

## Harvard University

### Partnerships in STEM Innovation and Future Africa

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#### Introduction

I would like to acknowledge President Larry Bacow and Prof Wafaie (Wa-Fi) Fawzi (Fouzi) for the invitation to join this important virtual symposium: Partnerships in STEM Innovation and Future Africa.

It is an honour for the MF to partner on the Presidential Research Accelerator Fund at Harvard university.

I am happy to be here, as we bring to the forefront the meaningful and magnificent work that has been undertaken by the researchers here with us today.

To the faculty members, students, and staff from Harvard, as well as those who are joining us from around the world, thank you for sharing in this gathering. We are confident that the results of the research being conducted will contribute to the development and growth of the economies and the people of Africa.

#### Need for STEM Innovation in Africa

To bring about Africa's transformation, the contributions of African people in the development of STEM innovation and research is the highlight of this partnership. To cite a TED talk by the late Professor Tania Douglas, a South African Biomedical Engineer, she often spoke of the importance of Africa developing its own biomedical solutions.

She introduced her TED talk with an image of an equipment graveyard. In the image we see expensive medical equipment still in perfect working condition, piled in a junkyard.

She goes on to explain that the equipment has been imported into Africa, where it is sent with the best of intentions to assist with equipment shortages and the treatment of severe medical conditions to save lives.

Unfortunately, this equipment goes unused because most of it is not designed for local conditions. The equipment is difficult to operate, maintain and repair, and requires a reliable electricity supply, which is not usually available in many rural parts of Africa.

To change this, Professor Douglas established the African Biomedical Engineering Consortium to tap into the knowledge already available on the continent.

An example of this, is the response to demands for ventilators during the Covid-19 pandemic. Such knowledge enabled the creation of hundreds of low cost, life-saving ventilators developed with locally sourced materials in Kenya.

Building on the work of Professor Douglas and other African scholars, scientists, engineers and mathematicians, the Motsepe Foundation and our global partners including Harvard University CAS, are investing in STEM (science, technology, engineering and mathematics) research and innovation, and we are calling on more partners to join us in this initiative.

In order to promote much needed collaborations and knowledge sharing to benefit Africa and other developing nations, it is important for Africa to collaborate and work in partnership with leading global innovators to reduce its reliance on imported innovation.

According to the world population clock (World-o-meter) Africa holds 17% of the world's population, and while education on the continent has expanded, the quality and relevance of education has not necessarily kept pace with the demands of an ever changing workplace environment.

STEM education is increasingly recognized as a driver of economic performance, which is essential for helping developing countries compete in the global market, create jobs and improve lives and livelihoods. This is more so in relation to the 4IR technologies and the demand for skills in these new sectors.

Africa is home to a growing youth demographic. Currently, almost 60% of Africa's population is under the age of 25, which makes Africa the world's youngest continent. By 2030, it is estimated that Africa will have 1 billion people within the working age, and Africa will house the largest workforce in the world by the end of the century.

The WEF in their Future of Jobs report, states that 5 of the rapidly growing and most in demand jobs are data analysts and scientists; AI and machine learning specialists; big data specialists; digital marketing and strategy specialists and process automation specialists. The demand for these skills have been compounded by a rapid automation of the workforce as well as the Covid-19 pandemic and recession.

This is why it is critical for quality education, particularly in STEM fields, to reach more people in developing nations.

Almost 60% of Africa's youth, between the ages of 15 and 17, are not enrolled in school, but with the roll-out of education, particularly education that is focused around STEM, the potential to scale human capital for innovation is colossal.

Across Africa, less than 4% of people have a university degree, and less than 25% of the currently enrolled students are pursuing STEM qualifications. Increased promotion of STEM, and the available opportunities within the labour market, can create the necessary work opportunities that will fulfil the aspirations of Africa's growing population.

The African Union estimates that 70, 000 skilled professionals emigrate from Africa every year, to pursue economic opportunities in Europe and America.

In addition, McKinsey reports a growing number of skilled management and technical positions being filled on the continent by Chinese, European and American professionals due to the lack of a domestic STEM trained workforce.

Chinese construction enterprises deliver half of all engineering, procurement and construction contracts on the continent. This is why China has become such an important contributor in development projects in Africa.

There is however an opportunity to train and up-skill the local workforce and to educate more young people in STEM studies.

To equip Africa's youth with skills that suit the future of work, and skills that relate to Africa's need for development and innovation, the interaction between the STEM subjects and the humanities needs to be recognised as critical for navigating the Fourth Industrial Revolution.

This is manifested by the STEAM movement (science, technology, engineering, the arts and mathematics) at universities globally to match the growing demand for arts and humanities skills in STEM fields with the advent of disruptive technologies such as 3D printing and robotics.

Based on this, Professor Joseph Aoun (Awn), President of Northeastern University in Boston, in his 2017 book *Robot-Proof: Higher Education in the Age of Artificial Intelligence* lays out the framework for a new discipline and research field – humanics – which prepares students to compete in a labour market in which smart machines work alongside human professionals. He identifies the following three graduate literacies as vital for navigating the 4IR: data literacy, technological literacy, and human literacy.

Africa urgently needs, in every sector, good leaders who have the vision and wisdom, who are well-educated, well-skilled citizens, together with strong institutions that can establish sustainable futures, inclusive economic development and social progress.

### **An African STEM Context**

Diversity and inclusion in STEM, which includes the contributions of marginalised people in our society, enables us to work toward eliminating digital divides.

South Asia and sub-Saharan Africa have the largest gender gaps in digital technologies. In the global South, women are 50% less likely than men to be online. These gender gaps prevent women from becoming activists that lead change on issues that affect them, and further prevents women from improving their circumstances through increased access to markets for their businesses and other work opportunities.

The African Union Agenda 2063 has prioritised human capital development, the future of work, and STEM for Africa's socioeconomic transformation. Members of the African Union are encouraged to spend at least 1% of their GDP on research and development to enhance STEM innovations.

Investing in research and innovation for Africa could level the playing field, or at least narrow the gap between the continent and the more industrialised countries in the global north. To build wealth the African Union is adamant on extending access to education and skills.

Already, great strides have been made in solving the challenges relating to education on the continent. In Africa there are 188 EdTech start-ups that are developing tools that require limited connectivity. The infrastructure for connectivity is lacking in the areas of Africa that need this technology most, and their understanding of the local context is what drives their innovation.

In South Africa, only 5% of primary and secondary schools are adequately resourced and staffed to teach these crucial STEM subjects.

Through the Motsepe Foundation, we have made it our mission to support schools in building and maintaining their infrastructure. For schools across South Africa, over the last three years, we have built fully equipped computer and science labs, to assist teachers and learners with nurturing a passion in STEM. We have selected schools in areas with a high population density, and it is expected that these STEM labs will impact the quality of education received by over 3 million learners.

The action taken by the Motsepe Foundation is a necessary and critical intervention but not nearly enough. More philanthropic foundations, governments, the private sector and international development agencies need to join hands to scale up so as to attain critical mass.

### **Importance of the Arts**

A criticism of Africa and its higher education sector is its concentration on the arts, humanities and social sciences. But these sectors are helping to restore Africans' identity after centuries of pressure to assimilate into colonial patterns.

In the context of Africa, this focus has been essential to healing historical injustices and nurturing the leaders that have built necessary bridges across race, tribe, gender and nationality.

Through innovation there is tremendous opportunity for Africa to scale the knowledge that has been gleaned over the past years of healing and reconciliation. Africa has knowledge to share with the world, as movements including Black Lives Matter aims to reconfigure the social fabric of the global north.

It is impossible to talk about Africa's contributions to the world without mentioning the arts. Africa has been a land of inspiration for artists, and Africa remains an influencer in music, fashion, dance, fine arts and literature.

The African Union, in its Agenda 2063, aims to develop an Africa with a strong cultural identity, common heritage, values and ethics. Africa is the cradle of human civilization, and through centuries of passed down heritage and values Africa has contributed to human progress.

By promoting and strengthening the cultural resources of Africa, the African Union aims to promote African pride, in order to emerge as a strong, united, resilient and influential global player.

African pride represents a growing movement for recognising and paying tribute to African knowledge. Such recognition has been difficult to find in traditional academic circles – not only for Africans but for researchers across the developing world.

A team of researchers at the Hungarian Academy of Sciences analysed publications in more than 7,000 science journals, published between the beginning of 1999 and the end of 2000. The team found that 70% of the research that was published, despite being carried out in the least developed countries of the world, was not co-authored with local research institutes, even though the fieldwork was conducted by local scientists.

Scholarship credit is denied to researchers who live in countries that are not industrialised, despite these countries offering opportunities to global researchers who are interested in solving the most complex and pressing issues of our time.

For Africa to power and harness the Fourth Industrial Revolution, the value of knowledge and expertise, which is already available on the continent, must be held in equal esteem by African people and by the global community of innovators and academics.

The Silicon Valley start-up Lyft, is said to have been inspired by the transport system in Zimbabwe. African people were shocked that their own inventiveness would become such a highly valued enterprise in the global north. The app was previously called ZimRide and it borrowed from the pooling transport network that is widely used in Africa by people who don't own cars.

### **Collaboration for the SDGs**

While much of the work that is already being done in Africa is necessary, it is not enough. Collaboration between universities in different parts of the world can help to build knowledge that is global and responsive to needs across different kinds of communities.

For example, Joy Buolamwini (boo-lam-vini) is a Ghanaian-American computer scientist and digital activist, who found unintentional discrimination in commercial AI facial recognition services.

In her research she found that the technology was almost accurate for light-skinned males, with a slight 0.8 percent error rate. But for dark-skinned females, the error rate was over 40 times higher at 34.7 percent. It was unintentional but it is in these blind spots that the contributions of African data scientists can ensure the effectiveness of globally introduced technologies.

Universities such as Harvard, which operate in stronger economies, have better resources and equipment than those that are available at some African institutions. It is inspiring to see cross-country and cross-continental collaborations such as the ones that Harvard CAS is promoting. These partnerships are crucial in order to do impact research that is transformative and can strengthen the capacities of partners in less resourced universities.

In addition, institutions in Africa will provide within the partnership and collaboration, the necessary local context and guidance to help ensure the success of the overall project.

African-based universities are already making a conscious commitment to apply their research to serving the needs of African people. For example, the prevalence of diseases such as tuberculosis, HIV/Aids and malaria have motivated South African researchers to focus on the specific needs of patients with those conditions, as well as lifestyle diseases such as diabetes.

This is what led the University of Cape Town Professor, Elmi Muller, to perform the world's first organ transplant between an HIV-positive donor and recipient in 2008.

In Africa, problems are more apparent but the solutions to these problems change the lives of people everywhere.

We are all now navigating a global crisis in climate change. How we cultivate, produce and transport our food is a cause of concern and Africa may hold the answers to our transformed food and agricultural industry.

A number of universities in Africa including the University of Pretoria as the lead institution in partnership with the universities of Ghana, Nairobi and Leeds in the UK are doing research in sustainable food systems and making inputs to the upcoming UN Food Summit to be held in September.

Sixty percent of the world's uncultivated arable land, is in Africa. If this land is used effectively, Africa could evolve from a continent of poverty to one that can contribute to food security. The research and innovation that will come from STEM fields to improve agricultural productivity, are what will enable this progress.

The Sustainable Development Goals, as well as the African Union's Agenda 2063, is what guides Africa's current research and development.

The United Nation's SDG framework highlights that the environment of education and learning is transforming. By implementing a design thinking methodology into classrooms, children are nurtured to apply themselves to global and local challenges, and engage with disciplines that will enable them to bring about change.

The African Union is emphasizing education that is underpinned by science, technology, and innovation. The African Union aspires that, by 2063, Africa shall be a continent of well-educated and skilled citizens. In this knowledgeable society it will be the norm that no child misses school due to poverty.

### **Closing**

I wish to thank all the researchers who collaborated on this inaugural Research Accelerator. The meaningful impact that this will transpire is the reason we chose to invest in this initiative.

Not only are you working toward developing Africa and increasing Africa's global contributions, you are also inspiring a generation of African youth who are looking to bring positive change within their own lives and their communities.

In the beginning, I mentioned the medical equipment graveyards. This cross-continental collaboration has allowed global innovations to become more efficient and more effective. More than research, this inaugural team has brought hope for Africa and African people.

Thank you all, and I look forward to engaging with your presentations this week.