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Association for the Development of Education in Africa

ADEA Inter-Country Quality Node

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Development of Monitoring and Evaluation System for Quality STEM Education at the Basic Learning Levels in Africa

1 INTRODUCTION

Africa is faced with many challenges including a rapidly increasing population, currently estimated at 1.2 billion people, with one in every three persons living in extreme poverty. Additionally, one in every five persons in Africa are youth aged 15-24 years, who are largely unemployed. Every year, 11 million youth in Africa join the labour market, and many of them are not prepared for the skills demand of the existing jobs. Meanwhile, the COVID-19 pandemic has amplified economic challenges in Africa, and this will continue to be felt for many years to come. These challenges are being felt in declining standards of living, increasing high poverty levels, increasing social, religious, and ethnic conflicts, low quality education, and poor health.

A strategic response to these challenges is to accelerate investment in quality STEM education at the basic learning levels to equip the youth with relevant STEM skills to take up emerging opportunities in the STEM careers in Africa. Furthermore, to ensure targeted and responsive investment in this key sector, there is need for a comprehensive monitoring and evaluation system for tracking progress in quality of STEM education at the secondary school level.

A key challenge, however, is that the function of tracking progress in quality of STEM education at secondary school level in education authorities in African countries is neither adequately established nor adequately resourced. Therefore, education authorities in Africa should develop a comprehensive monitoring and evaluation system for tracking progress in quality of STEM education at the secondary school level.

2 POLICY ISSUE

A situational analysis on the status of STEM education at the basic learning levels in Africa found a lack of consistent longitudinal data on enrolment and performance in STEM subjects at the secondary school level in Africa (ADEA, 2021). In efforts to increase enrolment in general, several African countries have introduced education policies and programmes at the basic education level that have led to an increase in student enrolment at different levels of the education system (Fomunyam, 2019; Majgaard & Mingat, 2012; Tikly, et al., 2018). However, although information on general trends in enrolment is available from periodic education statistics, this is not consistently reported and, in some cases, it is missing altogether. **Table 1** presents both the Gross Enrolment Rate (GER) and Net Enrolment Rate (NER) at secondary school level for some of the sample countries which shows that there is still a challenge in achieving universal access to secondary education. This has a negative spill over effect on student enrolment in STEM courses at the secondary school level, institutions of higher education, and STEM careers. Specific to STEM education at the secondary school level, there is very little information that could clearly demonstrate student enrolment trends in STEM subjects in Africa.

Table 1: Gross Enrolment Rate (GER) and Net Enrolment Rate (NER) at Secondary School Level.

Enrolment	Angola	Ghana	Kenya	Morocco	Rwanda	South Africa
GER (%)	50.7	74.7	70.3	81.2	44.3	100.5
Year	2016	2019	2018	2019	2019	2018
NER (%)	11.3	60.3	53.2	66.2	35.8	68.4
Year	2010	2019	2018	2019	2019	2018

Sources: *World Bank Education Statistics, UNESCO Institute of Statistics (UIS), Kenya Domestic Health Survey, UNICEF Basic Education Sector in Botswana*

Similar to student enrolment in STEM, there is insufficient data to clearly demonstrate trends in student performance in STEM in general at the basic learning levels in Africa. Despite the lack of consistent longitudinal data on performance in STEM subjects at the secondary school level in Africa, the available information points to persistent poor performance in these subjects.

Importantly, there are no comprehensive benchmarks and standards of performance in STEM education at the secondary school level in Africa which makes it challenging to assess and determine quality, and even more difficult to report on quality, use the feedback on assessment in any meaningful way, or engage in constructive discourse on quality issues of STEM education. Without benchmarks and standards, any description of quality is likely to be highly subjective and dependent on the diverse backgrounds, traditions, and perception of the assessors of quality.

Since quality assurance is very diverse and context based, the aspects of quality, standards of performance, and benchmarks and target thresholds should be clearly defined in a participatory and consultative process for the understanding of all stakeholders in STEM agenda. These benchmarks and standards should be set within acceptable limits, and all key stakeholders should understand how they are applied and interpreted.

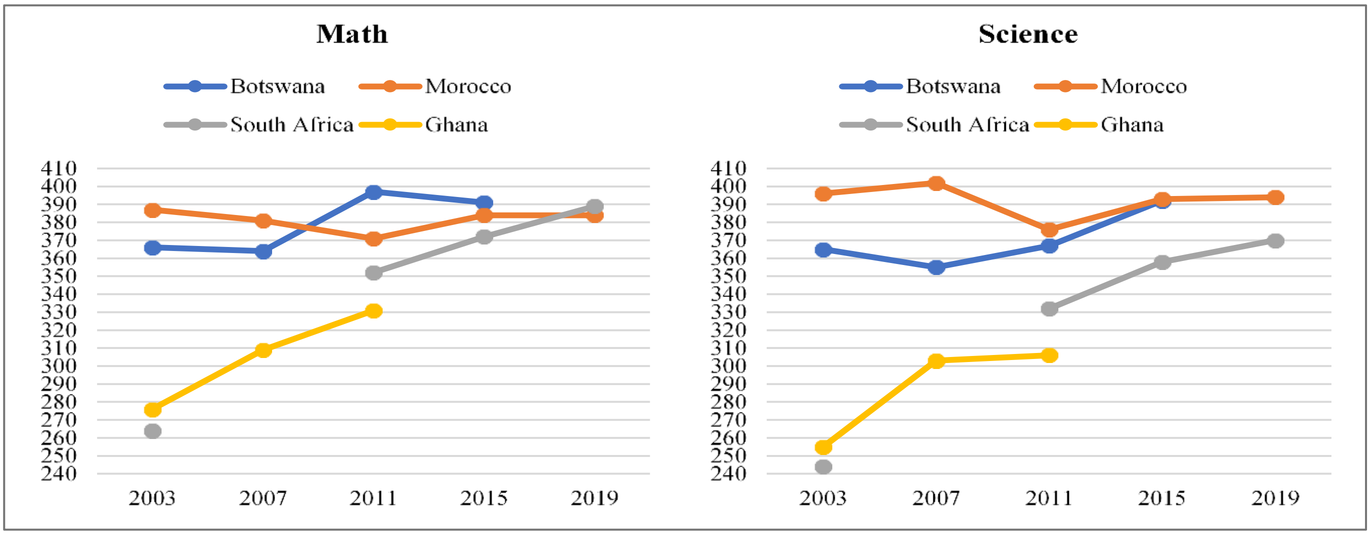
A comprehensive monitoring and evaluation system for STEM education at the secondary school level in Africa will ensure consistency in tracking and reporting on progress on the investment and quality of STEM education at secondary school level in Africa and ensure comparable data on key performance indicators, which will enhance focused and harmonized discourse in this critical sector in Africa.

3.1 Data on enrolment and performance in STEM subjects in Africa

A situational analysis on the status of STEM education at the basic learning levels in Africa found a lack of consistent longitudinal data on enrolment and performance in STEM subjects at the secondary school level in Africa (ADEA, 2021). Furthermore, there is no cross-country assessment programme for STEM education at the secondary school education cycle in Africa. For instance, both Southern and Eastern Africa Consortium for Monitoring Educational Quality (SEACMEQ) and Programme for the Analysis of Education Systems (PASEC) assess reading and mathematics at elementary grades covering only a few countries in Southern, Eastern, and Western Africa (SEACMEQ, 2020; PASEC, 2020).

Despite the lack of consistent longitudinal data on performance in STEM subjects in Africa, the Republics of Botswana, Ghana, South Africa, and the Kingdom of Morocco have participated since 2003 in the four yearly Trends in International Mathematics and Science Study (TIMSS) that assess eighth grade students' achievement in mathematics and science. **Figure 1** presents the TIMSS results for these four countries in five waves of assessment (2003-2019), which shows that they consistently scored below the benchmark of 500 points and were all ranked in the bottom quartile in all five waves of assessments (TIMSS& PIRLS International Study Centre, 2020).

Figure 1: Performance in TIMSS at Eight Grade by County.



Source: *IEA TIMSS and PIRLS International Study Centre (https://www.iea.nl)*

3.2 Monitoring and evaluation system for STEM education at basic learning levels

3.2.1 Institutional mechanisms for quality assurance at basic learning levels

Although most countries have a quality assurance department[1] in the Ministry in-charge of Education, these departments are understaffed, lack STEM subject specialists, and the existing staff doubles up in other functions including administrative tasks. Therefore, the staff cannot adequately deliver on quality assurance of STEM education at the basic learning levels.

[1] a) Inspectorate Unit in the department of basic education of the Ministry of Education in Botswana; b) Ghana Education Service , National Teaching Council, and the National School Inspection Authority (NSIA) in the Ministry of Education of Ghana; c) the Directorate of Quality Assurance and Standards (DQAS) in the Ministry of Education and Centre for Mathematics, Science, and Technology Education in Africa (CEMASTEA) in Kenya; d) Directorate of programmes and quality assurance in the Ministry of Basic Education in Namibia; e) Department of basic education and quality assurance in the ministry of education in Rwanda; f) Directorate of education standards in the Ministry of Education and Sports in Uganda, and; g) National institute of for education development, research, and pedagogical inspection in Angola.

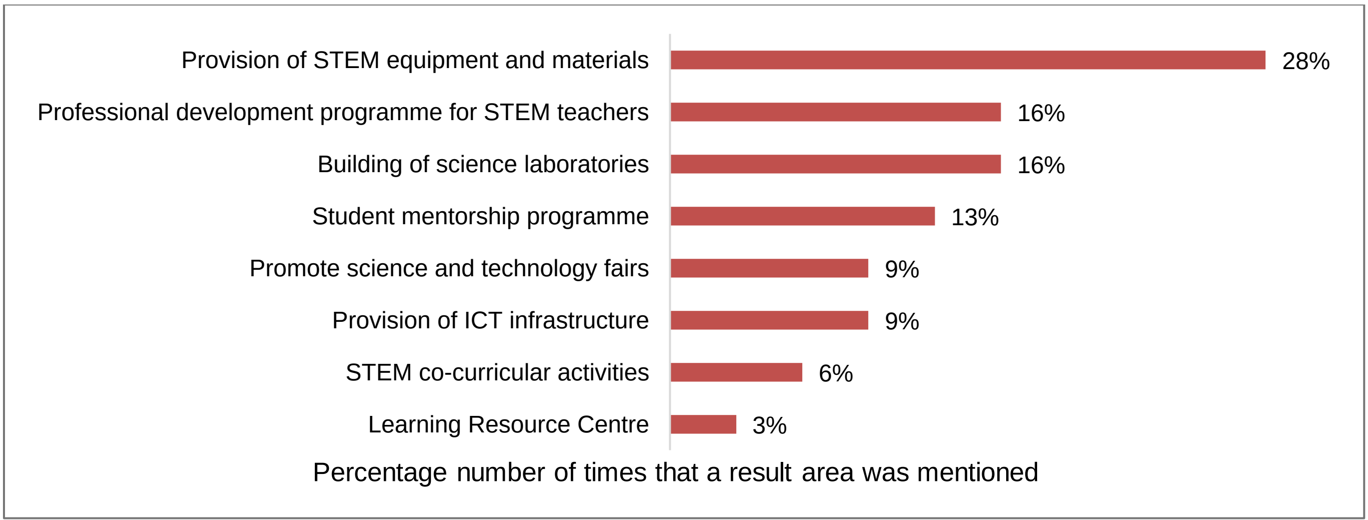
Some countries have specialized institutions or directorates dedicated for provision of quality STEM education, for instance, Kenya[2] and South Africa[3]. Meanwhile, although there is a budget allocation for quality assurance, this was not specific to STEM education, but a lumpsum allocation to the department in-charge of quality assurance who then apportion the amounts for each functional area on a needs and on-going basis, and overall, the budget was inadequate. Though inadequate, some countries including South Africa, Kenya, Rwanda, Uganda, have budget allocation from government for implementation of STEM interventions including quality assurance.

Meanwhile, quality reporting is an essential ingredient of a quality improvement system as it is the feedback and interpretation that influence the type and quality of decisions that are made. Although reports of national education sector assessment are generated in some countries, the practice was not consistent across years and was not specific to STEM education but general assessment of the education sector. While this is a good practice there is still need for specific assessment of the quality of STEM education given the importance of this sector in generating employment and long-term economic growth of the African Countries.

3.2.2 Results areas in tracking quality of STEM education at basic learning levels

Teachers, principals, and education officials identified three key areas for improvement of quality of STEM education as provision of STEM equipment and materials, professional development programmes for teachers of STEM, and construction of science laboratories (**Figure 2**). While the focus of STEM education should be to enable students achieve higher outcomes, the findings indicates that there is a greater focus on inputs and activity level results. Therefore, there is need to focus on higher level results and indicators for quality information on progress in STEM education at the basic learning level.

Figure 2: Areas of focus for improvement of quality of STEM education.



3.2.3 Key Performance Indicators (KPIs) for STEM education

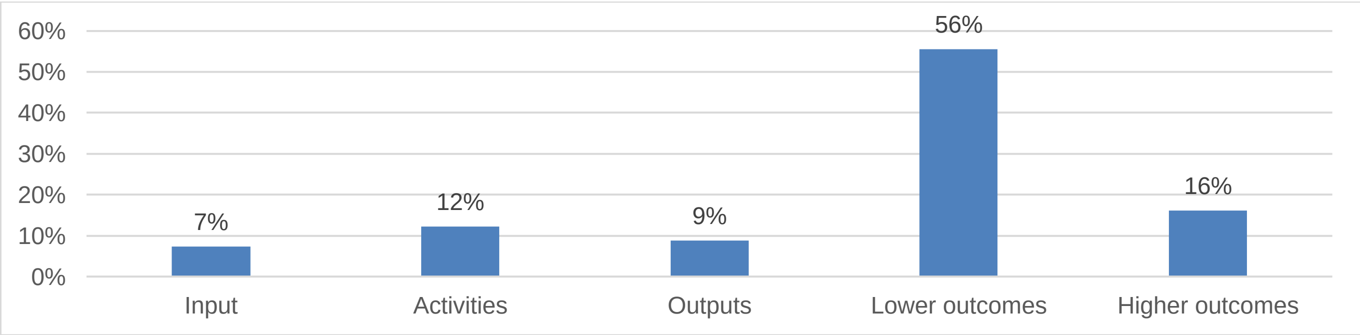
In tracking progress in improvement in the quality of STEM education, Key Performance Indicators and targets are critical as they serve as signals on progress towards quality improvement. Therefore, there is need for a set of clearly articulated indicators and respective targets at the national level, regional level, and school level. Some indicators may be relevant only at certain levels in the system, for instance at the national or school level, while others may cut across the different levels on the education system.

[2] Centre for Mathematics, Science, and Technology Education in Africa (CEMASTEA).

[3] Mathematics, Science and Technology Institute (MSTI).

The findings of the situation analysis indicates that teachers, principals, and education officials were aware of the key performance indicators that could be used in monitoring quality of STEM education, and the top three most frequently mentioned indicators were student subject scores in continuous assessments, proportion of students achieving quality grades in the subject, and student scores in national examinations. While the focus of STEM education should be to enable students achieve higher outcomes, the findings indicates that almost a third of the indicators that were being tracked were lower outcomes, outputs, activities, and inputs, all lower results areas[4], and though important, they are not adequate in providing information on progress in quality of STEM education (**Figure 3**). Therefore, there is need to focus on higher level results and indicators for quality information on progress in STEM education at the basic learning levels. Furthermore, information on these indicators was neither consistently gathered, reported nor reviewed for remedial actions in provision of quality STEM education. This makes it difficult to identify key challenges that need to be addressed systematically in efforts to improve the quality of STEM education.

Figure 3: Level of results of quality STEM education tracked at school.



3.2.4 Monitoring and evaluation framework for STEM education.

There is no comprehensive monitoring and evaluation framework for reference in monitoring progress in quality of STEM education at the basic learning levels in Africa. Although some countries in Africa conduct annual assessment of the education sector, these are not specific to STEM education as a priority area. Furthermore, there are no standards of performance and benchmarks for assessing progress towards provision of quality STEM education at the basic learning levels. An exception was South Africa which have a framework under the Action Plan to 2019; Towards Realisation of Schooling 2030 which has identified key result areas, targets, and corresponding indicators for tracking progress towards achievement of the results (**Error! Reference source not found.**).

Figure 4: South Africa – Select STEM Indicators.

South Africa under the Action Plan to 2019; Towards Realisation of Schooling 2030, education goals and respective indicators have been articulated for monitoring progress in quality of STEM education including:

(i) Indicator 2.2: Percentage of Grade 6 learners performing at the required mathematics level according to the country's Annual National Assessments.
(ii) Indicator 5: Number of Grade 12 learners passing mathematics.
(iii) Indicator 6: Number of Grade 12 learners passing physical science
(iv) Indicator 8: Average score obtained in Grade 6 in mathematics in the SACMEQ assessment.
(v) Indicator 9: Average Grade 9 mathematics score obtained in TIMSS.

[4] a) Number of class test conducted; b) Number of remedial lessons conducted; c) Records of student competitions; d) Science competitions at school.

3.2.5 Impact of interventions on quality of STEM education

Aside from the donor funded projects that normally conduct ex ante, final, and ex post evaluations, none of the countries conducts comprehensive impact evaluation of the interventions on STEM education at the basic learning levels. As part of the national school assessments that are conducted by the Ministries of Education in some countries, information on progress in school improvement is gathered, though without a specific focus on STEM education. However, there are some exceptions, for instance, in **South Africa**, attempts have been made on systematic impact evaluation through the Annual National Assessment (ANA). Additionally, some countries including Botswana, Ghana, Morocco, and South Africa have been participating in the Trends in International Mathematics and Science Study (TIMSS). Although reports are compiled from national assessments of the education sector in some countries, it was not certain whether or how they inform decision making on the provision of quality STEM education at the basic learning levels.

The overall picture that emerges is that there is no comprehensive monitoring and evaluation system for tracking progress in quality of STEM education at the basic learning levels in Africa. Without a comprehensive system for monitoring quality of STEM education, it will be a challenge in making decisions on what and where to invest in this critical sector. Overall, it will derail progress towards achieving youth employment and economic prosperity in Africa.

4 POLICY RECOMMENDATIONS

4.1 Develop and implement comprehensive monitoring and evaluation framework

The education authorities in Africa should develop and implement a **comprehensive monitoring and evaluation framework for quality assurance of the STEM education at the basic learning levels.** This framework should serve as a guideline in quality assurance and will be an important tool that: **a) sets the quality aspects to be assessed, b) the benchmarks and standards for assessments**, and **c) the process of assessment of the aspects**.

4.2 Develop Key Performance Indicators for tracking progress in quality of STEM

As part of the monitoring and evaluation framework, countries should develop and use **Key Performance Indicators** for tracking progress in quality of STEM education. The indicators should be aligned with specific strategies for improvement of quality of STEM education. Therefore, there is need for a set of clearly articulated indicators and respective targets at the national level, regional level, and school level. Some indicators may be relevant only at certain levels in the system, for instance at the national or school level, while others may cut across the different levels on the education system.

4.3 Undertake Comparative Analyses of Trends in Performance in STEM

As part of the quality assurance efforts to improve performance in STEM subjects, countries in the region should embark on comparative analysis of national examinations using rationalized benchmarks to identify undesirable trends in performance that could be addressed through targeted interventions. Therefore, education authorities should establish national assessment programmes in STEM subjects at the secondary school level where these are lacking.

4.4 Initiate Regional assessment programmes for STEM at basic learning levels

Countries in the region should start initiatives on cross-country assessments in STEM subjects at the secondary school level as a strategy for accelerated progress in achieving quality in STEM education. These assessments could be modeled on the existing SEACMEQ and PASEC to build on lessons learnt from these programmes.

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