions likely facilitated interactions by increasing the profile and network of the researchers, but also by providing the credibility and trust necessary for a collaboration to begin. Capacity-building organizations may be able to capitalize on this to encourage collaboration by further stepping up consortia activities that enable networking such as meetings between members and training placements, and by forming mentorship and alumni schemes, which would allow researchers to access the networks of other researchers.

As well as mentors providing networks and contacts to their mentees so that they can form collaborations that could help capacity-building, mentorship and training also allows direct capacity-sharing from mentor to mentee. A recent survey that asked researchers what they thought were the most important facets of being an excellent researcher showed that respondents placed the highest value on 'training and supporting future generations of researchers (Tijssen & Kraemer-Mbula, 2017, 2018). This is reinforced by our study, which shows that researchers greatly value the mentorship they have received, whilst also feeling a duty to pass on their knowledge and experience. Researchers are taking part in a wide array of mentorship activities, taking the initiative in setting up mentorship schemes and training people that do not have access to the same support that they do. The potential power of these interactions in increasing the impact of capacity-building appears to be recognised by capacity-building programmes who provide support for mentorship schemes and provide training in mentoring others.

Thus, this study highlights ways in which collaborations can impact on capacity building and ways in which capacity-building organisations can capitalize on this. However, it also reiterates the point made in a recent review of metrics for capacity-building (Pulford et al., 2020) that better metrics are needed to capture the full range of interactions that make up a scientific community, from formal and informal collaborations, to mentorship, training and meetings. Capacity-building organisations may also benefit from being aware of the constraints on collaborations that have been revealed by this study. The ready-established networks that they are providing to researchers may constrain collaborations to these pre-set patterns and an awareness of this may help to make sure that these do not become too entrenched. Capacity-building organisations could ensure to seek out new interactions, encouraging more local and regional meetings, increasing the range of countries they collaborate with and perhaps developing interactions with other consortia, increasing the pool of ideas and expertise to which their researchers are exposed. Researchers stated that developing their profile is essential and that identification of potential collaborators within the continent is not always easy; building a platform for linking potential collaborators and displaying the research that is being done across the continent could assist with this. The move towards virtual interactions through Zoom and WhatsApp, especially in a post-COVID world, is likely to further change the nature of collaboration. It presents new opportunities such as the removal of travel barriers from conferences and the ease of peer-to-peer mentoring via messaging apps, and new metrics should be considered to capture this collaboration as it develops.

Capacity-building organisations are increasingly recognising the power of collaborations in developing research capacity and we have shown that they can further harness this by developing intra-African collaborations to enable the sharing of capacity without external input and to amplify the capacity introduced through traditional-capacity building activities. To do this effectively will involve recognizing, understanding and being able to evaluate the full range of interactions that make up a scientific community.

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We would like to thank the researchers who participated in the interviews for sharing their experiences and insight with us, and Frédérique Bone for help in designing the interview protocol.

Consent

Written informed consent for participation in the study was obtained from the participants. Consent was reaffirmed verbally before interviews. Prior to consent, participants were informed of possible uses of the findings, including publication of a report using anonymised, amalgamated responses.

Data availability

Underlying data

Under the University of Sussex's Ethical review number: ER/HEB35/1, participants were assured that their interview data would be kept strictly confidential and due to the sensitive nature of the interview data, discussing working relationships and containing potentially identifying information, it is not possible to make this data freely available. Please contact Heather Burgess (heburgess2@gmail.com) to discuss access to the anonymised data. Access may be subject to further ethical review or re-consent of the participants. Anonymised questionnaire data has been provided as a supplemental file.

When using the findings and data of this study, the small and selective sample should be born in mind; these give an overview of the interactions experienced by this particular group of researchers and the ability to extrapolate to the general population of researchers may be limited.

Figshare: Research collaborations and research meetings in African Health Research, <https://doi.org/10.6084/m9.figshare.13726087> (Burgess & Chataway, 2021).

This project contains the following underlying data:

- Anonymised questionnaire data

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0).

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Overall:

An interesting article in terms of perspectives of African researchers on benefits and some challenges of research collaborations. Interesting concepts of intra-African mentorship and capacity sharing raised which should be highlighted more as the main contribution of the article. Some areas for further development of this article are provided below.

1. *Define what is meant by scientific* - the term in this article is quite specific and seems to refer only to laboratory sciences in terms of inclusion criteria used ('Researchers from the programmes who focused primarily on laboratory rather than clinical research were identified from the programme websites and contacted via email'). It would be best to refer in the title and throughout the article that the authors are referring to laboratory research capacity. As a social scientist I would have included all research conducted in a scientific manner, so some rationale for this narrower focus should also be given.
2. *Define what is meant by capacity-building* - there are many references to 'traditional capacity building' but this is not described and needs to be. Capacity development would be a preferable term as it goes beyond training and beyond the implicit assumptions of capacity building (where it is assumed that the community do not have any capacity at all to begin with and that the outsider is starting from scratch). As Suchman *et al.* (1988¹) (1988 - so we are going a long time back!) explains, we need to move beyond the "fallacy of the empty vessel". Nchinda (2002²) goes further and refers to both capacity and capability strengthening as often changes in the institution/organisation and environment such as national level policies are needed for large scale sustainable research capacity. Why the term capacity building is used and what this means needs to be explained.
3. Indicate that it is specifically *African lab research capacity* that is the focus.
4. Position article in the *debate of approaches to capacity development* and highlight contributions in terms of views from the south and capacity development through

mentorship and capacity sharing. Once the argument has been made in terms of the need for research capacity development then the authors should explain why within research capacity development the focus is on interactions. A way to do this is to look at the models/frameworks on capacity development (such as Bergeron *et al.*, 2017³ review of capacity development models) and argue what the added value is of your article. As Bergeron *et al.* note in their review knowledge networks and professional coaching were identified as common approaches to capacity development, but the authors could argue in this article that this debate is often in relation to research capacity straightening in north-south partnerships rather than south-south.

5. The arguments for (i) how to assess collaborations, and (ii) the approach to research capacity development are conflated - these are two different, though interlinked, arguments. You rightly argue that most collaborative research partnerships use publications as one of their metrics (but avoid generalised statements such as 'Most work on collaborations has used just one metric for collaboration, shared publications' - though measuring collaborations through publications is the predominant measure it is not the only one used and is often used with others - see Tigges *et al.* (2019⁴) review on measuring quality and outcomes of research collaborations.). Success or not of a partnership is often determined and driven by publishing. However, alternative metrics are not proposed in this article, so either include metrics that would enable measurement of interactions, mentorship and capacity sharing or leave this argument out. The second argument is how capacity is developed and this is often from a north-south view and this is where this article is different.
6. Additionally there is the need to separate out the benefits of the collaboration in general and then focus on the south-south capacity development that is facilitated through capacity sharing and mentoring. In the current version the discussion mixes these together. Not quite sure of the relevance of having a profile has to this debate - not very clear whether the collaboration helps create this profile.
7. The methodology is unusual. I am from a social science background and would have commenced this research from a qualitative lens as little is understood about this area. Possibly then after a better understanding is obtained a questionnaire might have been developed to see how widespread the issues raised in the interviews were. The authors should explain why a questionnaire was used initially and then interviews followed by deductive analysis. It would seem better to start with open ended interviews with inductive analysis as 'This is a small exploratory study aiming to highlight areas where new metrics should be developed and identify areas where capacity-building organisations might wish to focus their efforts in building a scientific community'. How can the themes to be analysed be predetermined?
8. The last section on results is more an interpretation than a finding 'A move towards online modes of interaction may remove barriers to intra-African collaboration' - the findings seems to suggest that there are limited interactions currently. The situation with COVID does mean many are using technology to interact and could possibly with increased confidence and acceptability of interacting in this manner expand these interactions with other African partners. However, this overlooks the other barriers to these interactions raised by the authors. There is possibly an argument to be made but would put this in the

discussion section as a suggestion on how this could happen.as it doesn't come out of the findings. Additionally little numerical analysis and no direct quotes are included to highlight the interviews held.

9. Some copy editing needed 'In the interview, researchers occasionally recalled collaborations that they had not at the time of the questionnaire, thus the interview appeared to give more complete information.' "For collaborations beyond the researchers' own institutes ..." Some sentences are unclear: 'Consortia or links with mentors likely provide the researchers with credibility and establish trust, reducing the risk to potential collaborators' 'As well as mentors providing networks and contacts to their mentees so that they can form collaborations that could help capacity-building, mentorship and training also allows direct capacity-sharing from mentor to mentee'.

Overall though, a useful contribution and hopefully the authors can address some of my comments above.to develop the article further.

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Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Not applicable

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health services research; research for development; qualitative methodology;

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

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