

THE STATE OF SCIENCE EDUCATION IN AFRICA



SURVEY REPORT

SCIENCE EDUCATION PROGRAMME (SEP)

August 2021



The State of Science Education in Africa

NASAC Science Education Programme (SEP)

Survey Report

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The Network of African Academies of Sciences (NASAC)

ABOUT
NASAC

NASAC was established on 13th December 2001 in Nairobi, Kenya, under the auspices of the Inter Academy Panel, currently known as the Inter-Academy Partnership (IAP). NASAC is an independent consortium of 28 science academies in Africa. Through its membership, NASAC facilitates the discussion of scientific aspects of challenges of common concern, make statements on major issues and provide mutual support to the academies. Drawing from this, NASAC specifically aims to provide credible science advice to governments and regional organizations on pertinent issues to Africa's development. NASAC's networking capacity serves as an effective resource for communicating appropriate thematic information, as well as coordinate efforts among different sectors and stakeholders in academia, policy and society. NASAC aspires to be the voice of science and is the affiliate network for InterAcademy Partnership in Africa.

The membership of NASAC consists of duly established national science academies in Africa that are merit-based, independent, non-governmental, non-political and non-profit scientific organizations. Through its members, NASAC seeks to enhance collaboration and knowledge sharing among scientists by using evidence-based research to African development policy in the domains of social, natural and economic sciences. NASAC aspires to make science academies in Africa vehicles of positive change for science itself, policy and societies. In so doing, academies ensure that science contributes to realizing Africa's full potential and sustainable development.

NASAC's is dedicated to enabling and inter-connecting African science academies to contribute to science, technology and innovation, to make the voice of science heard by African and global decision and policymakers, and to establish a culture of science in the continent.

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As an independent consortium of science academies, NASAC continues to unite and strengthen its membership to address challenges on the African continent using scientific knowledge and innovative expertise. Specifically, NASAC has continued to provide advice to regional bodies and organizations on science-related issues of importance to Africa's development through its membership. It has also enhanced the capacity of academies in Africa to improve their role as independent science advisors to governments and to strengthen their national, regional, and international functions. In turn, this has assisted the scientific community in the continent to set up national independent academies or associations of scientists where such bodies do not exist. The main goal of NASAC has remained the promotion of scientific excellence so as to create a culture of science in Africa.

NASAC aspires to be an authoritative voice of the science community in Africa. It is therefore only as strong as its members and has remained relevant since its inception by:

- I. Facilitating, through financial or technical support, the formation of science academies in countries where none exist.
- II. Offering science academies a platform for interaction and collaboration with their counterparts worldwide.
- III. Linking scientists and enhancing the voice in science through their national academies.
- IV. Strengthening existing academies through provision of capacity enhancing resources that facilitate their operations as well as offer training opportunities to their officials and staff members.
- V. Championing and facilitating effective networking of science academies by harnessing their collective strengths and enhancing their impact at national and continental levels.

For more information on NASAC, please visit www.nasaonline.org or contact the secretariat at nasac@nasaonline.org.

From the President

1

Addressing grand challenges of this century, which are defined within the framework of international agendas (2030 Agenda, 2063 African Union Agenda, Paris Agreement, Sendai Framework, etc.), undoubtedly requires science-based responses to sustainability issues. Engaging children and youth through science education and the SDGs needs time. Yet time is running out for Africa. Science academies and their networks must collaborate with other UN agencies like UNESCO to curb the declining enrollment in STEM (science, technology, engineering and mathematics) in schools globally. As advocates of STEM education, NASAC is convinced that Inquiry Based Science Education (IBSE) is the methodology that stimulates innate curiosity in learners rather than rote, dogmatic and book learning.

The growing world population lacks enough understanding of the vital contributions of STEM in mitigating many societal challenges. Science literacy must therefore become an integral part of science education. STEM through IBSE extends knowledge and understanding of science concepts and processes to society at large. This makes it a valuable tool for decision making, participation in civic and cultural affairs, and economic productivity. Bridging this gap will provide a basis for engaging in STEM-related issues and offer innovative ideas from research to practice. It is for this reason that the Science Education Programme (SEP) remains NASAC's flagship programme.

NASAC-SEP also highlights and prioritizes digital transformation for socio-economic development in Africa. Digital transformation stands not only to benefit areas of technology, but also every aspect of society, from education, healthcare, agriculture, habitations to large corporations and small businesses. In the current age, all socio-economic strategies must be underpinned by a strong investment in the ICT sector and in human capital development.

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NASAC member Academies continue to advise policymakers to strive towards building a national knowledge economy that is fueled by local innovation. The first unavoidable step in this regard is to recommend significant national investment on internet connectivity with the rest of the world, with emphasis on improving internet speeds and quality. The ICT sector can help develop any country's human capital through specialized learning opportunities and creation of attractive work environments to nurture technological innovation. Most importantly, science academies must work with national governments to develop and align artificial intelligence strategies with the global and regional agendas so as to address socio-economic challenges. Science education remains critical in the realization of the Fourth Industrial Revolution (4IR).

Rapid digital transformation underpinned by leadership, cooperation, innovation and a clear strategy will see connectivity become available in every corner of Africa. New initiatives for digital training will also develop to meet the demands and requirements of the labour markets in most African countries. 4IR will ensure artificial intelligence and knowledge democratization in Africa. Science academies must champion such ambitious science education strategies to policymakers, and stimulating the interest of learners and the youth in STEM, while integrating good ethical values and moral conduct. The basic pathway to attain 'the Africa we want' in the African Union's Agenda 2063 is hinged on delivery of relevant science education at all levels of teaching and learning.

In the words of the late Prof. Thomas Risley Odhiambo, founder of AAS and Icipe, "Science alone will not save Africa; but Africa without science, cannot be saved'.

Sincerely,



Prof. Mahouton Nobert Hounkonnou
President, NASAC

Executive Summary

2

In early 2020, members of NASAC Science Education Programme (SEP) Working Group resolved to undertake a baseline survey on the State of Science Education in Africa. The survey would enable NASAC review Science Education in the broad context of its availability as STEM (Science, Technology, Engineering, and Mathematics) in the curricula of different national education systems in the continent. The assumption was that science education in Africa is taught in the pedagogical context of Inquiry-Based Science Education (IBSE) (also described as discovery methods, 'learning by doing', problem-based approach, experimental science and innovation). A survey questionnaire was subsequently generated and circulated to NASAC members to distribute to secondary schools in their countries. The survey was administered between 11 November 2020 and 12 February 2021. This report provides an analysis and summary of the findings of that survey on 'The State of Science Education in Africa'.

By the lapse of the survey period, twenty-four schools from five countries (Benin, Kenya, Nigeria, South Africa and Tanzania) had provided responses to the survey questionnaire. In the survey, almost all schools indicated having science teachers holding undergraduate degrees, with the exception of one school that had a doctorate degree holder. Besides that, only 47.6% of the schools facilitated their teachers' participation in-service training.

The survey indicated that close to 92% of the respondents indicated that their schools had science laboratories, but only 82% had equipment, chemicals and other relevant materials for practical science lessons. Equipping laboratories in schools that have them, while capacitating those without is proposed as remedy to promoting practical lessons for science education. Most schools also indicated that theoretical and combined (theoretical and practical) methods of teaching science-related

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subjects were preferred to Inquiry Based Science Education (IBSE). Sustainable Development Goals (SDGs) in science education is mainly taught for general awareness and 62.5% of the respondents registered this as the case.

The report concludes that the survey tool should be more deductive and narrower in scope so as to obtain unique information for science education and not education in general. Additionally, the role that Information and Communication Technology (ICT) can play in science education is highlighted as instrumental in the realization of SDG4, which aims 'to ensure inclusive and quality education for all and promote lifelong learning'. SDG4 is notably a big ask for Africa, as it strives to bridge the technological gap with the rest of the world. ICT will help to leverage emerging opportunities for both teachers and learners in science education. Lastly, the report challenges science academies to foster interaction among scientists, science teachers and learners. In so doing, a link between education, research and industry is made possible and learners can then be encouraged to take up careers in STEM.

Introduction

3

3.1 Preamble

Science is an integral part of society in the current world. The quality of education in any country determines the kind of science and technological development that it can achieve. Science, in all its variations, is no doubt one of the most important tools for realizing the United Nations Agenda 2030 of the Sustainable Development Goals. Science subjects are therefore absolutely necessary for socio-economic development as stipulated in many national goals and targets. Be that as it may, it is a point of concern that African secondary schools record poor performances in science related courses such as Physics, Information Technology (IT), Chemistry and Physics. This is despite current efforts by the governments in Africa to ensure uptake of science courses through various programs such as Universal Primary Education which encourages more students to go to school (Ogunniyi & Rollnick, 2015).

There are a number of factors that affect the academic performance of students. One such factor is how students learn or intend to learn and what the teachers teach (Babygeya, 2002). Needless to say, other factors - like shortage of books and materials, teaching and teacher education - also affect students' academic performance. Also, the temperament of the teachers, their professional experience, qualifications and commitment to work may also contribute to the students' achievements. Instruction time allocated to students by teachers in actual learning activities also affect whether or not they understand the subject content, which then has a bearing their performance when examined.

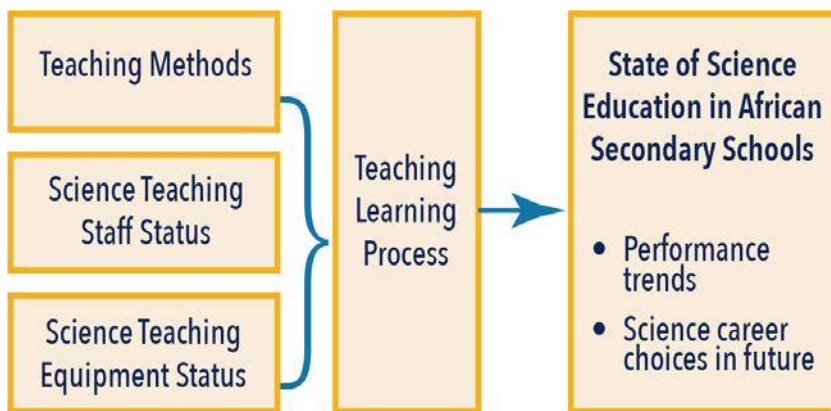
In early 2020, members of NASAC Science Education Programme (SEP) Working Group resolved to undertake a baseline survey on the State of Science Education in Africa. This survey would enable NASAC review Science Education in the broad context of its availability as STEM (Science, Technology, Engineering,

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and Mathematics) in the curricula of different national education systems in the continent. It was assumed that science education is taught using the pedagogical context of Inquiry-Based Science Education (IBSE) (also described as discovery methods, 'learning by doing', problem-based approach, experimental science and innovation). The target sample group was drawn from secondary schools in different countries in Africa, with learners of ages between eleven to eighteen years. All personal data information received for the purposes of this survey was solely utilized for analysis and sharing of the report for input. The information was not shared with third parties and was kept confidential.

3.2 Conceptual Framework



3.3 Survey Questionnaire and Responses

The survey questionnaire was presented in three main parts. The first part collected personal data of the respondent and basic information about the school, the second part covered general information on science education, and the third part sought information for a case study on the teaching of science in schools. For detailed information, the survey questionnaire used is enclosed as an Appendix to this report. The survey was administered between 11 November 2020 and 12 February 2021.

The target respondents were secondary schools in all the twenty-seven countries of NASAC membership. For some reason, responses to the survey questionnaire were received from only five countries. These were schools in Benin, Kenya, Nigeria, South Africa and Tanzania. A total of 24 schools participated in the survey.

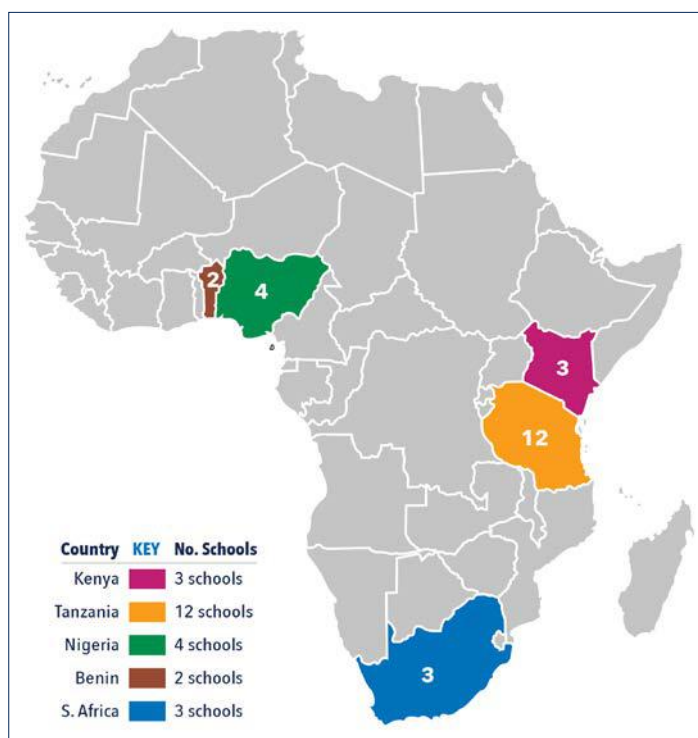
Participating Countries

4

As mentioned above, twenty-four schools from five countries provided responses to the survey questionnaire by lapse of the survey period. Kenya and South Africa both had 3 schools each. Nigeria registered 4 schools, while Benin had 2 schools. The remaining 12 schools were from Tanzania, which constituted fifty percent of the total respondents.

Based on the foregoing, it is recommended that another study be undertaken to attract the participation of more countries. National academies should be encouraged to put more efforts in mobilizing the participation of more schools in their respective countries. The results of the current study will therefore not be conclusive, but rather indicative of the State of Science Education in Africa. The survey tool also requires further revision and piloting prior to being administered so as to guarantee intelligible answers from respondents.

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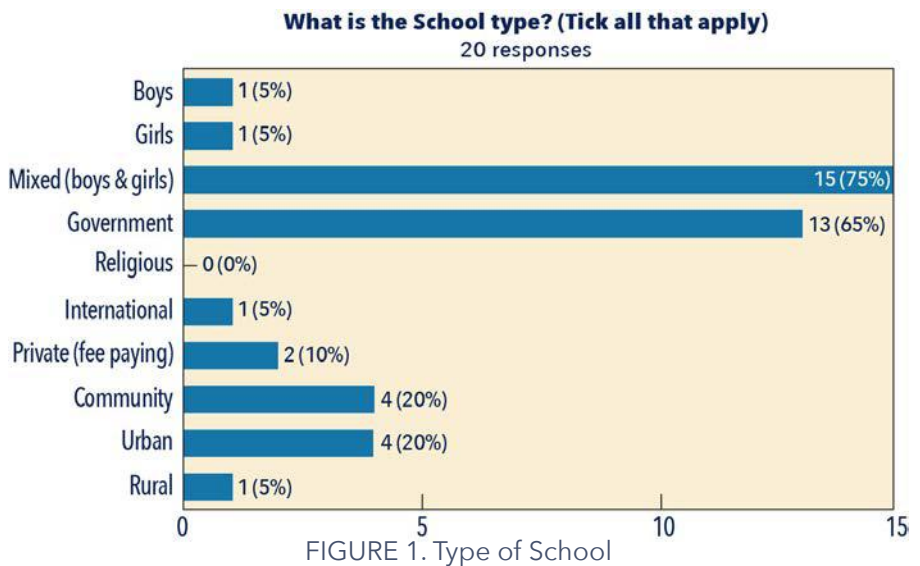
Countries that responded to the survey



5

Type and Level of Target Schools

Most of the respondents were from government schools that had both boys and girls (mixed). However, two schools were private (fee-paying), one was a girls' school and another one was a boys' school. See Figure 1 below on the type of schools that participated.



Secondary level of education was the primary target for schools that participated in the survey.

Academic Qualification of Science Teachers



In the survey, almost all schools indicated having science teachers holding undergraduate degrees. Only one school out of the twenty-four had a science teacher holding a doctorate degree. Two schools had teachers with certificate level of education. It was further noted that 47.6% of the schools facilitated their teachers' participation in-service training. The remaining 52.4% did not provide their teachers with opportunities to participate in any form of in-service training.

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What are the qualifications held by science teachers in your school?
24 responses

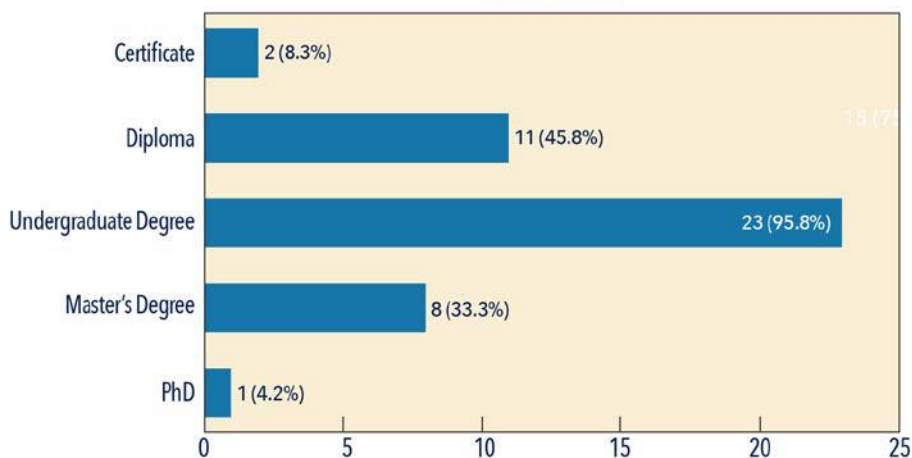


FIGURE 2. Qualifications of science teachers

Many African countries have recognized the important role that science education plays in socio-economic development. As a result, various African governments have enacted policies and allocated an outsized proportion of their gross national product to the education sector, with an emphasis on science, technology and innovation. Universal primary education is also currently being pursued by many African countries to cater for the bulging student population. Thereafter, a one hundred percent transition from primary to secondary level of education is consistently being sought using different criteria. However, educational facilities have not been improved commensurate to the demand. This in turn has compromised the standards



of teaching science in many African schools. Amongst various challenges being faced, the shortage of qualified science teachers has been mentioned as the biggest impediment (Ogunniyi & Rollnick, 2015). Science teachers play a critical role in laying the foundation of scientific literacy of students. No education system can outperform the quality of its teachers.

The impact of the teachers on performance in any subject is very high. The teachers are the facilitators who are to impart the theories and ideas to the scholars. The teacher is the major manpower saddled with the responsibility of imparting the concepts considered fundamental to science through the teaching of these basic concepts in the secondary schools (Association for the Development of Education in Africa, 2018). A country's manpower development depends on the quantity of well-trained and qualified teachers.

The objectives of the education sector of any country cannot be attained when the students are taught by incompetent teachers. Such teachers wouldn't be ready to properly and adequately disseminate the concepts to the scholars. The professional qualities of a well-trained teacher include: mastery of the subject matter, sense of organization, ability to clarify ideas, ability to motivate students, imagination, ability to involve the students in meaningful activities throughout the period of teaching, management of the details of learning and frequent monitoring of students' progress through tests and examinations (Ogunniyi & Rollnick, 2015).

There also exists a correlation between the teachers' content knowledge and student academic performance. Teachers play a central role in the effective dispensation of the curriculum. Research shows that learners exhibit poor academic performance when taught by unqualified teachers or qualified teachers who do not understand the nature of science that has to be taught.

To ensure that teachers are properly retooled to keep abreast with new advances in science, proper monitoring and feedback mechanisms have to be instituted both at the school and national level. It is important that teachers are well prepared to teach any new concepts, are motivated to impart knowledge to their students and have security of tenure in their professions. Modern teaching methods have also to be instituted without overwhelming the teachers by providing ample time for curriculum coverage and practical lessons (Miles, 2015). The scientific community also has to be interested and involved to offer well-informed opinions and research evidence that show that the type of science being taught in schools provide knowledge that is culturally and contextually relevant.

Resources for Science Education

7

7.1 Laboratories, Materials and Equipment

Adu-Gyamfi (2013), in his study on the challenges of science teaching at the basic level, revealed that, all the teachers cited lack of science materials and equipment as the biggest challenge. This lack of science materials and equipment meant that the teaching and learning of science became both inefficient and ineffective.

The survey indicated that close to 92% of the participating schools had science laboratories. This percentage dropped to 82% when asked whether or not those laboratories had equipment, chemicals and other relevant materials for practical science lessons. It is therefore important to equip the laboratories in schools that have them, but those do not have laboratories must be capacitated. Science education is practical and hence the more hands-on the lessons are, the better the understanding and retention of scientific concepts by learners. Below is the snapshot of the survey responses on the two questions.

Besides the unfurnished laboratories, inadequate resources such as text books and physical infrastructure can also make learners lose interest in the subjects and result in poor performance.

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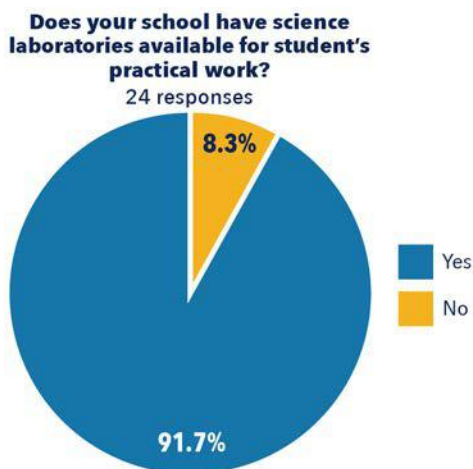


FIGURE 3: Availability of science laboratories

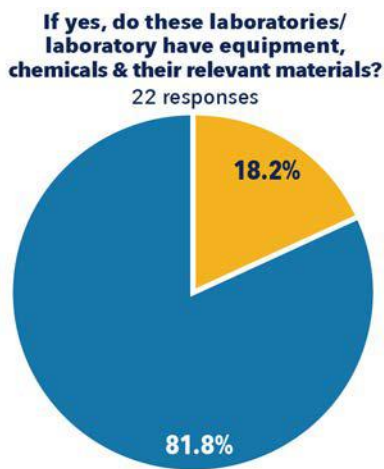


FIGURE 4: Availability of equipment, chemicals and relevant materials in laboratories



Schools that have inadequate infrastructural and human resources perform poorly (Munda, 2000). Learners are taught in theory. It also limits written work because the teacher is unable to give assignment when learners share books. Availability of practical lessons clarifies and reinforces scientific concepts. It further enhances learners' interest in science, increases their manipulative skills and memory of the content. Practical lessons make science relevant, enables the learners to acquire skills, and promotes problem-solving skills. Poor capital investment in provision of science learning resources contribute to students' low level of academic achievement (Mbugua, Kibet, Muthaa, & Nkonke, 2012)

7.2 Name of subject

From the survey responses, it is clear that at secondary school level, integrated science or basic science as a name of subject is rarely used at 12.5%. Specific science subjects like Mathematics, Biology, Chemistry or Physics are more frequently used as the name of courses, and 100% of the respondents indicated so.

Computer Studies and ICT (Information and Communication Technology) were also understood as different subjects in different schools, but infrequently offered at 37.5% and 8.3% respectively. Other subjects offered included History, Geography and Civics as elective courses for 66.7% of the respondents. Economics, Social Studies and Agricultural Science were offered and stand alone in rare circumstances because only 1 of the respondents indicated this registered as 4.2%.

7.3 Number of lessons

The survey revealed that on average, each school had a maximum of four lessons per week for the sciences. However, more time was allocated for mathematics which was a mandatory common course, as compared to the science subjects of Chemistry, Physics and Biology which were elective courses. For the elective courses, a maximum of three lessons per week were offered. On average, the students are expected to study fifty-nine lessons in a week. A teacher is however expected to teach, on average, twenty-seven lessons per week. Each lesson is usually forty minutes.

A reasonable workload for teachers to less than twenty-seven lessons per week is however necessary if students are expected to improve in the sciences. Sciences require more time for practical lessons and a more personalized approach. This means that the student to teacher ratio must be low for improved performance and ensure effective attention (Agunda, Oderi, & Ajowi, 2018). The solution worth considering therefore, is to increase the number of science teachers in the continent.

Teaching Methods

8

Most schools that participated in the survey indicated that theoretical and combined (theoretical and practical) methods of teaching science-related subjects were preferred. Unfortunately, Inquiry Based Science Education (IBSE) was the least used method with only one respondent selecting it an option for teaching science-related subjects. Reports have shown that IBSE, as a method of teaching science, is usually time consuming and restrictive for student assessments. There is also a possibility that the term itself may be unfamiliar to the teaching community at secondary school level.

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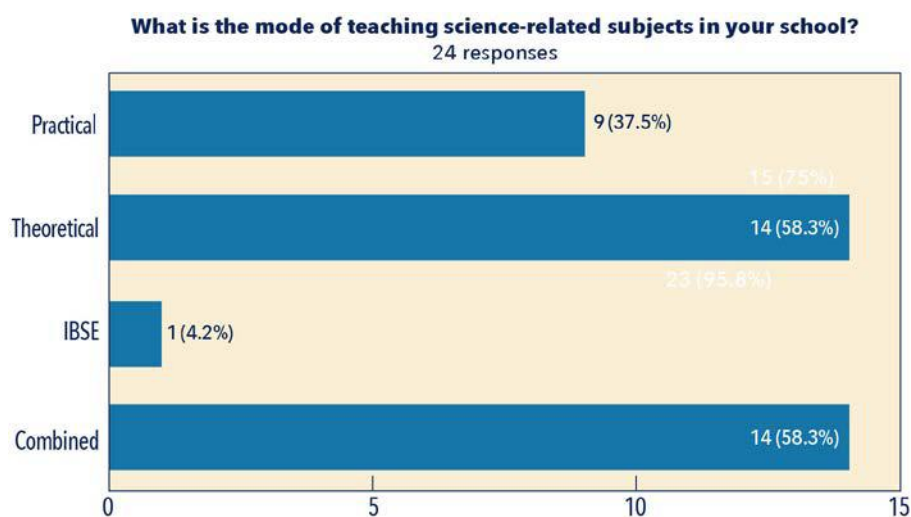


FIGURE 5. Mode of teaching science-related subjects
(Note: Combined mode of teaching includes IBSE)

Reports have further shown that Africa lags behind in ensuring its education system supports science, technology, engineering and mathematics (STEM) job opportunities within industries (Association for the Development of Education in Africa, 2018). The shortage is often linked to poor performance of students and examination-oriented syllabi at the secondary level of education. Education that is not geared towards application of knowledge to unravel real-world problems affecting



societies is not relevant (African Union, 2018). The survey confirmed that there are different teaching methods employed in Benin, Nigeria, Kenya, Tanzania and South Africa Secondary Schools. However, in all cases, the prevalent method is theoretical, which results in memorizing content for examinations rather than understanding concepts for application in real life (The Organisation for Economic Co-operation and Development, 2006). Practical methods of teaching, which would be the most ideal, aims to foster teacher-pupil interaction but is unfortunately least used or avoided all together (Hardmann, Dachi, & Ihubuzor, 2015). For NASAC, the most ideal method of teaching remains Inquiry Based Science Education (IBSE) (Network of African Science Academies, 2016).

Miles (2015) asserted that it is expected of a teacher to implement a range of instructional strategies that will bring academic success to all the science students. For any method to be able to bring good results in the present age, it should be a method that promotes maximum social interaction. Social interaction among students and between teachers and students plays a crucial role in learning (Nguyen, Williams, & Nguyen, 2012). An educator is expected to implement a variety of instructional strategies which will bring academic success to all or any of the science students. Nguyen, Williams and Nguyen (2012) further stressed the necessity for the students to be provided with a supportive, open and interactive environment, to help them discover knowledge. The teaching methods commonly utilized in science education classes are lecture and demonstration method. Lecture method is usually wont to deliver an outsized amount of data to the student during a short period. Lectures are designed to deliver a replacement information to an outsized group of students (Gehlen-Baum & Weinberger, 2014). This method is understood to be effective in handling big classes. Research has shown that this method dominates most of the tertiary institutions (Deslauriers, Schelew, & Wieman, 2011). Unfortunately, the same research also shows that retention of content learnt by students during a lecture-based science course is weak. An average student only retains 42% of what is taught after the lecture and only 20% one week later (Bok, 2006). This survey however, did not present lecture method of teaching as an option in the modes of teaching science-related courses in secondary schools. In terms of categorization and for our purposes therefore, the lecture method would be placed in the category of the theoretical method of teaching.

8.1 Teacher-student interaction

According to a study done in Tanzania on “Implementing school-based teacher development in Tanzania” (Hardmann, Dachi, & Ihubuzor, 2015), it was noted that teacher-pupil interaction is low in most levels of education, including secondary. The teacher-student interaction is even further reduced to a three-step process. First, the teacher asks a question. Second, the pupils attempt to answer that question. Then third and lastly, the teacher offers form of feedback, which in more instances is an evaluation of the pupil’s response. Thereafter, the teacher moves to the next question and cycle begins again. As a result, this process limits the dialogue time between teacher and students.

8.2 Teaching Science Methods

Science by nature, is a practical subject and therefore very resource intensive. Educational systems in African countries may not adequately resource teachers or the science departments to spur interest and better understanding of teachers and learners. A report by the Organization for Economic Co-operation and Development (2006) shows that the traditional “chalk and talk” method, which teachers are more comfortable with, is often chosen and avoid inquiry-based methods that necessitate them to have deeper integrated science understanding. The focus therefore becomes memorizing rather than on understanding. This leaves the students with the task of quickly writing the notes for future reference before the teacher can rub off the written notes from the chalk board, deleting the internalizing and the teacher-student interaction phase. This in future raises students who are very good at cramming science formulas with no real idea on how to apply them in real life.

8.3 Theory versus Practical Lessons

Students’ lack of interest in science is as a result of the less practical nature of learning science (Adu-Gyamfi, 2013). The teaching and learning of science have become the mere transfer of knowledge from science teachers and textbooks to the students. Theory lessons of science therefore become the norm and are usually preferred to practical lessons, backed by the lack of proper resources to conduct practical lessons. In such a scenario, the practical laboratory lessons are translated in to theoretical classroom lessons, much to the detriment of the learner and science education as a whole.

The survey showed that a majority of schools still heavily relied on using examination, set textbooks and traditional classroom teaching for delivery of science lessons in school. Use of laboratory and IBSE methods still remain underutilized.

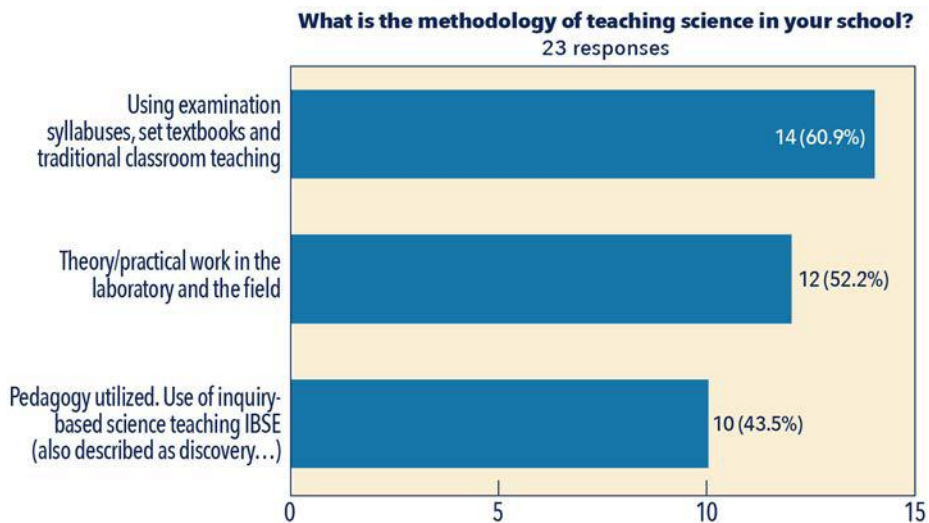


FIGURE 6. Methodology of teaching science

Sustainable Development Goals

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Globally, education systems must respond to the urgent need of defining relevant learning objectives and contents, empowering the learners and urge institutions to include the sustainability principles in their internal structures. In Africa therefore, education in general and science in particular must take cognizance of the sustainable development goals (SDGs). The UN Agenda-2030 on SDGs clearly reflects the importance of an appropriate educational response. Specifically, SDG4 with its education-related targets and indicators will facilitate the realization of all the other goals. Education is therefore an integral part of sustainable development, but also an enabler for Agenda 2030 (United Nations Educational, Scientific and Cultural Organization, 2017).

According to UNESCO, Education for Sustainable Development (ESD) aims at developing competencies in learners that empower them to reflect on their own actions. This self-reflection enables learners to take into account their current and future social, cultural, economic and environmental impacts, from a local and a global perspective (United Nations Educational, Scientific and Cultural Organization, 2017). Learners must therefore be empowered to act sustainably in complex situations and participate in socio-political processes that can move societies towards sustainable development. It therefore imbues a concept of lifelong learning, which is a concern of all educational institutions - from preschool to tertiary education and in non-formal and informal education (United Nations Educational, Scientific and Cultural Organization, 2017).

As significant as the SDGs maybe, it is unfortunate to register that only 62.5% of the respondents have SDGs as part of the curriculum for purposes of awareness or part of a subject. The remaining 37.5% did not include the SDGs. For those schools that had SDGs incorporated, it was only undertaken for general



awareness. This lack of intentionality in the African science education curriculum to deal with matters SDGs will prove detrimental for the continent and for the future generations.

Target 4.7 of the SDGs stipulates that, 'By 2030, ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture

Is the Sustainable Development Goals (SDGs) included in the curriculum either as awareness or as part of a subject?

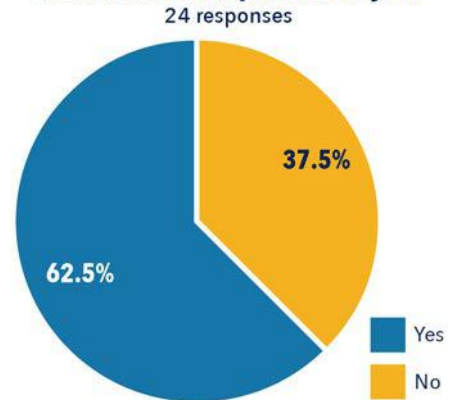


FIGURE 7. SDGs included in the curriculum

Please indicate what is applicable below:

22 responses

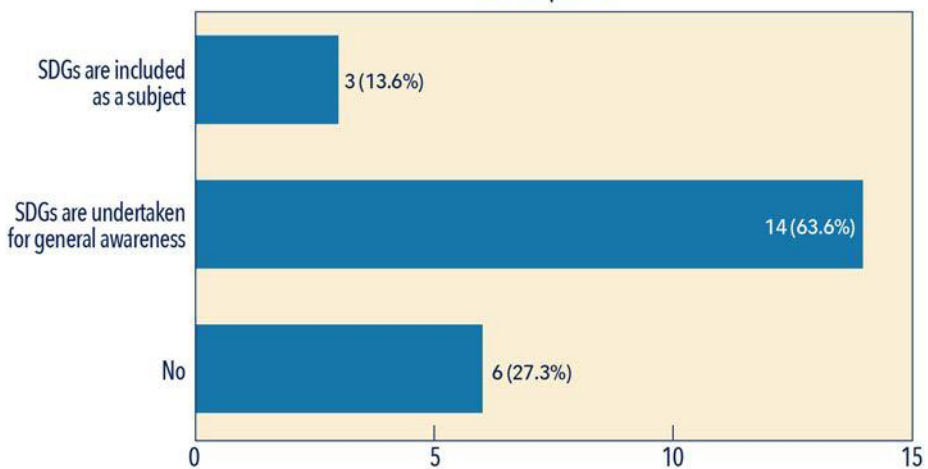


FIGURE 8. SDGs as a subject or general awareness

of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development' (United Nations Educational, Scientific and Cultural Organization, 2017; Network of African Science Academies, 2016). A lot more needs to be done in Africa for the education sector to aspire to attain this target. Science education has this unique niche that if SDGs are included as part of the curricula can empower learners to become agents of sustainable development in the longer term. For sustainability issues to become relevant and prioritized in education, cultural and socio-economic aspects of both teachers and learners have to be taken into account.

Conclusion

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In spite of the various efforts taken by various stakeholders in education in Africa with the aim of addressing challenges facing secondary schools, the state of Science Education in African can benefit from significant improvements (Association for the Development of Education in Africa, 2018). To be able to provide concrete recommendations, this survey is inconclusive and leaves room for further research. Due to the few respondents, the survey is only able to present a limited picture of the continental situation on the state of science education. Many more schools in many more countries should be encouraged to participate and provide intelligible responses to the survey questionnaire. The survey tool itself also needs to be more deductive and narrower in its scope so as to obtain specific information that can uniquely be attributed to science education and not education in general. For now, the responses provided will only serve as an indicator to the State of Science Education in Africa. Further research is still necessary on this topic covering a wider geographical scope in the continent.

It is also noteworthy that Information and Communication Technology (ICT) has a significant role to play. There are indeed ongoing initiatives and positive shift across Africa in using ICT (Nguyen, Williams, & Nguyen, 2012) to improve the quality of teaching and learning. The reality remains that a lot more work should be put in to ensure that all countries meet the 2030 United Nations Sustainable Development Goal. 'To ensure inclusive and quality education for all and promote lifelong learning' as stipulated under SDG4 is a big ask for Africa. The world is already undergoing fast-paced technological advancement and Africa need not lag behind. Africa must bridge the technological divide by leveraging the opportunities for innovation that emerge for both teachers and learners. The future of ICT for education in Africa hinges on embracing new technologies that will (a) improve motivation and enhance student engagement, (b) promote self-regulated

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and collaborated learning, and (c) enforce challenge-driven and human-centered learning (Barakabitze *et al.*, 2019).

Lastly, it is recommended that science academies foster the interaction between scientists, science teachers and science learners. This interaction will ensure that learners can aspire to take up careers in science, technology, engineering and mathematics (STEM). Furthermore, it is this same interaction that will spur, in practicable terms, the translation of research from the laboratories and into practice in the marketplace. A sure way of linking education to research and to industry. It is realistically possible for science education to become more relevant and contextualized for the needs and aspirations of the African continent.

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Appendix

12

Survey Questionnaire

NASAC Science Education Programme (SEP) SURVEY ON THE STATE OF SCIENCE EDUCATION IN AFRICA

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Preamble

Members of NASAC SEP Working Group resolved that it is important to undertake a baseline survey on the state of science education in Africa.

The survey will look at Science Education in the broad context of the availability of STEM (Science, Technology, Engineering, and Mathematics) education throughout the curriculum of national education systems.

Science Education is placed in the pedagogical context of use of Inquiry-Based Science Education (IBSE) (also described as Discovery methods, 'Learning by doing', Problem-Based approach, Experimental science teaching and Innovation).

The target sample group should be drawn from Secondary Schools in your country, with pupils of ages between 11 to 18 years old.

All personal data information received for purposes of this survey will solely be utilized for analysis and sharing the report for input. The information will not be shared with third parties and will therefore be kept confidential.

The deadline for submission of survey responses is 12 February 2021



SURVEY ON THE STATE OF SCIENCE EDUCATION IN AFRICA

Contact of NASAC member-Academy that circulated the survey:

Country:

Academy:

Academy contact (name and email):
.....
.....

School contact information:

Survey completed by:

Name:

School name:

School type (Tick all that apply):

- | | | |
|---|---|--------------------------------|
| <input type="checkbox"/> Boys | <input type="checkbox"/> Religious | <input type="checkbox"/> Urban |
| <input type="checkbox"/> Girls | <input type="checkbox"/> International | <input type="checkbox"/> Rural |
| <input type="checkbox"/> (Mixed boys & girls) | <input type="checkbox"/> Private (fee paying) | |
| <input type="checkbox"/> Government | <input type="checkbox"/> Community | |

Email contact:

Job title:

Dates for the survey: From To

Date of submission:

**This Survey has 2 parts of 11 questions each.
Please respond to all questions.**

PART I: General Information on Science Education

1. Is science (or science under any other title such as Technology (ICT), Environmental Sciences, Basic Sciences, Integrated Science, Chemistry, Physics, Biology, Geography, Geology, and Mathematics) offered as a subject of study in your school?

Yes No

2. Is Science a compulsory subject (part of the core curriculum) or an optional subject:

Compulsory Optional

3. Which of the following subjects are offered? (please tick all that are applicable)

<input type="checkbox"/> Integrated Science	<input type="checkbox"/> Geology
<input type="checkbox"/> Chemistry	<input type="checkbox"/> Geography
<input type="checkbox"/> Physics	<input type="checkbox"/> Mathematics
<input type="checkbox"/> Biology	<input type="checkbox"/> Technology (ICT)
<input type="checkbox"/> Other (Please list):	
.....	
.....	

4. Indicate the number of lessons devoted to science, mathematics and ICT on the timetable per week (Weightage in the school program against the total school contact hours per week)

Please indicate the total contact hours at school per week: _____ hours.

Teaching of Science: Number of hours per week _____ hours.
This amounts to _____ % of the total contact hours at school.

Teaching of Mathematics: Number of hours per week _____ hours.
This amounts to _____ % of the total contact hours at school.

Teaching of ICT: Number of hours per week _____ hours.
This amounts to _____ % of the total contact hours at school.

5. Are laboratories available for student's practical work in science subjects?

Yes No

In these laboratories, are necessary equipment, adequate chemicals and other materials available to undertake science experiments?

Yes

No

Comment on the state of equipment:

.....
.....

Is low-cost equipment used?

Yes

No

Comment on usage of low-cost equipment:

.....

6. What is the methodology of teaching science?

Using examination syllabuses, set textbooks and traditional class room teaching

Theory and practical work in lab and in the field

Pedagogy utilized. Use of Inquiry-Based Science Education (IBSE) (also described as Discovery methods, 'Learning by doing', Problem Based approach, Experimental science teaching, Innovation)?

Other (please explain):

.....
.....

7. Is the Sustainable Development Goals (SDGs) included in the curriculum either as awareness or as part of a subject?

Yes

No

Please indicate what is applicable below:

SDGs are included as a subject

SDGs are undertaken for general awareness

Other (Please indicate):

8. What are the qualifications held by science teachers in your school?

Certificate

Undergraduate Degree

PhD

Diploma

Master's Degree

9. Can you estimate the percentage (%) of teachers who hold specific qualifications in science education?

Yes

No

If yes, please give the number of teachers and the percentage they represent in the staff based on selected qualifications:

- Certificate (How many? _____ Percentage? _____)
- Diploma (How many? _____ Percentage? _____)
- Undergraduate Degree (How many? _____ Percentage? _____)
- Master's Degree (How many? _____ Percentage? _____)
- PhD (How many? _____ Percentage? _____)

10. Do teachers participate in any in-service training each year?

- Yes
- No

If yes, how many training sessions do they participate in annually?

.....

Any other comments on science education in the school:

.....
.....
.....
.....
.....
.....

PART II: Case Study on the Teaching of Science

1. Tick what is applicable and indicate the total number of hours the subject is taught per week:

- Science _____ hours
- Technology (ICT) _____ hours
- Engineering _____ hours
- Mathematics _____ hours

2. What is the mode of teaching science-related subjects?

- Practical
- Theoretical
- IBSE
- Combined (please indicate):
- Other (please indicate):
-
-

3. What are the teachers' qualifications? *Please select as appropriate.*

- Certificate
- Diploma
- Undergraduate Degree
- Master's Degree
- PhD

Indicate number of science teachers: _____ out of _____ members of teaching staff in the school.

For in-service training, what professional development methods are used?

Indicate the type of examination administered to science students.

- Theoretical Practical Combination
- Other

Do teachers use any of the following formative assessments?

- Pop quiz Gaming Mind mapping

5. Please elaborate on the science curricula

- Core and basic Advanced and elective

6. What mode of teaching is used for science?

Project based Chalk and board

IBSE (Please Define): Other:

.....

7. Please tick the facilities for science education available in your school

Equipment Facilities of fieldwork
 Reagents (especially for biology)

Other (please list):

.....

8 Are laboratories available for student's practical work

Yes No

If yes, please comment on the state of the facilities & equipment below:

Laboratory facilities:

.....

Equipment: Standard Low cost

Is 'learning by doing' encouraged?: Yes No

Please indicate the examination mean results for science subjects, as a percentage, for these two years:

2019.....2018.....

11. Specify which official examination was taken by the students i.e., SC, HSC, O level, A level, Baccalaureate, IB, GCSE etc.

.....

Thank you for taking the time to participate in this survey. Once all responses are compiled and analyzed, we will revert with the report for your consideration.



NASAC was established on 13th December 2001 in Nairobi, Kenya, under the auspices of the Inter Academy Panel, currently known as the Inter-Academy Partnership (IAP).

NASAC is a consortium of merit-based science academies in Africa and aspires to make the “voice of science” heard by policy and decision makers within Africa and worldwide. NASAC is dedicated to enhancing the capacity of existing national science academies and champions the cause for creation of new academies where none exist.

As at April 2022, the following academies constituted the membership of NASAC:

- African Academy of Sciences (AAS)
- Algerian Academy of Science and Technology (AAST)
- Académie Nationale des Sciences, Arts et Lettres du Bénin (ANSALB)
- Botswana Academy of Sciences (BAS)
- Académie Nationale des Sciences du Burkina (ANSB)
- Burundi Academy of Sciences and Technology (BAST)
- Cameroon Academy of Sciences (CAS)
- Académie Nationale des Sciences et Technologies du Congo (ANSTC)
- Académie des sciences, des arts, des cultures d’Afrique et des diasporas africaines, Cote d’Ivoire (ASCAD)
- Academy of Scientific Research and Technology, Egypt (ASRT) - *Provisional Member*
- Ethiopian Academy of Science (EAS)
- Ghana Academy of Arts and Sciences (GAAS)
- Kenya National Academy of Sciences (KNAS)
- Madagascar’s National Academy of Arts Letters and Sciences
- Mauritius Academy of Science and Technology (MAST)
- Hassan II Academy of Science and Technology in Morocco
- Academy of Sciences of Mozambique (ASM)
- Nigerian Academy of Science (NAS)
- Rwanda Academy of Sciences (RAS)
- Académie des Sciences et Techniques du Sénégal (ANSTS)
- Academy of Science of South Africa (ASSAf)
- Sudanese National Academy of Science (SNAS)
- Tanzania Academy of Sciences (TAS)
- Académie Nationale Des Sciences, Arts Et Lettres du Togo (ANSALT)
- Tunisia Academy of Sciences Arts and Letters
- Uganda National Academy of Sciences (UNAS)
- Zambia Academy of Sciences (ZaAS)
- Zimbabwe Academy of Sciences (ZAS)

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