PhD programs in Africa: The Arrows, the Targets, and the Archers

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HAL Id: hal-03810373

https://hal.inrae.fr/hal-03810373v1

Submitted on 11 Oct 2022

Standard Policy Brief Template
Under the UNESCO World Higher Education Conference (WHEC2022)
Section for Higher Education | Division for Education 2030

Type: One organisation ☐ | Alliance ☒

'PHD PROGRAMS IN AFRICA: THE ARROWS, THE TARGETS AND THE ARCHERS'

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Date [02/28/2022]

Abstract

The research ecosystem in sub-Saharan Africa is changing. Organised around new centres of scientific excellence, the sub-continent is building a research agenda aimed toward major development challenges and the achievement of the sustainable development goals. Thus, strengthening doctoral programs and their beneficiaries becomes crucial in supporting this transformation.

However, great challenges remain in the designing and implementation of impactful scholarship programs to accompany the creation of African scientific communities of excellence. Stakeholders suffer from a lack of investment in research infrastructure and its operators as well as the absence of sufficient qualified supervisory staff. An increase in the student population and heavy dependence on international partnerships accentuates these challenges.

In this context, five doctoral support programs operators in sub-Saharan Africa (ICIPE, IRD, LPI and UNU) offer an inventory of the challenges associated with regional doctoral support. We offer a field vision, based on experience supporting over 1,500 doctoral students in Sub-Saharan Africa. We propose an approach that addresses SDG 4 - Quality Education and 9 - Industry, Innovation and Infrastructures (mainly objectives 4.b and 9.5) and demonstrate how these programs have become vectors in building sustainable solutions to development challenges in Africa.

This proposal aims to draw up the archetype of an impactful regional doctoral program in Sub-Saharan African that also ensures the well-being of the students involved. This contribution is intended for decision-makers (public and private) and national and international donors committed to strengthening research funding in sub-Saharan Africa through doctoral programs.

Content

Acronyms

IRD: Institute for Research and Development, France, https://en.ird.fr/

ICIPE: International Centre of Insect Physiology and Ecology, Kenya, https://www.rsif-paset.org

UNU: United Nations Universities, Germany, https://ehs.unu.edu/vice-rectorate

LPI: Learning Planet Institute, France, https://www.learning-planet.org/en

Introduction

Sub-Saharan Africa is increasing its scientific production and its investment in higher education. The subcontinent's scientific production (number of published articles) doubled its contribution to the world scientific research from 0.44% to 0.72% during 2003-2012[1], regional investment in research and development as a share of GDP is increasing[2], the African student population is booming, notably within its doctoral student's body (3% of the world population of doctoral students)[3]. Public decision-makers and socio-economic actors are becoming aware of the role that science and innovation have in the development of the continent's human capital. The support of a competent workforce through Higher Education is key to meeting the continent's major development challenges and to achieving sustainable development goals. In this context, funding doctoral programs is crucial to the strengthening of a critical mass of qualified academic and specialised staff. Highly qualified individuals are fundamental to meet the demands of the socio-economic sector, reducing brain drain and strengthening the pan-African scientific pools of excellence.

It is fundamental for Africa to increase PhD programs on the continent and to continue to engage in partnerships that increase the number of PhD holders in Africa (Kigali Communique, 2014[4]). SDG 4, especially indicator 4.b emphasises this objective[5]. International funding flows for scholarships in Sub-Saharan Africa have increased by 120% between 2010 and 2019[6]. SDG indicator 9.5 calls states *to encourage innovation and substantially increase the number of researchers*[7]. Globally, the number of researchers per million inhabitants stands at 1,198 (in 2017). Europe & Northern America have an above world average with 3,707 researchers per million inhabitants, while it is as low as 99 in sub-Saharan Africa[8].

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[1] Blom A, Lan G, Adil M. Sub-Saharan African science, technology, engineering, and mathematics research: A decade of development. Washington, DC: International Bank for Reconstruction and Development/The World Bank; 2016.

[2] UNESCO (2021) UNESCO Science Report: the Race Against Time for Smarter Development. S. Schneegans, T. Straza and J. Lewis (eds). UNESCO Publishing: Paris.

[3] Bernard, Ariane, Camille Longépé, Olivier Marichalar, Guillaume Tétard, et Hugo Zusslin. « CAMPUS France : Les doctorants à l'international : Tendances de la mobilité doctorale en France et dans le monde ». Campus France, 2019.

[4] https://www.hoarec.org/images/hesti_event_in_kigali_communique_march_13_2014-2.pdf

[5] https://unstats.un.org/sdgs/metadata/?Text=&Goal=4&Target=4.b

[6] UNESCO - Global and thematic indicators for the SDG 4 by Country (2010-2021) - Tab 583 http://data.uis.unesco.org/

[7] https://unstats.un.org/sdgs/metadata/?Text=&Goal=9&Target=9.5

[8] UNESCO - Global and thematic indicators for the SDG 9. Indicator 9.5

Volume of official development assistance flows for scholarships by sector and type of study, constant USD in Sub-Saharan Africa[9]
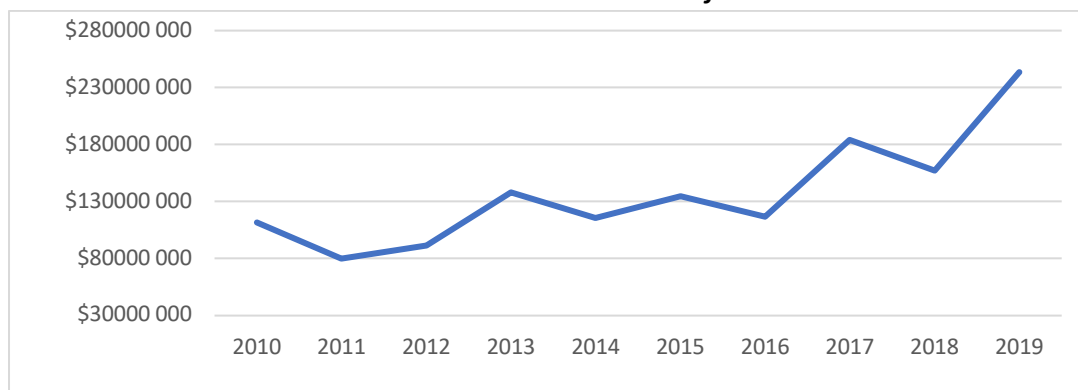
Although many African countries have regulated and enhanced doctoral training, the quality and support of PhD programs in sub-Saharan Africa remains challenging. African research infrastructures stay underfunded, many qualified staff migrate and student flow is increasing[10]. African research is dependent on international collaboration and funding, few pan-African scientific networks of excellence exist, and collaborations with industrial partners are rare and sometimes challenging. Meanwhile, the PhD holds the key to the creation of a highly-skilled workforce that will contribute to the knowledge economy. Strengthening PhD programs and students through African universities and innovative international cooperation will enhance educational standards and research capacity, as a lever of innovation for development.

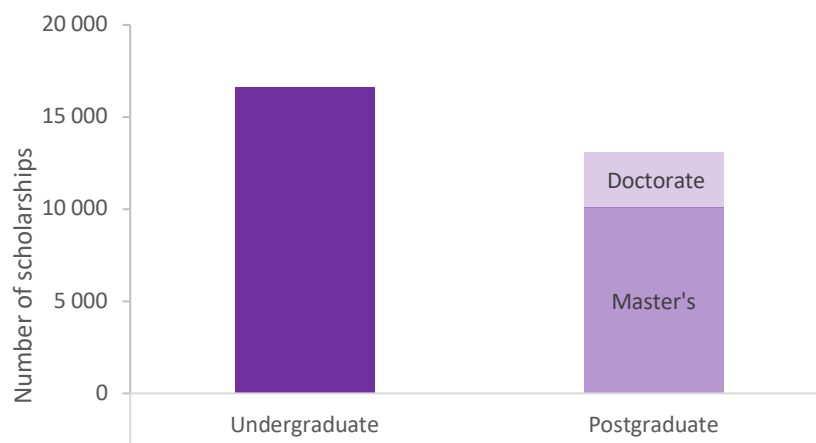*Distribution of tertiary education scholarships for sub-Saharan African students offered by the largest 50 providers, by degree type, 2019[11]:*

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[9] UNESCO - Global and thematic indicators for the SDG 4 by Country (2010-2021) - Tab 583
http://data.uis.unesco.org/

[10] Meyer J-B., Pilon M., et Ravalihasy A, « Les effectifs étudiants en Afrique au XXIe siècle : évolution passée et exercice de prospective », Working Paper du Ceped, n°48, Ceped (UMR 196 Université de Paris IRD, ERL 1244 Inserm), Paris, Septembre 2020.

[11] Source: Education Sub Saharan Africa (2020). GEM StatLink: http://bit.ly/GEM2020_fig18_3

Gathered around the opportunity represented by the WHEC 2022, five operators of doctoral programs in sub-Saharan Africa have come together to propose this contribution. Its objective is to share practices and reflect on the major challenges of doctoral support in Africa. ICIPE (PASET Program), the United Nations University, the IRD (ARTS and ACE Partner programs) and the Learning Planet Institute offer this contribution to open a discussion. Using the metaphor of an archer, its arrow and targets, we will conclude our discussion by sharing recommendations on a successful and impactful doctoral program in Sub-Saharan Africa.

The arrows: a focus on PhD students

In 2020, contributors to this note were responsible for 471 PhD students[12], and 1,507 since their creation[13]. PhD students are the future of African research[14]. Their well-being and capacity building are integral to the mission of doctoral program designers.

PhD students well-being

Doing a PhD is a stimulating, but also a challenging and stressful experience. Many stress factors affect PhD students: research project elaboration, integration in a research environment and into various networks, relationships with the supervisor(s) and with peers, growing competition, the quest for funding, scientific writing, solitude, lack of self-confidence, precariousness, uncertain future, cultural background, education system, mobility in a new environment etc. These factors directly affect the thesis quality and the way that stakeholders deal with them determine the impact of such experiences.

PhD programs may offer a professional and financial environment adapted to the needs of a doctoral thesis. Gratification mechanisms generally provide a living allowance or grant, and a series of services to scholarship holders, such as insurance, reimbursement of registration fees, etc. Determining the adapted student's allowance is key to achieving the right balance between student well-being and its insertion in its research environment. These amounts must be regularly revised to consider inflation and the local ecosystem. A PhD student should not be gratified more than a local early career researcher. Programs must also adapt to tuition funding. We observe a general rise in tuition and great differences between thematic and universities.

The difference in the cost of living between countries of intervention and Northern countries represents a challenge for South/North mobility. Gratification models need to adapt, but sometimes-poorly cover transition periods (new housing, initial purchases, etc.). Third parties, such as supervisors, family or friends must sometimes intervene to make up for the income gap.

In many African countries, gender gaps exist when it comes to women's enrolment and completion of PhD studies. This subsequently affects recruitment into university teaching and

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[12] IRS (ARTS): 130; ACE-Partners: 40; FIRE doctoral school (LPI): 120; ICIPE: 173; UNU: 8, total of 471 PhD students.

[13] IRD (ARTS): 800; ACE-Partner: 40; FIRE doctoral school (LPI): 475; ICIPE 184; UNU: 8, total of 1507 PhD students since the beginning of the program.

[14] Except for the 40 PhD students of FIRE doctoral school, all programs are mainly dedicated to African PhD students.

research positions. On average, women comprise 30% of Africa's researchers[15]. Female student well-being can be addressed through a gender-inclusive framework, especially for engagement of women researchers and paying attention to their specific needs. This has implications for successful completion rates and eliminating gender disparities in higher education and beyond.

PhD students' skills and capacity building

The most in-demand skills are creativity, persuasion, collaboration, adaptability and emotional intelligence[16]. These skills are completely interdisciplinary. Many students at African universities are technically strong in their own subject matter areas, but struggle to compete in work environments. Soft skills and transversal skills such as scientific communication, research methods, scientific paper writing, monitoring/evaluation and grant writing, are critical for career growth. The delivery of such skills emphasises a combined approach with research skills for PhD researchers to practically apply e.g. through entrepreneurship, consulting, the opportunity for supervision, teaching or potentially leading their own projects. More and more, these skills are accessible through online courses (MOOC, SPOC).

Higher education internationalisation (and the Covid 19 pandemics) forces African actors to develop new tools for collaboration. Reliant on digital technology, they remain used in a heterogeneous way and sometimes create inequalities of use in academic populations. As a result, access to the Internet is essential, yet it remains expensive and low quality in a majority of African universities. Moreover, the pandemic has shown that physical interaction, travel and access to funds may be curtailed. In future, PhD programs may face challenges with limited opportunities for on-ground/physical data collection because of pandemics and political unrest.

Like many arrows launched simultaneously by an archer, thousands of African doctoral students are launched towards doctorate degrees. As we just saw, equipping them with skills and ensuring their well-being will allow them to go far in their careers. Evidently, these doctoral students each have an individual path, a history, and free will. Still, where are these arrows headed?

The multiple targets of PhD programs

Doctoral programs aim at different targets. Firstly, the employability of doctoral students so that they can integrate into the job market once they have obtained their degree, either in the academic, entrepreneurial, private, public or NGO sectors remains a priority. Secondly, they aim to respond, through their scientific production, to the challenges of sustainable development (SDGs).

Employability

Africa is expected to host the largest and youngest workforce by 2050[17]. This demographic pressure exists in a context of low economic development, lack of human skill and employment

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[15] UNESCO - Global and thematic indicators for the SDG 9. Indicator 9.5 http://uis.unesco.org/en/news/new-uis-data-sdg-9-5-research-and-development-rd

[16] B. Durette et al., The core competencies of PhDs, Studies in Higher Education 41(8):1355-1370, 2016
B. Anderson, The Most In-Demand Hard and Soft Skills of 2020, LinkedIn Business Solutions, January 9, 2020

[17] https://population.un.org/wpp/Download/Probabilistic/Population/

opportunity and education backlogs. Until the turn of the century, primary education funding was favoured above higher education. This approach contributed to the decrease of high-level human capital training, and the erosion of research infrastructures. Little data exists on the destinations and employment characteristics of international African doctoral graduates after completion of their studies, especially in the poorest countries. Although, employment remains at the heart of doctoral students' preoccupations.

Strengthening the relations between research programs and the associated socio-economic sector, through events, workshops, summer schools, thesis committees or thesis subject co-creation is crucial. Alumni networks are emerging with a range of services, job offers, post-doctoral fellowships, training, networking, etc. involving socio-economic partners. Post PhD progression framework can be designed for example in collaboration with industry, funders, civil society, innovators and beyond.

Entrepreneurial momentum is rising amongst the PhD students. Empirical observations within the doctoral population suggest that the creation of start-ups based on doctoral work is now a valid alternative to employment in academia or industry. Entrepreneurship can contribute to local ownership and wider utilisation of research outputs and technology acquisition.

Sustainable development, SDGs and interdisciplinarity

The problem-solving approach is critical to the PhD program conceptualisation. There is a need to ensure that research directly responds to the needs of African communities and impacts on development. Borrowing and adapting existing technology to the specific needs of the continent will support leapfrogging[18].

But how can we concretely nurture interdisciplinarity? This is addressed by various mechanisms: firstly, by selecting priority areas for the program to focus on that are aligned to the needs of the continent; secondly developing cooperation between institutions with different research focus coming together for cooperation; thirdly, creating an environment and events behind interdisciplinary programs. Those events -intercultural and intersectoral- can be workshops or summer schools[19] that build capacities through innovative andragogical approaches. They focus on capacity building knowledge objectives, such as being able to:

➢ Focus on an important scientific question and to define the means to approach it from different disciplines;

➢ Zoom out (have a broader view) and zoom in (be precise and define the key experiments);

➢ Think and express ideas more clearly;

➢ Gain confidence in proposing, exploring, developing ideas;

➢ Discuss, reject or accept ideas;

➢ Learn to take constructive scientific criticisms;

➢ Learn to write a research proposal with scientists from other domains;

➢ Discuss scientific questions thoroughly; and

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[18] https://openknowledge.worldbank.org/handle/10986/28440

[19] Example: https://www.ird.fr/4e-ecole-dete-des-odd-une-edition-dediee-lapproche-one-health-linterface-entre-biodiversite-et

➢ Interact with people from different backgrounds and cultures.

Employability and the SDGs can be two different targets. How can we achieve several targets at the same time? We must ensure the employability of graduates in a job market that does not always care about the major issues of sustainable development. This represents an important challenge that must be addressed by doctoral programs. Our challenge is to align these targets so that an arrow can hit them both.

The archer: a stable and solid framework

Symbolically, the archer is the one who selects and launches the arrow. He/she must therefore implement all the measures to make the doctorate a success. This includes the general doctoral regulation framework, the doctoral supervision and the way the doctoral program is designed.

In partnership with multilateral organisations (European Union, World Bank…), the African Union is promoting a new framework for research and innovation policy. The Science, Technology and Innovation Strategy for Africa (STISA-2024[20]) aims to mobilise African research toward the wellbeing and improved quality of life of African citizens as articulated in the African Union Agenda 2063[21]. Despite this general framework, regional doctoral fellowship programs tend to be limited in comparison to those promoting North/South collaboration.

Doctoral programs are dependent on strong and reliable postgraduate education. It is expected that poor graduate programs within African Universities will lead to poor doctoral programs. These challenges force African academia to respond more directly to the needs of the socio-economic sector. To reach this goal, a multi-actor research program (ideally involving public, private and civil society actors) can partly answer that question. In practice, including actors outside of academia within the PhD experience faces many challenges. Few mechanisms exist in Sub-Saharan Africa toward the facilitation and the co-construction of thesis programs between academic actors and industrial actors (CIFRE fellowship in France for example). In general, the academic and industrial worlds tend to evolve apart from each other. Incentive programs are being developed to break academia/industry silos, aiming at changing the ways researchers do research and encouraging economic actors to mobilise local expertise (ex: FONSTI in Côte d'Ivoire…).

PhD mentoring: thesis supervision

PhD mentoring is challenging in two ways: the lack of critical mass among staff able to supervise doctoral students and the supervision quality. Regarding the first point, some supervisors will mentor a large number of students, which will have a direct impact on the quality of supervision. Some thesis scholarship programs reward supervision, some do not. This question remains open and may have consequences on the number of students by supervisor. What happens when a supervisor mentors five, six or more PhD students? How viable is this situation, regarding the availability of supervisors for students? This challenge is most prevalent in interdisciplinary thesis subjects. In this case, supervisors are about twice as many because the interdisciplinary

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[20] https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf
[21] https://media.africaportal.org/documents/Competences_techniques_essentielles_French.pdf

nature demands double supervision of theses for the sharing of experience and facilitates as much as possible the interactions between supervisors.

Regarding the supervision quality, seemingly inadequate supervision and mentorship support by African university supervisors exist. Consequently, doctoral students can easily lose contact with one of the supervisors in case of co-supervision. Training courses exist, and allow the acquisition of very important scientific and pedagogical (hard and soft) skills specific to doctoral supervision, such as:

- ➢ creating a thesis subject while thinking about its employability;
- ➢ managing a bibliography;
- ➢ creating hypothesis;
- ➢ reading and decoding a scientific article;
- ➢ scientific writing to increase chances of being published;
- ➢ how to avoid predatory journals;
- ➢ managing conflicts;
- ➢ setting milestones throughout the thesis;
- ➢ providing constructive feedback;
- ➢ thinking about employability throughout the thesis;
- ➢ helping your doctoral student stay motivated;
- ➢ communicating;
- ➢ managing fieldwork;
- ➢ supporting the autonomy and empowerment of the doctoral student;
- ➢ managing data;
- ➢ scientific ethics…

Furthermore, regarding international mobility, the role of supervisors is important, as they provide much help upon arrival with the resettlement. Supervisors who are supportive at crucial moments in the thesis process allow for PhD's greater empowerment, autonomy, and quality of production. Conversely, students who are left to their own devices are more likely to quit, waste time, and lose motivation.

PhD programs: a challenging design

The mission of thesis program operators is multifaceted. They are the architects who have to think about how to involve each partner institution in every country to ensure their sense of ownership. Indeed, from the very beginning, it was very important that all program partners be involved in defining a clear, verifiable and realistic scope and schedule for the PhD program. This includes clarifying milestones and deliverables at every stage of the program, defining a transparent selection process to attract the best African students (in Africa and beyond, within the diaspora), as well as the funding available for program activities. Program designers have to facilitate the mobility for both students and thesis supervisors, which enables the exchange of knowledge and experience among researchers from institutions in the global north and south.

Through this journey, the importance of access to relevant resources, transversal skills acquisition, as well as published academic literature is evident to ensure successful completion and PhD research. Funding for open access publication of PhD research outputs also proves to be important in ensuring widespread, unrestricted access to research results and recommendations. Conference participation also enables researchers to present their work to wider international audiences and receive initial feedback on their research. This implies a permanently integrated approach for interdisciplinary research and practice while taking care of the students' well-being, caring for their future regarding the professional and cultural challenges they will face. As stable and solid the program might be, it paradoxically implies strong agility to adapt to:

- unexpected challenges (political unrest, strikes, pandemics);
- onboard new and well-selected key partners joining the program; and
- find ways of eliminating bottlenecks and bureaucracy.

It is, therefore, necessary to constantly zoom in and out so as not to lose sight of the major development issues, nor of the day-to-day lives of doctoral students, who individually live a unique and challenging experience.

Recommendations

The ideal doctoral program provides doctoral students with the means to conduct research, experiment, publish, grow, develop, build key skills, create a multi-actors network, defend their thesis in good conditions, travel, work in the field, find answers, find work, produce knowledge, and contribute to the achievement of the SDGs. All this in a setting where they are guided, educated, cared for, can take a variety of courses, and benefit from high-quality thesis supervision.

In order to achieve this ideal, we suggest better interactions between universities and doctoral schools in Africa, to **harmonise practices in the sub-Saharan region** at different levels:

1. Develop regulation practices (easing mobility, thesis defence criteria, co-supervision);
2. Promote soft skills training that will improve the employability of doctoral students (related to 21st-century skills[22] and the skills tree[23]);
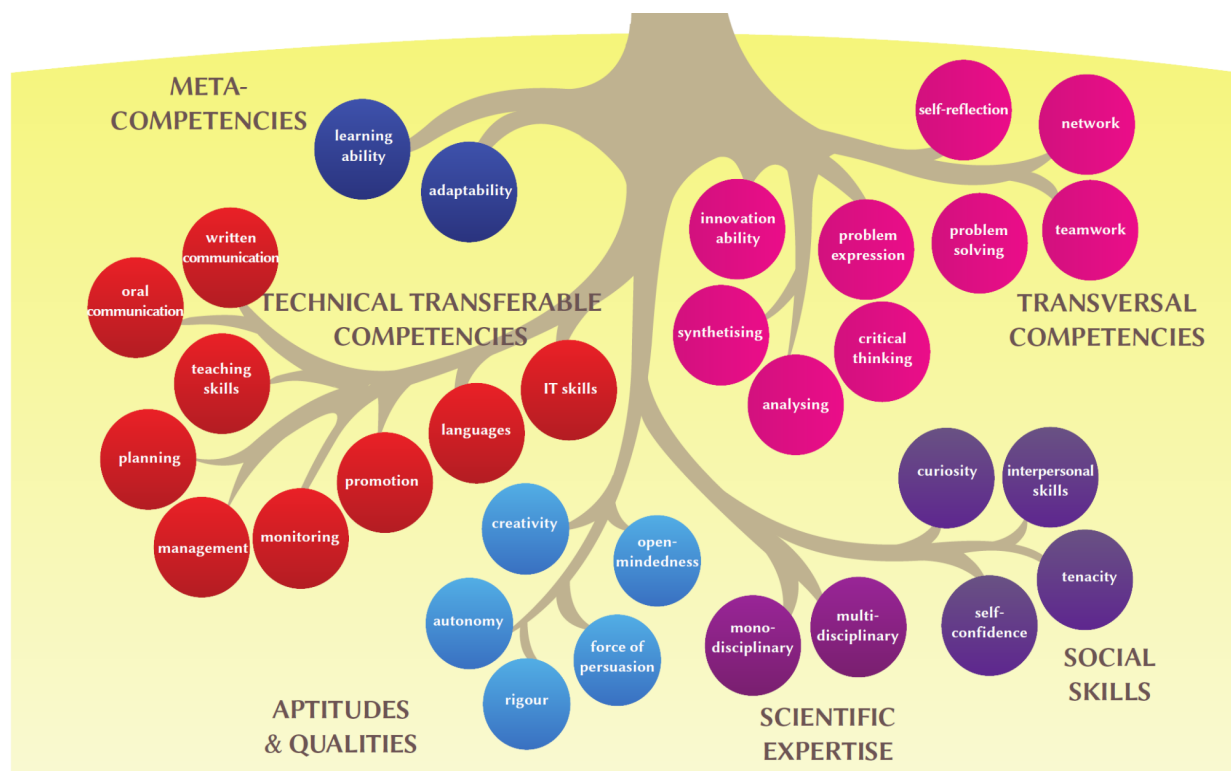
3. Develop access to a quality Internet network and to publications (open science), which requires massive investments and funding; and
4. Enhance the quality of doctoral supervision through the training of supervisors.

Those aspects have a direct and long-term impact on the research quality. Regarding the last point about **the quality of doctoral supervision**, we advise taking no more than one interdisciplinary project proposed per supervisor each year, because these are theses that are

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[22] Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review - Ester van Laar, Alexander J. A. M. van Deursen, Jan A. G. M. van Dijk, … First Published January 24, 2020

[23] B. Durette et al., The core competencies of PhDs, Studies in Higher Education 41(8):1355-1370, 2016

essentially off the beaten track. Moreover, we consider that the supervisors should not lead more than three other theses at the same time to ensure good availability, and training in thesis supervision should be systematised. Regarding the lack of critical mass of supervisors; should PhD programs prepare future supervisors? One idea would be to encourage mentoring of master's students by doctoral students to introduce transmission and mentoring. Another idea is that capacity for PhD mentorship and training could be significantly enhanced, where there was access to collaborations both across countries and within.

Regarding **student well-being**, we need to rethink the grant system to support quality of mobility and social inclusion (women with children, visa process, health care, arrival allowance, accommodation, and any facilitation upon arrival) for PhD students to avoid additional stress. This implies an efficient and trusting partnership with the host institute and preparation and training of local operators. The emergence of gender-based violence mitigation mechanisms and policies within universities is not enough. We need to think about dedicated grants adapted to women's mobility that can adapt to local socio-economic and cultural differences.

Moreover, student well-being should be addressed through regular meetings between a designated authority (thesis committee) and students where each student gives a non-technical summary of the PhD progress and raises any issues and challenges faced. Follow-ups and recommendations do not just focus on thesis content, but on the broader experience of students during their PhD. In the same frame, regular PhD colloquia should be organised between the students and the supervisors to provide constructive feedback on the progress of their PhD research. In the case of international cooperation, the project management team and the supervisors should hold regular coordination meetings to assess the progress of the project and explore opportunities for collaboration. We may also systematically assess the well-being of students through questionnaires or semi-directed interviews, which leads to PhD program regular adjustments.

We recommend the creation and support of alumni networks with a wide range of services, job offers, post-doctoral fellowships, training, networking, etc. that would be designed with socio-economic partners. Such networks can create new spaces for exchange and understanding of the expectations and needs of the private sector and NGOs, through conferences or workshops. **Partnerships** are a key component for successful PhD programs. We need to make sure that any partner (North and South) is aware and agrees about the scientific scope (interdisciplinary, problem-solving, coherent with the employability, and aiming at SDGs). They provide something additional that strengthens the collaboration. Partnerships may not include only academic partners such as universities, but also need to include socio-economic actors who will help us to develop tomorrow's tools. Facilitating the co-construction of thesis subjects between academic actors and the socio-economic sector will improve employability and technology transfer. In the broader partnership approach, we encourage all stakeholders (universities, funders, public and private actors…) to shift the power balance toward Africa in order to end North/South unequal partnerships.

A new paradigm based on **scientific excellence** and **ethical partnership** will allow us to design African solutions for Africa. *PhD Sandwich programmes* between institutions should be promoted since it provides a sustainable alternative to conduct PhD with joint resources (infrastructure, laboratory, joint supervision…). Such international cooperation fosters collaboration beyond the PhD programme. It provides opportunities for institutions with no PhD programme or with no potential to issue a PhD certificate. This approach helps to develop research programmes through the sharing of infrastructure and expertise between heterogeneous but complementary partners.

At the regional level, we encourage African governments and multilateral organisations involved in the development of science and innovation in Africa (African Unions, European Union, World Bank, French Development Agency, foundations…) to strengthen their support toward doctoral support. This support can take two forms:

1. Provide additional funding toward South/South/North **impactful doctoral programs**; and;
2. Encourage the creation of **gateways between academia and socio-economic actors** (incentives for multi-actor research programs and events, support science-based entrepreneurship…).

Doctoral programs must prepare students to become international professionals and fulfilled researchers, with the final objective of achieving the SDGs. It is necessary to support doctoral programs that encourage African universities to join or consolidate international standards of excellence. It requires different types of resources: financial on the one hand, but also to move the lines in terms of pedagogical innovation, considering the expectations of the economic sector and keeping in mind the challenges of sustainable development. The operators of doctoral programs must be resolutely inclusive. The academic and private sectors, NGOs, scientists, donors and students must be brought to the table before, during and after the implementation of doctoral programs. We are getting closer, but we are not here yet.

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