

China-Africa Cooperation on Science Technology Engineering and Mathematics: Challenges and Prospects

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Abstract: Study Focus: This Study explores some contemporary issues of China-Africa cooperation on Science Technology Engineering and Mathematics (STEM), suggests how some areas of the cooperation among stakeholders should be reformed to improve the status quo and higher the overall image of the China-Africa Education Cooperation.

Methodology: The content of this paper relies on written documents (including books, scientific journals, articles, and official reports) from primary and secondary sources most of which are available online as well as on the author's teaching experience in Chinese and African Universities.

Findings: 1) African countries are still lagging behind in terms of STEM basic infrastructures, teaching programs and adequate teachers. 2) Africa's inability to fill most STEM jobs within industries is of greater concern. The shortage of such workforce is linked to inadequate classroom teaching and learning practices. The stronghold of colonial legacy in formal education of African countries is also to be blame. 3) African governments should create the necessary environment for acquired STEM skills to be applied, otherwise STEM education will remain a waste of time as it is presently the case in several African countries. 4) Despite criticisms on the actual patterns of China-Africa Education Cooperation, China successful story at home should be a great source of inspiration and China's experience may well be very precious for striving developing African countries.

Conclusion & Suggestions: Instead of a continuous donation of STEM equipment to African countries, more Chinese equipment manufacturing industries should outsource and relocate in Africa, more Chinese STEM experts made available, virtual campuses established to speed up the knowledge transfer. Short-time vocational training and recycling of STEM teachers and professionals of African countries should be considered. Most importantly, more funding should be made available at a bilateral level by China to support STEM projects and basic infrastructures development in African countries.

Keywords: Science Technology Engineering and Mathematics (STEM), Science and Technology Education (STE), China-Africa Education Cooperation, Covid-19, African Education.

I. INTRODUCTION

Education cooperation between nations deepens the mutual understanding, enhances ties of friendship and paves ways for sustainable development. China-Africa Cooperation

on Science Technology Engineering and Mathematics (STEM) has always been part of the China-Africa Education Cooperation's agenda carry out through platforms such as FOCAC (Forum on China-Africa Cooperation), or major initiatives such as BRI (Belt and Road Initiative), as well as through various development projects between China and African countries at a bilateral or multilateral level. Education as the process of facilitating learning, acquisition of knowledge, skills, values, beliefs, habits and most importantly acquiring the technological know-how is essential for African countries to achieve high levels of economic growth (Taling, 2020). Science and Technology Education (STE) as the process of learning by doing, as an innovative way of making learning a practical process that connects to real life through application of science and technology, should be the top priority of China-Africa Education Cooperation. Some researchers believe that the China-Africa Education Cooperation has been a successful story, for it has brought countless benefits to both sides (Mvuh & Liu, 2019). The ongoing criticisms on the China-Africa Education Cooperation pointed out by other thinkers (King, K. 2019, Alden, C., & Large, D. 2019) are to remind us that Chinese and Africans still have a long way to go to improve the actual status quo of their relationship and cooperation. In fact, after decades of cooperation with China, some African countries still faces some of the basic STEM development's challenges such as infrastructures, teaching programs and adequate teachers. One may wonder what went wrong and what can be done in the framework of China-Africa STEM Cooperation to fix such trivial matters. What are the prospects of STEM education development in Africa with regards the continent's development goals preset by the African Union (AU) in its Agenda 2063?

II. STEM IS A HUMAN RIGHT

The first World Science Day for Peace and Development was celebrated worldwide on November 10, 2002, under UNESCO auspices to ensure that citizens are kept informed of developments in science. That day highlighted the significant role of science in our daily lives and the need to engage the wider public in debates on emerging scientific issues. In this 21st century where Science and Technology have become

essential tools of development and main drivers of human evolution, STE (Science and Technology Education) has come to be a human right as clearly stated in the 2018 theme of the *World Science Day for Peace and Development* that was: “*Science, a Human Right*”, in celebration of the 70th anniversary of the *Universal Declaration of Human Rights* (article 27), and of the *Declaration on Science and the Use of Scientific Research*. Recalling that everyone has a right to Education and the right to participate in and benefit from science. This was an anticipation to the 2020 global pandemic of Covid-19 that has threatened the human existence and reinforce the idea that our survival is heavily dependent on scientific and technological development. In fact, During the Covid-19 pandemic, a collaborative relationship between scientists and scientific researches including potential vaccines must be shared universally for the sake of human kind. There is no doubt that an efficient response to Covid-19 will eventually implies a resourceful use of science and technology. Hence, the 2020 World Science Day for Peace and Development themed “*Science for and with Society*” was set as a global response from UNESCO with regards to the pandemic.

III. STEM CAN UNLOCK AFRICA’S POTENTIAL

Concerns have been raised by prominent institutions on Africa’s inability to fill most science, technology, engineering and mathematics (STEM) jobs within industries. Currently in Africa, most STEM jobs are performed by or outsourced to multinationals from China, India and the US (Source: World Economic Forum, 2015). For example, in 2014, 87 construction teams arrived in Kenya from China to ensure the construction of the Standard Gauge Railway in Kenya. Most Kenyans could not do the job. Also included from China were 2000 pieces of equipment in readiness of the start of the project (Patrick Otieno, 2015). The shortage of such workforce is linked to classroom teaching and learning practices that are pre-dominantly geared towards passing examinations, and not towards applying knowledge acquired to solve real life problems affecting societies. In addition, the stronghold of colonial legacy in formal education of African countries is to be blame. As matter of fact, some African countries since their so-called “independence” still remain heavily dependent on their former colonizers’ education programs, and so missing the opportunity to shape and design their own teaching programs so as to meet their most urgent needs of basic infrastructures development and industrialization, crucial to build up and sustain a strong economy. Moreover, technological transfer between some colonized African countries and their former colonizers has been deliberately ineffective, deepening the dependence and further exploitation of African countries. To be convince of this reality, it suffices to examine the case of sub-Saharan francophone African countries that still remain the poorest countries on the continent. Formerly colonized by France, most of these countries still maintain with their former colonizer some cooperation accords dating from the time of the so called decolonization as outlined by Steven Erlanger,

the chief diplomatic correspondent in Europe for The New York Times in an article published the 12 September 2011 in which he stated that,

“France’s relationship with its former African colonies is known as ‘Françafrique’, which is commonly mocked as ‘France à fric’, since ‘fric’ is slang for money” (Steven Erlanger, 2011). He was on the same wave with Tony Chafer who asserted earlier that *“Since political independence (of African countries), France has maintained a privileged sphere of influence—the so-called ‘pré-carré’—in sub-Saharan Africa, based on a series of family-like ties with its former colonies* (Tony Chafer, 2005).”

These family-like paternalist ties have created a heavy dependency of African countries vis-à-vis of their former colonizers and exposed them to further exploitation today known as neocolonialism (Taling, 2020). Professor Yoro Diallo believes that

“Europe has dominated, acculturated, assimilated and exploited Africa for centuries. Despite such a long period of domination, the academic work of Europeans on Africa has remained peppered with clichés, prejudices and unbridled paternalism, often distorting historical realities and misinterpreting essential elements of African cultures” (Yoro, 2019).

It is worth emphasizing that, African countries themselves should work hard to break-off that vicious circle and set up new reforms and cooperation that prioritized their interests, most importantly reforming educational programs in accordance with their most urgent development needs. The responsibility here is for African leaders to show more political will and determination to end up a century old dependency, defend their national sovereignties and vow for more partnership at a multilateral level with rising powers such as the BRICS countries.

IV. BENEFITS OF CHINA-AFRICA EDUCATION COOPERATION

It is believed by many (Cambridge, James; Thompson, 2004; Hayden, Mary; McIntosh, 2018) that the benefits of international cooperation are reflected in mainly three gradual levels: Individual-level, Institutional level and Governmental level. The scholars Mvuh Zouliatou and Liu Hongwu have scrutinized the benefits of the China-Africa cooperation on education at these levels, with Cameroon as case study the findings of that investigation can be resumed as follow (Mvuh & Liu, 2018):

Benefits for Cameroon.

At the Institutional level, the education cooperation between China and Cameroon has enabled the construction of primary schools and secondary technical and vocational schools in Cameroon, and the Confucius Institute at the University of Yaounde II; the construction of microbiology laboratory

within the University of Yaounde I. Some Cameroon teaching institutions have received many learning and teaching materials from China including books, computers, etc. which have been useful in enhancing the schools' environment thereby attracting more students to be enrolled. At the management layer, China-Cameroon education cooperation has provided training opportunities in China for Cameroonian education managers through the inter-university partnership, the education delegations from Cameroon have participated in several seminars in China. From 2002 to 2006, Cameroonian's education delegations participated in about 40 seminars in China through the partnership between the University of Yaounde I and Zhejiang Normal University.

At the individual level, the cooperation has created jobs opportunities for those Cameroonians who have studied in Chinese Universities with better salaries than those trained at home. For, once they returned at home, they are prioritized by Chinese companies operating in Cameroon because of their abilities to cross the language and cultural barriers as bonus to their professional skills shaped on Chinese standards.

At the governmental level, not only diplomatic ties have been reinforced, but more cultural ambassadors have been trained to help carry out the multiple cooperation projects within the two countries. Experience sharing in education between the two countries has also been noticed.

Benefits for China.

As for China, the authors mentioned, Internationalization of China's Universities that has led to China becoming a prioritized destination for higher studies (rather than western countries), the improvement of China's Soft Power in Cameroon, the job and research opportunities for Chinese volunteers teaching the languages in the Confucius institutes and some other institutions in the country. At the diplomatic level. the reinforcement of diplomatic ties, friendships and mutual understanding through cultural exchanges between China and Cameroon. This takes in the inclusion of Chinese language in Cameroon official secondary school curriculum (as optional language).

In a word, the China-Cameroon education cooperation is a successful story according to both scholars, and these outcomes can be generalized on the entire continent, for the cooperation patterns are likely similar. However, we can notice a lack of statistics and precisions in numbers that seems very characteristic of the cooperation with China.

V. CRITICS OF THE CHINA-AFRICA EDUCATION COOPERATION

Despite some concrete achievements and pragmatic outcomes, the actual pattern of the China-Africa Education Cooperation has been largely criticized. Some critics have voiced out concerns on the internationalization of Chinese education, language and culture, saying that it leads to the erosion of local education systems and indigenous values and norms of recipient countries, which tend to be replaced with the

internationalized Chinese systems and cultural and ideological values and orientation (Alden & Large, 2019). Kenneth King and al. have criticized the FOCAC platform to technically pledging labels such as "*scholarships, cultural partnerships, mutual learning, knowledge sharing, research, capacity building, training opportunities, people-to-people exchanges*", etc. at a Pan-African level without specific policies following at a bilateral level with each specific African countries according to its own needs. He goes further and demonstrate that a great deal of Chinese support in education cooperation is oriented to the most strategic BRI countries. For example, in 2017, no less than 66% of all Chinese government scholarships were going to students in the BRI countries. It was noted besides that 153 Confucius Institutes were operating in 54 BRI countries (King K., 2019). It has also been argued that Chinese investments in Africa's education tend to be more oriented in language and culture for propaganda purposes rather than in Africa's most needed sector of education such as STEM. For example, already in 2009, James F. was claiming that the Confucius Institute projects can be seen at one level as an attempt to increase Chinese language learning and an appreciation of Chinese culture, but at another level, it is part of a broader soft power projection in which China is attempting to win hearts and minds for political purposes. And that besides Confucius Institutes, some other ways China raises its cultural profile overseas include Chinese contemporary art exhibitions, television programs, concerts by popular singers, and translations of Chinese literature. (James F., 2009). Steven Mosher went far in 2012 by labeling the Confucius Institutes as "*Trojan horses with Chinese Characteristics*". He argues that, unlike Alliance Francaise, the Confucius Institutes are not independent of their government; unlike the Goethe-Institute establishments, they do not occupy their premises. Instead, participating universities agree to provide office space in exchange for funding, and to cede academic control to the United Front Work Department of the Chinese Communist Party (Mosley S., 2012). In short, not much has been done in the interest of African countries according to those critics. But most of them come from western scholars and academic circles. As for African elites and decision makers, they have remained quite confident, and are definitely convinced that the cooperation with China is far more fruitful compare to that with westerns countries. We will rather suggest that there is a necessity to restructure the actual patterns of the cooperation on so as to meet the fast-increasing needs of African countries for education development and improve the overall image of the China-Africa Cooperation.

VI. TOWARDS BUILDING A STRONG CHINA-AFRICA STE COOPERATION: SUGGESTIONS AND RECOMMENDATIONS

A- China's Successful Story of Education Reform Should Inspire African Countries

Despite of being a developing country itself, China has successfully set up the right policies, built up the necessary institutions and trained talents necessary to its own

development in all sectors, and today is competing with technological advanced countries such as the United States of America, Japan and Germany in fields such as Automatic Intelligence, 5G technology, etc. This has been made possible thanks to the education reforms and the political determination of Chinese leadership. In the meantime, China has been working hard to lift up other developing countries with a very different approach in its foreign policy compare to that of the traditional western “donors”. China’s education aid includes higher education, vocational training, Chinese language training, school construction, and collaboration with multilateral organizations (King K., 2014). In recent years, Chinese universities scholarships and vocational training programs have grown sharply, as has the teaching of Chinese-language and culture. Moreover, China non-interference policy, request driven aid, no-string attach aid and respect of national sovereignty of recipient countries have made China a very attractive partner for African countries. China successful story provides a great source of inspirations for African countries which must leaned from China’s experience but build their own models suitable for themselves.

B- Establishing a China-Africa Scholars Union Can Propel the China-Africa STEM Cooperation

Scholars are the frontline soldiers when it comes to the cooperation through Research, Education and Technology. So, it is for Chinese and African scholars and STEM professionals a sole duty to brainstorm new patterns of cooperation, and so paves new ways for an in-depth study and application of STEM knowledge and skills in African education. Among the most urgent issues that requires Chinese and African scholars to work out in such a union, is the increasingly biased image of China-Africa relationship as well as some preconceptions and misunderstandings affecting the Chinese and African scholars’ circles as noticed by professor Liu Hongwu, distinguished scholar (Changjiang Scholar) of the Chinese Ministry of Education. More precisely the “*Sino-western duality view-world narrow-minding the Chinese academia*”¹ and the need for “*African scholars to de-westernized their appraisal of China*” (Liu, 2019). By joining hands and working together, Chinese and African scholars will be given

¹ “After modern times, due to the gradual baptism of the western wind and the European civilization, Chinese people have gained a new dimension of world cognition, and their world outlook and self-knowledge have been broadened and changed. However, the western stronghold was so strong that China, which was relatively backward, have to recognize and integrates some westerns values in the process of saving the nation from extinction, thinking that the path of reform was to seek for strength. Over the past 100 years, Chinese people have made great achievements in learning from the west. This process of ‘learning from Europe and America’ has itself become one of the reflections of the renaissance and the rise of Chinese civilization. However, in this process, western civilization was (mistakenly) understood by the Chinese as universal, and some Chinese thinkers took western civilization as synonym of global civilization. As result, Chinese people’s world conceptions have unconsciously shaped a kind of ‘Sino-Western dual dimension’, and the ‘opening-up’ to the outside world has almost become ‘opening-up to western civilization’”. (Liu Hongwu, 2019. p :36-37.)

the opportunities to tackle these basic issues alongside with other tuff challenges that undermine the China-Africa Education Cooperation.

But how Should such a “Scholars Union” Operates? We suggest 3 major layers of operation, namely the individual layer, the institutional layer and most importantly the governmental layer.

Individual layer: This stage is about a shift of attitude and posture that should take place in every scholar’s mind. A self-assessment on what really matters in the China-Africa cooperation agenda is key important. The process of de-westernization of both Chinese and African scholars’ minds must be effective so as to think out of the box, path a different way and provide new approaches to tackle the China-Africa Problems. This process is also useful for the rebirth of the cultural identity and self-cognition of African stigmatized by the century of intellectual alienation brought by western colonization, only then the African scholars will embrace the world with a perspective that better serves the interest of Africa.

Institutional Layer: It is true that African and Chinese Universities have been signing and implementing MoU, Confucius Institutes have been expanding over the continent, and more Chinese Universities have been setting up Centers for researches. China-Africa Think-Thanks Forums and roundtables are also being organized to deepen the mutual understanding between China and Africa. Without underestimating these previous achievements, we highly recommend the creation of “China-Africa Joint Research Centers” that gather scientists, researchers and STEM experts in both China and African Countries. Here we mean specialized institutions that will be devoted on specific questions with priority first hands data and a certain autonomy and budget of their own. We acknowledge that certain efforts have already been done in this way, for example with the creation of institutions such as the China-Africa Institute² in Beijing (Source: Ministry of foreign Affairs of the People republic of China), but a lot still remains to be done in term of the efficient co-management, the projects’ contents planning as well as the setting of joint research teams of these institutions.

Governmental Layer: At the governmental level, more soft policies should be enacted to encourage African scholars’ visits and research in Chinese most prominent institutions, more financial supports for joint research projects that prioritized STEM development as well as specialized scholarships and training programs should be provided to support African and Chinese scholars to work together. But most importantly, they should be real followed up policies for

² Chinese President Xi Jinping sent a congratulatory letter to the establishment of the China-African Institute. Representatives of Chinese and African government departments, academic institutions, think tanks, social celebrities and African nationals in China attended the conference along with 350 people.

these research programs or scholarships to make sure the target is reached and that the results benefit the stakeholders.

In a world, unity and togetherness between Chinese and African scholars and STEM professionals will bring countless benefits as it may speed up the STEM development in Africa and improve the overall image of STE cooperation between China and African countries.

C- Rethinking the China-Africa STEM Cooperation Strategies under the Covid-19

The issue of Security surrounding the China-Africa Cooperation in general and the China-Africa Cooperation on Education in particular has not only been one of the top priorities of the FOCAC summit, but has also been at the frontline of various development initiatives between China and Africa since the beginning of the coronavirus pandemic. Despite billions of Yuan investment in the sector, health security in particular still remains a big challenge in African countries given the very fragile healthcare infrastructures, lack of qualified scientists and medical personnel etc. once again we are caught up with the backwardness of STEM development that largely justifies the state of health insecurity in Africa in times of greater threat such as the Covid-19. But the problem seems more complex than simple education reforms, for, it implies domestic and international players. International organizations such as the UN, the WHO (World Health Organization) in joint efforts with leading powers such as the U.S, China (that supported for example the construction of Africa's CDC headquarters, sending teams of Chinese doctors as well as medical equipment to Africa during the hot times of the pandemic), etc. have been devoting efforts to support African countries. However, African countries as well should be doing more and taking more shares and responsibilities to safeguard their people. And to achieve this purpose, African countries must speed up their technological advancement in the field of health security, medical science and this could be made possible only through a deep STEM reforms and advancement. UNESCO's response to Covid-19 from the perspective of science is structured around three major pillars (Source: United Nations, 2020): (a) promoting international scientific cooperation, (b) ensuring access to water, (c) supporting ecological reconstruction. These major pillars have also served as a guideline for the China-Africa cooperation under COVID-19. As a matter of fact, in an extraordinary session on China-Africa cooperation under covid-19 co-organized by China and African governments, the Chinese president Xi Jinping addressed a very comprehensive and concise speech to the African and the world community under the witness eyes of several African heads of States and governments, and other world personalities such as its Excellency Moussa Faki Mahamat, Chairperson of the African Union Commission, its Excellency António Guterres, Secretary-General of the United Nations, its Excellency Tedros Adhanom Ghebreyesus, Director-General of the World Health Organization. Very respectfully, president Xi highlighted some important points of the cooperation that need not to be neglected such as

education, research and innovation. This was followed by the 4 main pledges among other made by the Chinese leader: (1) The construction of the Africa CDC headquarters, (2) African countries being among the first beneficiaries of China's made vaccine against covid-19 once ready, (3) Great financial support and debt canceling under the framework of Belt and Road initiative (BRI) for African countries hardly hit by the virus, (4) Uphold the UN-centered global governance system and support WHO in making greater contribution to the global COVID-19 response, oppose politicization and stigmatization of COVID-19, oppose racial discrimination and ideological bias (Source: Ministry of Foreign Affairs of the People's Republic of China, 2020). This was so far a great achievement even though Africa's response to the pandemic has been very weak due to its crucial lack of scientists and medical professionals, added to its very fragile and embryonic healthcare systems. Basically, everything has to be started over from the most basic level of STEM.

VII. PROSPECTS OF CHINA-AFRICA STEM COOPERATION

The Aspiration 1 of the AU's Agenda 2063 envisioned a prosperous Africa based on inclusive growth and sustainable development where no African will be left behind. This dream will be made possible only through concerted efforts and appropriate reforms of African countries' school curricula and related implementation practices at the classrooms level. A great focus needs to be done on STEM subjects so as to provide students with the necessary skills for collaboration, creativity, tech-innovation in order to scale the heights of achieving the sustainable development goals. Most importantly, African governments must shoulder the responsibilities of creating the necessary environment for these acquired skills to be applied, otherwise STEM education in Africa will remain a waste of time as reflected by the status quo in some African countries. In fact, many infrastructure development projects in Africa are still being carried out by multinational cooperation and enterprises, despite the existence of technical schools that theoretically are designed to train local engineers and skill workers. Most of the time, those schools and learning environments are not equipped with the necessary tools and materials for learners to apply or experiment their knowledge. In other cases, the equipment is outdated to match the most advanced countries' standards. As immediate consequences, many African talents and students choose to study overseas in technologically advanced countries. And in this case again, many do not return in their home country to share their knowledge, or in case they choose to return, they are not favorable policies to welcome them and make good use of their talents and expertise. In recent years, China has been a prioritized destination for African students. Based on the past experience with regards to the education cooperation between Africa and western countries, China as a new comer has a unique opportunity to make the difference in education cooperation with Africa in general and in STEM field in particular. Below we suggest a few practical things that

should be done to help Africa reach his aspirations of the century in accordance with its Agenda 2063:

- Short-time vocational training and recycling of STEM teachers (High schools and Universities) and workers of African countries (in the frame of cooperation between the relevant Chinese and African Institutions).
- More STEM scholarships should be made available to African students in the framework of bilateral cooperation between China and respective African countries with the responsibilities for African countries to follow up those students and make use of their acquired technological know-how.
- Instead of a continuous donation of STEM related equipment to African countries, more Chinese equipment manufacturing industries should outsource and relocate in Africa so that to boost the manufacturing capacities of African countries and made available at the cheapest price possible the needed equipment while creating more jobs locally.
- More Chinese STEM experts should be made available at the request of African countries to assist on specific needs and trainings on ground zero in Africa.
- More funding should be made available by China (at a bilateral level between China and each individual African country) to sponsored and developed projects and STEM infrastructures development in African countries.
- Virtual campuses could be established to speed up the knowledge transfer and expertise sharing between Chinese and African STEM teachers, students and workers.

These measures if meticulously implemented, will undoubtable propel the STEM development in Africa to new highs and set once for all a strong foundation for a win-win cooperation on education between China and Africa. However, it remains the responsibilities of Chinese and African leaders to set up policies and frameworks so as to implement these measures for the benefit of the masses.

VIII. CONCLUSION

As the world is undergoing a geostrategic rebalancing of power with the rise of China and the developing world, the China-Africa Cooperation on Education is once again on the spotlight, with a special attention paid on the Science Technology Engineering and Mathematics (STEM) Cooperation. Not only science and technology appear as a human right of this 21st century as acknowledged by UNESCO, but it is widely recognized and accepted that no development is possible out of Science and Technology. Therefore, African countries must do their utmost to catch up with their technological backwardness by providing its fast-growing population the necessary skills to meet its development needs, and most importantly to provide African

countries with the necessary tools to fulfill the continental agenda 2063 vital for its survival and prosperity. From STEM basic infrastructures developments to teaching programs upgrading, from related institutions management to professional staffs training, almost everything needs to undergo a strategic reform, well-designed to meet the short, medium and long terms development goals of African countries. In this process, China as a reliable partner has a lot to offer, from its own experience as developing country, to its huge potential of technological know-how and generous funding. However, a special attention should be paid on the overall image of the China-Africa cooperation which somehow is reflected in the criticisms from western countries. That is to remind stakeholders that things can be improved and the cooperation made better. By exerting more political actions through platforms such as FOCAC or through major initiative such as BRI and by implementing the aforementioned measures, the China-Africa Cooperation on STEM could have a bright prospect in a near future.

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