# **Policy Paper**

Science, Technology, Engineering and Mathematics (STEM) as an Enabler for Development and Peace

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Cover: Children attending class with their tablets at Radi School in the village of Safi, in southern Niger. (Frank Dejongh/UNICEF)

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### Acknowledgements

The present policy paper reflects on the pre-recorded policy conversation on science, technology, engineering and mathematics (STEM) education as an enabler for development and peace, convened on 21 September 2021 and moderated by Dr. Monica Kerretts-Makau, Professor of Practice and the Academic Director at Thunderbird's Centre for Excellence for Africa based in Nairobi. The discussants were Dr. Beatrice Khamati Njenga, Deputy Vice Chancellor, Institutional Advancement, International Leadership University, Kenya (former Head of Education Division, African Union Commission); Professor Francisca Nneka Okeke, Professor of Physics, University of Nigeria; Professor Shadreck Chirikure, Professor, Department of Archaeology, University of Cape Town, and British Academy Global Professor, School of Archaeology, University of Oxford; Ms. Sicelo Dube, Zimbabwe Science Ambassador, founder of LEC Biotec and Elevate Trust; and Ms. Winifred Ereyi, Chief Executive Officer, ThinkSTEM Foundation.

The discussions in the policy paper have been informed by the ongoing research and experience of the experts in their individual capacities and in the framework of the Knowledge Network of the Office of the Special Adviser on Africa (OSAA). The Knowledge Network, which was launched on 29 June 2021, brings forward voices and knowledge from African experts, academia, think tanks, civil society organizations, governments, the United Nations system and the African Union with the objective of supporting analysis, advocacy and advisory activities on critical issues on peace, security, development, human rights and humanitarian assistance in Africa that contribute to influencing agenda-setting at the regional and global levels and promote the changing of the narrative from and about Africa. The Office of the Special Adviser on Africa would like to express its appreciation for and acknowledge the written inputs and comments provided by STEM experts, Dr. Beatrice Khamati Njenga, International Leadership University, Kenya, and Ms. Winifred Ereyi, ThinkSTEM Foundation.

### I. Executive summary

1. Peace and security issues are major factors that impinge on sustainable development in Africa. In his 2021 report on the promotion of durable peace and sustainable development in Africa (A/75/917–S/2021/562), the Secretary-General argues that exclusion from service delivery may lead to an aggravation of grievances and even trigger conflict. In the report, he recommends inclusive, just, transparent and efficient public service planning and provision in order to ensure that development interventions further contribute to the prevention of conflicts and instability.

2. Against this background, how can development actions be assessed in order to analyse whether they are leveraging their prevention potential? In order to

reply to this question, the Institute for Economics and Peace has identified eight pillars of peace, which are a new conceptual framework for understanding and describing the factors that create peaceful societies. The pillars are: (a) a well-functioning government; (b) a sound business environment; (c) the equitable distribution of resources; (d) acceptance of the rights of others; (e) good relations with neighbours; (f) the free flow of information; (g) a high level of human capital; and (h) low levels of corruption. According to the Institute, peace can be viewed through the lens of both negative and positive peace. Negative peace is the absence of violence or fear of violence, while positive peace can be defined as the attitudes, institutions and structures that, when strengthened, lead to a more peaceful society.1

<sup>&</sup>lt;sup>1</sup> Institute for Economics and Peace, *Pillars of Peace: Understanding the Key Attitudes and Institutions that Underpin Peaceful Societies* (2013).

3. In this regard, the present policy paper seeks to address how science, technology, engineering and mathematics (STEM) education can be an enabler for development and peace, using the Institute for Economics and Peace peacebuilding framework. It highlights that STEM education is critical for creatively developing solutions and innovations that Africa needs for sustainable development (Iboronke, 2021). It underscores the need for a holistic and multidisciplinary approach to promote STEM education in order to foster significant development in Africa. The aim of STEM education is to have an integrative approach to solving real-life issues with the use of technology. Such issues span all sectors, including creating alternative solutions to energy, health, food production, basic infrastructure, manufacturing and environmental issues. Some of those issues are exacerbated by Africa's growing and urbanizing population, requiring new approaches for the appropriate management of available resources and ensuring inclusive and sustainable access to the required resources. The paper will also assess how the eight pillars affect the implementation of STEM education in the continent. For instance, inadequacies in management often lead to inequitable access, which has been one of the factors leading to conflicts and instability. STEM education aims to encourage the development of groundbreaking technologies to tackle these issues and presents the possibilities of economic growth and global competitiveness within the context of generating Africaled solutions to African challenges.

4. The policy paper notes the impact of the coronavirus disease (COVID-19) pandemic on education and how this has led to the growing recognition of the importance of strengthened science, technology and innovation framework to build forward better. Before looking forward, the policy paper examines the current status of STEM in Africa. There has been much progress in access to and the quality of STEM education, with significant examples of good practices and results. However, despite a significant budget outlay in the area of education, visible outputs in terms of scientific productivity and knowledge systems are still below acceptable levels. That is to say that STEM education needs to contribute more tangibly to social and economic development for the "Africa We Want", and help establish Africa as a peer in the global knowledge economy. The challenges highlighted herein range from the shortage of funding and resources; the lack of educational infrastructure and equipment; deficient education curricula; the gender gap in STEM education; and the lack of structural, governance and human resource capacities of educational institutions in Africa. The policy paper concludes with policy recommendations for enhancing the continent's STEM capacity and capabilities.

### II. Situational assessment

5. Education in STEM subject areas has been identified as a priority for a fast-moving technology-driven world. Unfortunately, African countries fall behind in STEM education outputs compared to the rest of the world. For example, according to the African Development Bank, less than 25 per cent of Africa's higher education students are in STEM fields, with the majority of students studying social sciences and humanities. Comparatively, STEM degrees in the United States of America represent over 30 per cent at the bachelor and master's level, over 50 per cent of research doctorates and almost 65 per cent of professional doctorates. Furthermore, in developed countries, the number of STEM graduates continues to grow. For example, in the United States, between 2010 and 2018, the number of STEM bachelor's degrees awarded grew by 62 per cent, compared with 20 per cent growth for all degrees.<sup>2</sup> Consequently, these differences have further exacerbated the economic development gap between Africa and the rest of the world, undermining the innovation capacities of African countries.

<sup>&</sup>lt;sup>2</sup> See the analysis of federal employment and education data by the Pew Research Centre, in Richard Fry, Brian Kennedy and Cary Funk, "STEM bobs see uneven progress in increasing gender, racial and ethnic diversity", 1 April 2021.



Children at Radi School in southern Niger use tablets in the classroom. This initiative provides every child with access to technology for equal learning opportunities. (Frank Dejongh/UNICEF)

6. Some African countries have limited capacity in terms of the technical skills training that is imperative for the technicians needed to support science, technology and innovation-based economic activities. Such low STEM skill output negatively affects science, technology and innovation-enabled and knowledge-based socioeconomic development. In spite of these gaps, there is a lot of effort being made by African Governments to promote STEM education, particularly as it relates to mathematics and science. 7. STEM is not only critical for Africa to leapfrog towards sustainable development, but can also play a very relevant role in promoting peace and stability throughout the continent. In his 2021 report on the promotion of durable peace and sustainable development in Africa, the Secretary-General states that the continent must overcome considerable deficiencies in reaching –the targets of Sustainable Development Goal 4 relating to secondary, tertiary and vocational education, often with marked disparities along gender, ethnic, geographical and linguistic divides. In the wake of the COVID-19 pandemic, school closures have exacerbated previously existing inequalities, in particular the digital divide, which mostly affects children who were already most at risk of being excluded from a high-quality education. Furthermore, the Secretary-General states that grievances around access to and the quality of education tend to escalate tensions and lead to violence. For example, in 2020, there were over 1,300 incidents of protests, violent demonstrations, abductions and attacks in Africa related to educational institutions, educators and students, with more than 100 education-related cases of violent demonstrations and mob violence (A/75/917-S/2021/562, para. 33).3 Against that background, increased access to STEM education can be a way to address those shortcomings in the implementation of Goal 4 and help bridge existing gaps along gender, ethnic, geographical and linguistic divides.

8. Indeed, aspiration 4 of the African Union "Agenda 2063: The Africa We Want" emphasizes the role of education in promoting peace and stability by affirming that "a culture of peace and tolerance shall

### Pillar 1 Well-functioning government

Over the past three decades, a global wave of 10. market liberalization has improved the ability of some nations to master and utilize STEM as key determinants of economic growth, development and security (Khumbah, n.d.). In response, most African countries have developed national policies that promote STEM education, research and development, as well as innovation through domesticating the Science, Technology and Innovation Strategy for Africa 2024. Even though most African Governments mention STEM in their development policies and national plans (usually referring to mathematics and science), there is a need for greater implementation of programmes that promote STEM education. The trickle-down effect from policies to implementation remains a challenge. With 1 billion children projected to live in Africa by 2055, enhancing STEM education systems<sup>4</sup> would provide an incredible opportunity to build human capital and lift millions out of poverty.

be nurtured in Africa's children and youth through peace education". This is echoed in strategic objective 10 of the African Union Continental Education Strategy for Africa 2016-2025: "Promote peace education and conflict prevention and resolution at all levels of education and for all age groups". Peacebuilding work focuses on reducing or ending violent conflict and the promotion of a culture of peace, which promotes development. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), some of the predisposing factors, such as the negative effects of climate change and food insecurity on unrest and conflict may be addressed through transformative and empowering STEM education. Thus, the strategy proposed herein focuses on changes in both the mindset and the social and political structure of society.

9. STEM education as an enabler for development and peace is assessed below in the context of how STEM influences the Institute for Economics and Peace "Eight pillars framework" and how the different pillars may have an impact on the evolution of STEM in Africa.



Enhancing STEM education systems would provide an incredible opportunity to build human capital and lift millions out of poverty. (Martin Thaulow/Good people)

11. The implementation of these national policies should entail adapting the concept of STEM to make it Africa-centred. According to the experts on STEM who are part of the Knowledge Network of the Office of the

<sup>&</sup>lt;sup>3</sup> Armed Conflict Location and Event Data Project database, available at https://acleddata.com/#/dashboard.

<sup>&</sup>lt;sup>4</sup> Across all levels – primary, secondary, tertiary, vocational, etc.

Special Adviser on Africa, there is a significant amount of innovation and of the utilization of local knowledge being implemented across Africa. However, the value and potential of local indigenous knowledge on issues such as climate change and medicine have not been sufficiently recognized, harnessed and incorporated in innovation ecosystems. More policy support is needed to encourage and nurture the harnessing of endogenous science and innovation. In addition, there is often an inequitable implementation of STEM education policies between rural and urban areas, with urban areas often attracting more attention and investment. The result is a poorer quality of infrastructure and more limited access to equipment, textbooks and appropriately qualified STEM teachers, mostly in rural areas.

12. Although most national development policies in Africa mention STEM, in some form, as being important for industrialization and social and economic development, one of the challenges is the lack of depth in the intersectoral linkages that would situate STEM education in the whole development framework. Mentioning development policies is not sufficient without reference to an implementation strategy; a monitoring and evaluation framework with clear performance indicators; and a budget line. It is

#### Pillar 2

### Sound business environment: existing frameworks supporting education in science, technology, engineering and mathematics

14. The innovations powering the fourth industrial revolution and those necessary for thriving in a fast-changing world with new and emerging challenges and opportunities are anchored in solid scientific knowledge, cutting edge technology, advanced engineering and mathematical skills.

15. STEM education and practice are drivers of economic performance, and this is essential for helping growing economies to compete in the global market, create jobs (especially STEM jobs), and improve wealth, which leads to the development of peaceful and resilient communities (Rosca, Agarwal and Brem, 2020). A workforce with the ability to apply critical important to note that some African countries have developed excellent policies in this respect, including Egypt, Rwanda and South Africa.

13. Within education policies, science and mathematics are highlighted, alongside languages and national values. It is important to note that African countries seem intentional about not wishing to do away with social sciences, recognizing their importance in national cohesion, personal development and even in the utilization of STEM for technological innovation. Many countries have specific interventions to increase the uptake of STEM subjects. Such interventions include: making some STEM subjects compulsory in secondary education; in Ethiopia, providing scholarships preferentially for STEM studies at university; in Uganda, providing monetary incentives to schools that register higher numbers of STEM students; and Egypt, Kenya and Zimbabwe have established special STEM schools for developing and exemplifying best practices. Many countries have introduced career guidance as a compulsory part of the curriculum in schools and colleges. Linking such services to industry needs is paramount so that young people know in advance the employability benefits of STEM subjects.



African countries are undertaking significant initiatives to strengthen STEM education. (Martin Thaulow/Good people)

thinking, creativity and innovation to create applications that can be commercialized and create jobs is desired by all countries. Entrepreneurship and social entrepreneurship initiatives led by young women and men have shown increased potential in responding to the prevalent social and economic challenges. Enterprises led by young women and men not only trigger the necessary drive for local innovation and sustainable development, but also contribute to job creation, reduce inequalities and contribute to economic growth and the creation of sustainable inclusive and equitable societies (United Nations, 2020).

In order to realize the objectives in terms of 16. science, technology and innovation and information and communications technology in Africa, which are high on the agenda of the African Union and its New Partnership for Africa's Development and of the 2030 Agenda, there is a need to enhance STEM education. Such education must enable Africans to be entrepreneurial and innovative so as to incubate solutions using African resources. It is imperative to change mindsets and build human capital in order to empower African youth, scientists, researchers and innovators so as to develop a world class science, technology and innovation environment and achieve inclusive and sustainable development. In aspiration 1 of Agenda 2063, States members of the African Union envision a prosperous Africa based on inclusive growth and sustainable development. That dream is possible but requires concerted efforts to reform African countries' curricula and related implementation practices along the education to employment pipeline, from the classroom to industry and everyday life.

17. There are existing frameworks in support of STEM education. In implementing Agenda 2063, member States have adopted the Continental Education Strategy for Africa 2016–2025 and the Science, Technology, and Innovation Strategy for Africa2024, which promotes science, technology and innovation-enabled socioeconomic development in 10-year phases. The latter, for example, has as its mission to accelerate Africa's transition to an innovation-led, knowledge-based economy. If effectively implemented, it could play a substantive role in meeting the aspirations and goals outlined in Agenda 2063. The Continental Education Strategy for Africa 2016–2025



The innovations necessary for thriving in a fast-changing world are anchored in solid scientific knowledge, cutting edge technology, advanced engineering and mathematical skills. (Martin Thaulow/ Good people)

has several strategic objectives which cover, among others, strengthening science and mathematics, and harnessing the capacity of information and communications technology. There are also strategies for technical and vocational education and training, agriculture development, infrastructure and energy, among others, all which demand significant STEM input for ensuring the availability of the needed human resources and intellectual capacity.

Furthermore, the new global framework 18. of UNESCO for the period 2020-2030, entitled "Education for Sustainable Development: towards achieving the Sustainable Development Goals" (ESD for 2030), builds upon the experience of the Global Action Programme on Education for Sustainable Development as follow-up to the United Nations Decade of Education for Sustainable Development after 2014, in its five priority action areas of policy support, education and training, educators, youth and local communities .The framework emphasizes the learning content that is necessary for the survival and prosperity of humanity. It includes the knowledge, skills, values and attitudes that can empower every learner to contribute to sustainable development (A/76/228, para. 3).

19. Significant initiatives are being undertaken by African countries as part of global, continental and regional compacts to strengthen STEM education. Among these are the World Bank programme on Africa Higher Education Centers of Excellence; the Pan African University and Mwalimu Nyerere Scholarship of the African Union, and its Innovating Education in Africa initiative; the African Union Development Agency-New Partnership for Africa's Development "Skills for Africa" project, and the Regional Universities Forum initiative on agricultural technical and vocational education and training for accelerating youth employment, among others.

# Pillar 3 Equitable distribution of resources

#### Poverty

20. Poverty remains one of the main factors responsible for exclusion from education. Even where there may be a numeric indication of access, the quality of education remains poor and with multiple social challenges, dropout rates tend to be higher among poorer households, and even worse for girls in poor households. As shown in figure I, a child from the richest quintile of households in Africa is 8 times more likely to complete primary education than a child from the poorest quintile of households. That ratio rises to 12 for secondary education (United Nations Children's Fund (UNICEF) and African Union Commission, 2020).

#### **FIGURE I**

# CHILDREN FROM THE POOREST FAMILIES ARE THE MOST EXCLUDED IN EDUCATION



**Source:** Calculations based on data from the UNESCO Institute for Statistics in "Transforming education in Africa" (UNICEF and African Union Commission, 2020).

21. Inequity based on the two factors of geography and poverty exacerbates the social divide, whose tension may provide a breeding ground for conflict. Fewer years of education lead to unemployment, job insecurity and general income deficiencies that are perpetuated across generations. The UNESCO *Global Education Monitoring Report* 2021/22 indicates that primary school completion rates have continued to increase significantly in Africa, with the average now being over 70 per cent.<sup>5</sup>

#### Funding

22. Currently, sub-Saharan African countries allocate considerable resources to education, both in terms of gross domestic product (GDP) (i.e., the size of the economy as shown in figure II) and total government expenditure (see figure III). In particular, countries in the region allocate a larger share of their government budget to education than the global average, indicating the governments' strong commitment to education (UNESCO, 2021). However, the African Development Bank notes that, while many African countries met at least one of the two education financing targets of the Education 2030 Framework for Action, only 46 per cent met both targets over the period from 2010 to 2017.<sup>6</sup>

<sup>&</sup>lt;sup>5</sup> UNESCO, Global Education Monitoring Report 2021/22.

<sup>&</sup>lt;sup>6</sup> African Development Bank, African Economic Outlook 2020: Developing Africa's Workforce for the Future (Abidjan, Côte d'Ivoire, 2020).

#### **FIGURE II**

# GOVERNMENT EDUCATION EXPENDITURES AS A PERCENTAGE OF GROSS DOMESTIC PRODUCT



Source: Global Education Monitoring Report database 2020. Note: The two financing targets are 4 per cent or more of GDP and 15 per cent or more of government budgets allocated to education, as set out in the Education 2030 Framework for Action.

#### **FIGURE III**

#### GOVERNMENT EDUCATION EXPENDITURES ON EDUCATION AS A PERCENTAGE OF TOTAL GOVERNMENT EXPENDITURE



Source: Global Education Monitoring Report database 2020.

23. However, in spite of the efforts to allocate a substantial amount to the education sector, African Governments have allocated limited funding towards science and technology. Earmarked funding for science is either meagre or non-existent in many African countries. The effect is a widening gap between STEM progress in Africa and that of more advanced countries, thus exacerbating the prevailing disparities in income and development, in spite of Africa's positive economic performance.

24. The emphasis on STEM education at the policy level in most countries is yet to be met with sufficient funding for relevant interventions to be implemented at the grass-roots level, especially in rural areas, where in some cases, even basic permanent classrooms are yet to be constructed. The lack of permanent structures is in part is due to the overriding challenges of merely ensuring access to education, where countries prefer to ensure that children have access to at least some form of education for literacy, basic numeracy and the acquisition of basic employable skills. As a result, many countries in conflict or post-conflict situations, such as South Sudan, Somalia ("Somaliland") and Uganda (Northern Uganda) have developed alternative basic education, conducted within minimally built infrastructure. In such cases, STEM education is a pipe dream, except in a few basic technical and vocational education and training institutions.

In addition to countries prioritizing access for 25. children to at least some form of education at the expense of developing infrastructure, there are other issues, such as poor governance and weak accountability in service delivery. According to the African Development Bank, public funds do not always produce effective outcomes owing to poor governance and weak accountability in service delivery. Most African Governments have allocated a substantial amount of funding to infrastructure for schooling (school buildings, textbooks) and less to more cost-efficient modes of service delivery as well as to key inputs that have a substantive impact on learning outcomes (nutrition, early childhood education, teaching effectiveness).

26. The main sources of inefficiency include inadequate and inefficient resource allocation and financing options; inadequate domestic production of and access to commodities; inappropriate procurement and management of equipment and commodities; inappropriate composition ofstaff; a lack of performance incentives; and weak participatory and accountability mechanisms. In most cases, public funds do not reach the intended beneficiaries. For instance, in Cameroon, 60 per cent of funds allocated never reached schools and in Morocco, the poorest 20 per cent of the population received only 15 per cent of the education budget.

27. Furthermore, the inclusion of communities in service delivery processes is lacking. According to Transparency International, in Morocco and the Niger, only 7 per cent of head teachers are aware of the budget approved for their schools. A survey conducted in north-western Nigeria found that 80 per cent of third grade pupils in Sokoto cannot read a single word.

# Pillar 4 Acceptance of the rights of others

#### Gender gap

28. According to UNESCO, the number of women involved in STEM has significantly increased at the global level. However, despite these encouraging signs, women are still underrepresented in science, as women account for only about 30 per cent of the world's researchers and for even lower percentages at higher decision-making levels, according to recent figures from the UNESCO Institute for Statistics.

29. Women are still grossly underrepresented in STEM fields in sub-Saharan Africa. As shown in figure IV, the share of women graduating from third-level education in engineering is below 30 per cent for many such countries.

#### **FIGURE IV**



SHARE OF FEMALE THIRD-LEVEL GRADUATES IN ENGINEERING (percentage)

Source: World Bank, "Let's accelerate the women in STEM agenda today; tomorrow will be too late!", https://blogs.worldbank.org/africa-can/lets-accelerate-women-stem-agenda-today-tomorrow-will-be-too-late.

30. According to UNESCO, only 35 per cent of STEM students in higher education globally are women, and differences are observed among STEM disciplines (UNESCO, 2017). In Africa, low enrolment numbers among women in the field of STEM is evident. This can be attributed to a number of factors, such as family responsibility, and difficulty in finding work-life balance, discrimination against women



Gender equality in STEM education is a matter of principle and a basic human right. (Frank Dejongh/UNICEF)

in decision-making positions, traditional beliefs and perceptions that women are not capable of undertaking hard sciences. Stereotypes and cultural norms dampen girls' interest in STEM. It should be noted that in a few African countries, girls' and women's uptake of science has overtaken that of men, for example, in Lesotho and Namibia.<sup>7</sup>

31. Since gender equality in STEM is a matter of principle and a basic human right, it should also be considered as a crucial means for promoting scientific and technological excellence. Sustainable Development Goals 4 and 5 on ensuring quality education and on the empowerment of women and girls, respectively, recognize the importance of advancing gender parity in the process of striving to achieve the Goals. In that vein, the African Union established its International Centre for Girls' and Women's Education in Africa, in Burkina Faso, to provide guidance for member States on integrating gender perspectives into their programmes and into the implementation of the Continental Education Strategy for Africa 2016–2025.

32. The Gender Equality Strategy for the Continental Education Strategy for Africa 2016–2025<sup>8</sup> provides a detailed account of how African Governments can bridge the gender gap. Among other perspectives,

<sup>&</sup>lt;sup>7</sup> World Bank, The Equality Equation: Advancing the Participation of Women and Girls in STEM (Washington, D.C., 2020).

<sup>&</sup>lt;sup>8</sup> African Union and Forum for African Women Educationalists, "Gender Equality Strategy for the Continental Education Strategy for Africa 2016–2025". Available at https://issuu.com/fawe/docs/gender\_equality\_strategy\_for\_the\_co.

the strategy encourages state and non-State actors to create an enabling environment for promoting innovations for girls and young women and to revise regulations and other school requirements linked to time on task, teacher/pupil ratio, class design and class size. The strategy calls for creating and developing a mindset of creative confidence in technology, for girls and boys, through education and training.

33. Several efforts have been made to bridge the gender gap in STEM, which should be scaled up. For example, scholarships are being offered by Governments and institutions to girls and young women, including support from teachers, peer-topeer support and financial support in the form of tuition payments, and they are another significant layer in developing and implementing interventions to enhance girls and women's participation in STEM. The Forum for African Women Educationalists model for gender-responsive pedagogy, mentoring girls and sensitizing key stakeholders has yielded significant results in several countries, including Burkina Faso, Eswatini, Kenya, Mali and Mozambique.

#### Youth

34. Africa has a huge competitive advantage, with 60 per cent of its population being below the age of 25,9 which is attributed to high fertility coupled with declining child mortality. The fourth industrial revolution has ushered in a wide range of jobs in STEM fields. Even though STEM education should be equally available for all children, there is a need to focus on out-of-school youth, who are the key players in peacebuilding, in order for them to acquire STEM-related skills of critical thinking and inventiveness. According to UNESCO, of all the regions, sub-Saharan Africa has the highest rates of education exclusion. Over one fifth of children between the ages of 6 and 11 are out of school, as are one third of youth between the ages of 12 and 14. According to the UNESCO Institute for Statistics data, almost 60 per cent of young people between the ages of 15 and 17 are not in school.<sup>10</sup> High dropout rates are primarily due to poverty. However, violence, poor quality of education and a misperception regarding the benefits of obtaining an education

have all been shown to be factors. Displacement due to conflicts also increases the likelihood that a child will stop attending school. Conflict-affected countries have higher dropout rates, with children in those countries 30 per cent less likely to complete primary school and 50 per cent less likely to complete the lower cycle of secondary school.<sup>11</sup>

35. STEM education will increase opportunities for youth to work in growing STEM- based industries, which will in turn promote socioeconomic development and address youth unemployment issues and thereby contribute to more stable societies. It is also widely acknowledged that one of the main reasons for increased levels of youth unemployment is the phenomenon of structural unemployment, a mismatch between the skills that workers can offer and the skills required in the labour market (United Nations, Division for Social Policy and Development, 2017). Outdated curricula, teacher-centred approaches and a focus on rote learning and memorization do not equip students with the essential skills for lifelong learning, employability, personal empowerment and active citizenship. Given the poor quality of education and limited job prospects, young people may not see the relevance of going to school. It is therefore essential that as STEM education and training are developed, the linkages



STEM education should be equally available for all children. (Frank Dejongh/UNICEF)

9 World Economic Forum, "The future of jobs and skills in Africa: preparing the region for the fourth industrial revolution", May 2017.

<sup>&</sup>lt;sup>10</sup> See http://uis.unesco.org/en/topic/education-africa.

<sup>&</sup>lt;sup>11</sup> African Development Bank, African Economic Outlook 2020.

with industry, employability and entrepreneurship are strengthened so as to maintain relevance and increase the positive development outcomes.

# Pillar 5 Good relations with neighbours

The African Continental Free Trade Area could 36. potentially fuel the socioeconomic transformation of Africa through entrepreneurship and industrialization. However, some of the obstacles being faced are low literacy levels among African youth, the lack of access to business training skills, the lack of access to technical training and insufficient access to technology, markets and funding. Fostering collaboration between member countries and increasing the level of investment in STEM education and entrepreneurship is essential in order for Africa to be able to leverage its competitive advantage and the opportunities created by the Free Trade Area. Considering the high cost of STEM education, including technical and vocational education and training, there is an opportunity for partnerships across borders, such that resources are pooled for establishing regional and continental model STEM centres for education and training, based on each country's strengths and opportunities. Those centres would then be shared by all neighbouring countries, hence multiplying the dividends of peaceful coexistence, which are necessary to facilitate transborder movements, mutually agreed standards and accreditation frameworks, and mobility. As borders open up systematically for education and training, they are more likely to remain open for trade and employment, thus fostering development and peace. Lessons can be learned from the



STEM education and practice drive economic performance, which is essential to economic growth, job creation and improved wealth, and also promote peace and development. (Martin Thaulow/Good people)

Southern African Development Community (SADC) and the East African Community in this respect, as well as from the higher education STEM initiatives of the African Union and World Bank. For instance, the SADC Regional Indicative Strategic Development Plan 2020-2030 contains a proposal to consider a regional visa for students, researchers, scientists and academics, in a development that could provide them with benefits such as customs exemptions, if it is approved. The proposal builds on the SADC "Protocol on education and training: interventions", which underscores the need for member States to develop harmonized and standardized policies regarding education and training. The protocol also requires members to work towards the elimination of constraints and promote the free movement of students and staff within the region.<sup>12</sup>

# Pillar 6 Free flow of information

37. STEM education is an ideal communication channel that enhances social engagement as well as the sharing of information and innovative ideas to overcome poverty and to promote peace and prosperity for all. At the core of STEM education is critical thinking and problem-solving. Students are taught how to think critically, not what to think, in order to solve reallife problems. This method of instruction empowers

<sup>&</sup>lt;sup>12</sup> Kudzai Mashininga, "Regional education visa mooted in SADC strategic plan", University World News, 11 March 2021. Available at www.universityworldnews.com/post.php?story=20210304084622717#:~:text=The%20Southern%20African%20 Development%20Community,exemptions%2C%20if%20it%20is%20approved.

students to be researchers, fosters collaboration, transforms mindsets and attitudes and builds stronger communities. When students are allowed to challenge the status quo, conduct research and discuss their findings respectfully in a team environment in order to collectively solve problems it creates communication, cooperation, collaboration and co-creation. These are all at the heart of the peacebuilding process.

38. Technology products developed as a result of STEM education can also be important in developing early warning systems that enable timely interventions

## Pillar 7 High level of human capacity development: educational curricula and institutional infrastructure

39. The challenges for Africa in terms of reorienting educational curricula from a focus on humanities and social sciences towards STEM subjects constitute a serious hurdle to the ability to sustain its current economic growth and become one of the world's leading continents in terms of manufacturing and exports. In recent years, many African Governments have been reviewing their education curricula towards a project-or competency-based curriculum aimed at promoting creativity and innovation, as well as relevance to reality.

40. However, the development and implementation of such curriculum reforms are demanding. It is an expensive venture that, if not effectively implemented, could lead to deepening the divide between richer and poorer regions and populations. Collaboration among academic institutions, industry, government and non-governmental organizations will be required in order to achieve those reforms. The place of industry cannot be overemphasized, given that competence-based education entails relevant competence for industry and for life. The fourth industrial revolution is powered by technology, meaning that a failure to prioritize STEM education will affect the ability of countries to be globally competitive. It will also threaten livelihoods, employability and quality of life.

in the prevention of conflict or restoration of peace. Already there are initiatives to use space science and mobile technologies to enhance communication for the purposes of monitoring and reporting early warning signs of unrest and releasing information that would help to defuse situations of unrest. Drones are being used to relay information, equipment and supplies in difficult-to-reach areas around Africa, which would otherwise tend to be excluded from mainstream services, and can hence foster a sense of community and peace.



In many African countries, existing challenges to STEM education are anchored in the inadequacy of resources available for educational development. (Martin Thaulow/Good people)

41. In order to achieve the reforms, it will be necessary to prioritize addressing the factors behind the inadequate provision of STEM education. In most African countries, existing challenges to STEM education are anchored in the inadequacy of resources available for educational development. Challenges include the institutional infrastructure for education, including laboratories, access to the Internet, electricity and water supply, classrooms and libraries, as well as inadequacy in the numbers and quality of the workforce, which are exacerbated by high and increasing enrolment in education. At the higher education level, other challenges include the lack of research infrastructure and funding and inadequacies in the governance of quality assurance. The lack of teacher

development, including both initial and continuing professional development in STEM fields, is another challenge to be overcome.

# Pillar 8 Low levels of corruption

42. Corruption, like low-quality education, is a real problem across Africa. In its 2017 Ibrahim Index of African Governance, the Mo Ibrahim Foundation noted that a 1 per cent increase in the measure of local government corruption is associated with an increase of between 0.4 per cent and 0.9 per cent in the percentage of students affected by poor human or physical school resources in local public schools. This statistical evidence suggests that tackling such issues in local governance can help education systems in Africa.

In his 2021 report on the promotion of dura-43. ble peace and sustainable development in Africa, the Secretary-General stated that corruption has been found to worsen poverty and impede peacebuilding efforts. In several African countries, weak institutions, fragile governance and weak accountability mechanisms continue to provide fertile ground for corruption.<sup>13</sup> The report underscores that the lack of transparency, for example, has not only enabled corruption in service delivery in the areas of education and health but has also created perceptions of unfairness or corruption, which have a destabilizing effect. In Guinea, for instance, the low level of teachers' salaries and the irregularity of service bonuses in remote rural areas, coupled with a perceived lack of transparency in the management of the country's education resources, led to strikes and demonstrations by teachers over their wages, in 2019 and early 2020.

44. STEM education promotes the development of technologies that combat crime and foster low levels of corruption. On the other hand, the challenge of



STEM education promotes the development of technologies. (Martin Thaulow/Good people)

integrity implies that even as STEM subjects are identified as a priority, it is necessary that all children be exposed to learning experiences that foster values and character-building. This is why most African countries have included national heritage and values, as well as language, among priority subjects from an early age. In order for STEM education to foster peace and development, it must be accompanied by significant inclusion of subjects that are carriers of societal values.

45. In order to achieve this, the United Nations has worked to promote stronger inclusion of communities in service delivery processes, both by African Governments and development partners, with a focus on several mutually reinforcing entry points, including: (a) direct participation in public budget cycles, including planning, formulation, monitoring and analysis; (b) performance monitoring, whereby citizens can monitor and evaluate public service planning, delivery and reform; and (c) public engagement in the enforcement of the rules that govern public services, including grievance redress mechanisms (see A/75/917–S/2021/562).

<sup>&</sup>lt;sup>13</sup> Fund for Peace, Fragile States Index database, available at https://fragilestatesindex.org/; and Uppsala University, Uppsala Conflict Data Programme/Peace Research Institute Oslo Conflict Dataset, available at https://ucdp.uu.se/.

### **III. Recommendations**

46. The policy paper presents the following recommendations for promoting STEM education as an enabler for development and peace:

#### Policies

- (a) The promotion of STEM education can and should inform policymaking on a wide range of issues pertaining to development, peace and security. The promotion of STEM education and its impact on policymaking shall be established by anchoring STEM education in various existing frameworks and working instruments that the continent and its partners have adopted over the years;
- (b) Specific STEM policies are necessary, in addition to the more common science, technology and innovation policies. This is because such policies focus more on research and development and are not usually sufficient to cover STEM education;
- (c) STEM policies need to be better articulated and strengthen multisectoral approaches so as to reinforce the appreciation of the value of STEM and promote the relevance of STEM offerings in schools and colleges and enhance dynamic linkages between education and training in STEM on one hand, and the labour market and industry on the other hand;
- (d) There is a need to develop enabling policies to: (i) reduce the gender gap in STEM at all levels of education and research; (ii) increase the visibility and participation of, and respect for, women in STEM; (iii) build capacity for data collection on gender in STEM, identify gaps in the policy mix and improve national science, technology and innovation policies related to gender, based on evidence; and (iv) improve tools to measure the status of women and girls in science (UNESCO, n.d.);
- (e) Policy and programmatic measures should be institutionalized so as to safeguard gender

equity in STEM in both the education system and the workplace;

- (f) Furthermore, there is a need for more specific policy, with monitoring and evaluation and earmarked funding; collaboration among different stakeholder groups and sectors to jointly achieve a policy outcome in development; and follow-up of implementation;
- (g) The promotion of STEM must not be to the exclusion of certain social sciences that provide knowledge and skills that are essential to peacebuilding and social values;

#### Funding

- (h) The requisite funding for infrastructure, equipment and teaching and learning processes for STEM education should be allocated in national budgets by African Governments;
- In order to promote peacebuilding, an equitable distribution of resources is needed to ensure that all people, including those in rural areas, have access to tools and equipment that can enable STEM education to be implemented in schools;

### Curricula

- (j) In developing competency-based curricula, it is essential that African Governments build buy-in from major stakeholders and follow up on the process with articulate, scientific and strategic reviews. Teachers in particular need to be involved in the process; their training and capacity-building must be among the first interventions before the roll-out of new curricula. Participatory approaches are essential in informing and bringing on board the general population, parents and industry;
- (k) Continuous professional development is particularly important for all teachers in order to ensure optimal pedagogic, philosophical and content competence;

- Given the difficulty associated with STEM subjects, the availability of resources must be accompanied by mentorship and information clarifying the relationship between STEM subjects, STEM skills and the world of work;
- (m) Curriculum reform at the primary, secondary and tertiary levels is necessary to align with policy expectations, enhance quality and learning in STEM and to disabuse people of the notion that STEM subjects are too difficult. Curricula for teacher training and continuous professional development need to accompany overall curriculum reforms, and also require stakeholder participation;
- (n) There is a need to link education and practice in order create opportunities for job creation and employment in communities;

#### Gender gap in STEM education

- (o) Interventions such as providing scholarships aimed at girls and women to pursue STEM programmes should be a priority of African Governments and industries. In addition, the introduction of more flexible academic opportunities, including online education and short courses, to increase the accessibility thereto for young women balancing many demands, and increased training for teachers on gender-sensitive instruction and how to engage girls in STEM, should all be promoted;
- (p) In order to reduce the gender gap in STEM education, financial support for women's and girls' youth-led, grass-roots organizations that seek to address gender inequality in STEM should be a priority for African Governments. Such support would go a long way in creating a holistic learning programme for students through career guidance, role models, life skills and practical projects;

#### Monitoring and evaluation

(q) It is essential to develop monitoring and evaluation frameworks for STEM so as to be able to map out the STEM education ecosystem sufficiently, in order to appropriately direct investment and other interventions. It is impossible to create adequate interventions where data are not available or sufficiently granular to clearly define situations. Such frameworks should include data on gender disaggregation, infrastructure and equipment, the training of teachers in specific STEM subjects, enrolments in STEM subjects and other matters;

#### Partnership

- (r) The African Union Gender Equality Strategy for the Continental Education Strategy for Africa 2016–2025also calls for the creation of appropriate interfaces between government bodies that make policies, the university community that trains the workforce and the business community that absorbs university graduates and translates research into improvements in the economic and social sectors. For instance, there is a need to create spaces for both teachers and learners, particularly girls and young women, to become creators of information, best practices and educational resources that can be shared among Africans and even with the world at large;
- (s) STEM can be an instrument for countries to work together in sharing and exchanging knowledge and replicating best practices, hence the notion of STEM diplomacy. Such collaboration between and among countries can go a long way in addressing specific regional challenges: food, energy and water security; resilience and adaptive capacity to climate change; improved health and quality of life for all; and the promotion of the Sustainable Development Goals and the aspirations of Agenda 2063;
- (t) Within countries, partnerships between and among schools and training institutions should be promoted, an example of which might be the sharing of laboratories among schools.

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