





# **Conference Report**

for

# **C O M S T E DA 17**

17<sup>th</sup> Conference on Mathematics, Science and Technology Education in Africa [COMSTEDA 17], Ministerial Round Table, & Annual Delegates Meeting held in December 16<sup>th</sup> – 20<sup>th</sup>, 2019 CEMASTEA, NAIROBI-KENYA



March, 2020

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Approved for Circulation

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# SPONSORS AND PARTNERS



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#### ACKNOWLEDGEMENT

The successful implementation of the 17<sup>th</sup> Conference on Mathematics, Science and Technology Education in Africa (COMSTEDA 17) was the contribution of various players. On behalf of the SMASE-Africa Executive Committee and the delegates, I take this opportunity to thank all that made the international event a success.

We are indebted to the Government of Kenya through the Ministry of Education for accepting to host this conference. Much appreciation to Prof. George Magoha, Cabinet Secretary and Dr. Belio R. Kipsang, Principal Secretary, Ministry of Education (MoE), Mrs. Jacinta L. Akatsa, Director CEMASTEA / the executive secretary, SMASE-Africa for providing strategic leadership in hosting such a successful conference. Kenya as the pioneer of STEM education in Africa provided an example that other African countries will aspire to emulate.

We are equally grateful to the conference organizing committees with membership drawn from various organizations for showing teamwork and passion during the planning and implementation of the conference. Our gratitude goes to all the sponsors and the host CEMASTEA in terms of financial, material and human resources that immensely contributed to a successful event. We value your contribution and hope to work together in the future.

To the SMASE Africa delegates, participants, and paper presenters we are grateful that you chose to come and be part of this great millstone.

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#### Dr. Benson Banda

President, SMASE Africa / Director, National Science Centre, Zambia

# LIST OF ABBREVIATIONS

AFEW	African Fund for Endangered Wildlife of Kenya		
ASEI-PDSI	Activity for Students, Experiments and Improvisation and Plan,		
	Do, See and Improve		
AUC	African Union Commission		
CESA	Continental Education Strategy for Africa		
COMSTEDA Conference on Mathematics, Science, and Technology Ed			
	in Africa		
GPF-K	Global Peace Foundation Kenya		
GMin	Global Minimum		
ICT	Information and Communication Technology		
KCB	Kenya Commercial Bank		
KEPSHA	Kenya Private School Heads Association		
KESSHA	Kenya Secondary Schools Heads		
KUPPET	Kenya Union of Post Primary Education Teachers		
NRF	National Research Fund		
NACOSTI	National Commission for Science, Technology and Innovations		
SMASE-Africa	Strengthening Mathematics and Science Education in Africa		
STEM	Science Technology, engineering and Mathematics		
STI	Science Technology and Innovation		
STISA	Science, Technology and Innovation Strategy for Africa		

#### **EXECUTIVE SUMMARY**

The 17<sup>th</sup> Conference for Mathematics, Science and Technology Education in Africa [COMSTEDA 17] and, Annual SMASE Africa Delegates meeting was held at CEMASTEA, Nairobi, Kenya in December, 16<sup>th</sup> – 20<sup>th</sup> 2019. The theme of the conference was, *"Teacher Professional Development in Africa: Knowledge, Skills, Values & Attitudes in STEM Learning Environments."* 271 out of expected 250 delegates attended all drawn from 12 countries namely; Kenya, Botswana, Namibia, Malawi, Nigeria, South Africa, Uganda, Zambia, Mozambique, Niger, Tanzania, and Malawi. Three ministers of education; Hon Dr. John Chrysostom Muyingo, Minister of Higher Education, Uganda; Hon Makwinja Tebogo, Assistant Minister of Basic Education - Botswana; Hon. David Mabumba, Minister of General Education – Zambia attended the forum. Other organizations represented in the conference were; African Union Commission Head Quarters - Ethiopia, Siemens Stifftung - Kenya, Coalition of Concerned Teachers - Ghana, Education department of the Ministry of Defence Army – Nigeria, Snaplify, Allan and Gill Philanthropy, Sci-Bono Discovery Centre - South Africa, Science Equipment Production Unit – Kenya, AFEW – Kenya, Public and Private Universities, Global Minimum, Global Peace Foundation - Kenya, and Shule Direct – Tanzania.

The opening ceremony was graced by the Minister of Education, Kenya represented by Dr. Belio R. Kipsang, the Principal Secretary, Early learning and Basic Education. In his opening remarks, he reiterated the importance of STEM education in enhancing national development. He noted that the conference provided an excellent opportunity for sharing practical and evidence-based research outcomes, and best practices. He said that STEM-based innovations control social-economic status and Africa is in the process of adopting it. He challenged delegates to equip young people in STEM education because it will ensure that they become job creators.

The keynote speakers were slotted for each of the conference days as follows:

- 1. Dr. Muavia Gallie School Turn around Foundation, South Africa, on the topic: "Reengineering approaches in education systems and schools: Towards Model STEM Schools".
- 2. Prof Genevieve Wanjala University of Nairobi, Kenya, on the topic: "STEM Education in Africa – Professional Experience"
- 3. Dr. Purity Ngina Strathmore University, Kenya on the topic; "STEM Education: Professional experiences".

**COMSTEDA 17** provided an opportunity for delegates to discuss various aspects of STEM education under the five strands below:

- Strand 1: Teacher Professional Development in Africa: Developing Knowledge, Skills, and Values in STEM learning/teaching engagements
- Strand 2: Role of Professional Associations in STEM Teaching and Learning
- Strand 3: School Culture and Learning in STEM
- Strand 4: STEM Curriculum Development, Implementation and Assessment
- Strand 5: ICT Integration in STEM Education

A total of one hundred and twenty-five (125) papers were reviewed and accepted for inclusion in the conference proceedings. The papers were of high quality and scholarly presented. Out of these over fifty papers were presented at the forum. It was evident that more studies need to be done on strand two, the role of Professional Associations in STEM Teaching and Learning which attracted only two papers. Strand one recorded the largest number of papers presented in the forum.

A total of 50 displays were exhibited drawn from CEMASTEA, Kenya Science Engineering Fair (KSEF) students, and external Entrepreneurial Exhibitors. The participants interacted with exhibitors in quest for each innovation insights. Approximately 300 participants visited the innovation rooms. The participants were provided with guidelines on how to engage the STEM exhibitions. Besides these observations, there were specific reports from each country on how each country organizes STEM fairs. Kenya reported that Kenya Science and Engineering Fair (KSEF) is mandated by the Ministry of Education (MOE) to organize science fairs from zonal, through to regional culminating at National level. Zambia reported that science fairs for the junior categories are implemented to ensure that STEM and ICT integration is registered during the competition. Namibia reported that science fair begins at grade 8 and the students are encouraged to incorporate global skills into projects aimed at challenging learners thinking beyond the classroom. Malawi reported that they have science fairs that are organized by the MOE. However, the main challenge to all these innovations is education systems that are focused on examination results as a determinant of success which puts to question on whether STEM-based innovations are being inculcated.

#### **1.0 CONFERENCE INFORMATION**

#### **1.1 Introduction**

The conference information and is organized under a background on SMASE-Africa, COMSTEDA and COMSTEDA 17 planning and implementation.

#### **1.2 About SMASE-Africa**

SMASE – Africa started in the year 2001 as an initiative for addressing challenges facing mathematics and science education in Africa. Its regional secretariat is hosted at CEMASTEA with offices inside the University of Nairobi - Kenya Science Campus. Officials of the network include the SMASE-Africa President, Dr. Benson Banda (Zambia), Vice President, Prof. Sarifa Fagilde (Mozambique), Executive Secretary, Mrs. Jacinta L. Akatsa (Kenya) and the treasurer Mrs. Mary W. Sichangi (Kenya). The Patron is the Minister of Education, Kenya. SMASE-Africa is a member of the African Union Continental Education Strategy for Africa's (CESA) Teacher development and STEM education clusters.

#### **1.3 About COMSTEDA**

The Conference on Mathematics, Science and Technology Education in Africa (COMSTEDA) is one of the programs of SMASE-Africa designed as a continental platform for educators to share innovative ideas, best practice and interrogate issues relating to teaching and learning of mathematics and science. The aim is to strengthen the capability of youth in Science, Technology, Engineering and Mathematics (STEM) subjects for 21<sup>st</sup> century living. The forum brings together educators, policy makers, researchers, teachers, NGOs, public and private sector stakeholders to present papers, posters, exhibitions and workshop concepts. The conference is held annually in African countries. Since2001 to 2013, the regional conference was known as SMASE-WECSA. It later changed to COMSTEDA in 2014. COMSTEDA 14 was held in Nairobi, Kenya (2016); COMSTEDA 15 Livingstone-Zambia (2017); COMSTEDA 16 Maun-Botswana (2018) and COMSTEDA 17 Nairobi, Kenya (2019).

No	Forum / Year	Host country &/ budget	SMASE Africa &	Number of
		input	Partner Contribution	delegates
1	SMASE-WECSA:	Kenya (1 <sup>st</sup> & 2 <sup>nd</sup> ), Ghana	Varied inputs including	150 - 300
	1 – 13	(3 <sup>rd</sup> ), South Africa (4 <sup>th</sup> ),	partner funds	annually
	/ Years 2001 – 2013	Rwanda (5 <sup>th</sup> ), Senegal (6 <sup>th</sup> ),		
		Zambia (7 <sup>th</sup> ), Kenya (8 <sup>th</sup> -		
		13 <sup>th</sup> ); Varied budget inputs		
		and JICA: 90% of the budget		
2	No conference in 2014	None	None	None
	& 2015			
3	COMSTEDA 14 / 2016	Kenya / 40% of budget	60% of the budget	100 Pax
4	COMSTEDA 15 / 2017	Zambia / 70% of budget	30% of the budget	150 Pax
5	COMSTEDA 16 / 2018	Botswana / 90% of budget	10% of the budget	298 Pax

	Table	1:	Past	Conference	s and	Country	<b>Contributions</b>
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# 1.4 COMSTEDA 17 Planning and Implementation

# 1.4.1 General Administration, Organizing Committees and Conference Program

The conference was spearheaded by an organizing committee co-chaired by the director Policy, Partnerships and East African Cooperation (D-PPEAC), Dr. Silvester Mulambe and Director – CEMASTEA, Mrs. Jacinta Akatsa. The committee drew membership from various organizations both private and public, local and international. The organizing committee entailed 38 members (Annex 1). The meetings were initially held after every three weeks then after two weeks and finally weekly when the conference was one month away. The hosting committee consisting of CEMASTEA staff (Annex 1) chaired by Mr. John Odhiambo who implemented the decisions of the organizing committee. The host committee members were broken down into four sub – committees namely; finance, communication, transport and procurement. The two committees complemented each other in terms of resource mobilization and utilization to realize a successful conference.

# 1.4.2 Registration, Attendance and Participation

215

2

1

The conference attracted ministers and directors in charge of education, educators, policymakers, researchers, teachers, NGOs, public/private sector stakeholders drawn from African countries. The attendance was 271 out of expected 250 (Annex 3) translating to 108.4%. countries represented were 12 namely; Botswana, Ghana, Kenya, Malawi Mozambique Namibia, Niger Nigeria, South Africa, Tanzania, Uganda, and Zambia. The ministers of education included; Hon Dr. John Chrysostom Muyingo, Minister of Higher Education, Uganda, Hon. David Mabumba, Minister of General Education – Zambia and Hon Makwinja Tebogo, Assistant Minister of Basic Education - Botswana.

Lubic 2.	Disti	IDuu	UII UI	part	icipan	us (Inc	n hah	i prese	inter	5) 1101	n cac	n cou	nu y		
No.	1	2	3	4	5	6	7	8	9	10	11	12			
Country	Bot	Gha	Ken	Mal	Moz	Nam	Niger	Nigeria	SA	Tan	Ug	Zam	Actual Total	Exp Total	% age
No of															

Table 2: Distribution of participants (Incl. paper presenters) from each country

1

Key: Bot: Botswana, Gha: Ghana, Ken: Kenya, Mal: Malawi, Moz: Mozambique, Nam: Namibia, SA: South Africa, Tan: Tanzania, Ug: Uganda, Zam: Zambia,

1

10

5

1

3

14

271

250

108.4%

#### **Observations**

participants

15

- a. Despite the long queue's participants were registered in the shortest time possible
- b. Participants registered everyday resulting to double registration especially when participants were in breakaway rooms
- c. Conference materials were inadequate hence participants were not happy

#### Recommendations

- a. Provide two or more registration desks to effectively manage the registration process
- b. Plan registration for categories of participants for instance VVIPs
- c. Introduce online registration and provide timelines to ensure delegates register in advance
- d. Induct the registration team before the conference to enhance effectiveness

e. Provide slightly more conference materials than the expected number to accommodate surplus numbers

### 1.4.3 Financial report

The SMASE-Africa, Ministry of Education, Kenya and Centre for Mathematics Science and Technology Education in Africa (CEMASTEA) hosted the 17<sup>th</sup> Conference on Mathematics, Science and Technological Education in Africa (COMSTEDA 17). The Financial report encompasses four main areas: budget, income, expenditure and variance. As per the COMSTEDA hosting modalities, the host country prepared the conference budget in consultation with the secretariat, fund-raised and covered the following vote heads: Book of abstracts, publicity, local travel within the country, security, and conference venue, welcome dinner; and subsistence costs for the local organizing committee members.

The secretariat in consultation with the local organizing committee utilized the **conference registration fees** to cover the day conference package (two teas, lunch and water) for the following; paid up participants and delegates; invited guests during the opening and closing ceremonies; local organizing committee; SMASE Africa executive committee members; and all CEMASTEA staff. Travel and accommodation for the executive committee members and the keynote speakers was covered by SMASE Africa.

		BUDGET			EXPENDITURE			VARI	ANCE	
	VOTEHEAD	USD	KSH		USD	KSH		USD	KSH	NOTES
1	HOSPITALITY & DAY CONFERENCE PACKAGE	37,446	3,782,000	1	89,380	9,027,355	1	(51,934)	(5,245,355)	Cost increased due to increased number of participants for day conference
2	TRAVEL / TRANSPORT & SECURITY	10,985	1,109,500	2	6,968	703,730	2	4,018	405,770	Cost decreased because partners and ministry sagas supported in-kind
3	PLANNING MEETINGS & ADMINISTRATIV E COSTS	11,910	1,202,953	3	17,110	1,728,148	3	(5,200)	(525,195)	Cost increased because the organizing committee expanded to include officers from ministry Sagas as well as centre staff & drivers that brought the vehicles
4	BRANDING, TRANSLATION, ENTERTAINMEN T & GIFTS	28,798	2,908,600	4	8,569	865,490	4	20,229	2,043,110	Cost reduced because no French or Portuguese translation costs were incurred, KISE donated sign language translators, and entertainment done only on one day
5	MEDIA & PUBLICITY	15,644	1,580,000	5	5,660	571,643	5	9,984	1,008,357	Cost reduced because CEMASTEA communication staff undertook the management of media and publicity

Below is a summary of the budget, expenditure and variance.

6	INNOVATION & EXHIBITION	3,168	320,000	6	602	60,800	6	2,566	259,200	Cost reduced because exhibition booths were not procured, and instead a classroom was used, some partners supported (eg Education devpt trust)
	GRAND TOTAL	107,951	10,903,053		128,289	12,957,166		(20,338)	(2,054,113)	

#### Summary Budget, Expenditure and Variance

No	Item	USD	KSH	Source / Remarks
1	Budget	107,951	10,903,053	
				• Registration fees and Partner donations: Ksh. 3,694,831.00
2	Expenditure	128,289	12,957,166	• CEMASTEA: Ksh. 9,262,335.00
	Variance =			
	Budget -			
3	Expenditure	(20,338)	(2,054,113)	CEMASTEA covered the surplus budget

#### Observations

- a. Kenya government through CEMASTEA provided the largest financial and in-kind contribution in hosting the conference.
- A number of partners were engaged to support the forum making substantive financial contributions; National Research Fund Kenya, KCB & Mwalimu Plus. However, fund raising strategies to potential partners began late in the year
- a. The conference recorded the largest funds raised compared to the previous forums. Some participants paid cash registration fees thereby compromising the security of funds and validity of some of currencies
- c. A large number of funding proposals were shared with various partners both local and international thereby creating visibility for the forum.
- d. Various partners were invited to be members of the local organizing committee thereby improving the forum visibility and funds drive.
- e. The subsidized registration fees meant to motivate the focal point persons was extended to other members of the country arising from inadequate information among the registrars
- b. Partners who were members of the local organizing committee indicated that the registration/exhibition fees rate need to be subsidized

# **Recommendations:**

- a. Fund raising initiatives to begin early enough in the year to plug into partner financial calendar
- b. Host countries to confirm at least one year in advance on hosting modalities and capture forum budget in the financial year

- c. Ensure all participants pay registrations fees in the bank and avoid cash payments
- d. The subsidized registration fees should only be for the **focal points** and organizing committee members

#### 1.4.4 Hospitality

The hospitality department was able to meet the expectations of the conference due to the effort and resources allocated by CEMASTEA management and partners. The hospitality department provided conference facilities and accommodation for some 62 participants (48 participants, 4 interpreters and 10 drivers) on half board throughout the conference. Otherwise the rest were accommodated in the nearby hotels at negotiated rates done by the forum hospitality team. Participants began arriving on 14<sup>th</sup> December, 2019 and departed by 22<sup>nd</sup> December, 2019. The total number of days for accommodation in different venues during the conference are shown in (Annex 4). The hospitality department catered for participants' day conference for 5days, welcome dinner, drinks and accommodation on bed, dinner and breakfast.

No.	Day	Number
1.	16.12.2019	349
2.	17.12.2019	337
3.	18.12.2019	323
4.	19.12.2019	260
5.	20.12.2019	197

Table 3: Daily number of participants

#### Observations

- a) Rooms were inadequate because more guests preferred to stay within the centre, therefore allocated on double occupancy the non-self-contained rooms. However, from feedback given the desire for a self-contained room with TV & internet connectivity was evident. There was no feedback from participants who stayed in other hotels or guest houses.
- b) Parallel activities hosted at the conference can be sources of conflict if not well managed especially during meal times.
- c) Lapses in the conduct of registration were observed especially in terms of coordination between hospitality and registration as well as transport teams
- d) Arising from the large turnout of participants, the plenary room was in-sufficient
- e) The welcome dinner was planned late in order to determine the expected number of participants as observed in the extra food

#### Recommendations

- a) In future events plan for plenary rooms whose capacity is more than the expected number
- b) Plan to reserve self-contained rooms equipped with necessary amenities such as internet access, recreation facilities and TV-sets for delegates
- c) Where possible avoid hosting parallel activities in the same venue when numbers are large
- d) Provide a central coordination for hospitality, registration and transport to ensure harmony

e) Include request for confirmation from delegates on participation in dinner activities in advance to determine expected number for planning purposes

# 1.4.5 Logistics (Transport), Security and Protocol

The success of hosting COMSTEDA 17 to a large extent relied on transport and logistical arrangements. The logistics on planning for transport required meticulous planning to ensure a seamless movement of conference participants in the context of the location of CEMASTEA. The team worked closely with the Director CEMASTEA, the COMSTEDA security team and the Karen police station in ensuring convenience and safe passage for participants and delegates. The logistics and transport plan entailed: Airport pick-up/drop off, hotel pick-up or drop off, drop-off/pick-up at the conference venue and VIP transport to areas of interest. The limited number of vehicles owned by the host was complimented by several institutions namely; providing the same in-kind while others were hired. To ensure effective movement of participants and delegates, the itinerary for all participants from outside the country was prepared and shared with all the drivers (Annex 5). The whole compound was under 24 hours CCTV surveillance at the key strategic locations.

#### Observations

- a) Transportation to all venues was done on time and drivers displayed commitment to tasks including late night arrivals and departures
- b) The police riders were effective in picking/dropping VIPs and helped ease traffic challenges.
- c) The protocol team worked well in connecting delegates and participants to assigned vehicles
- d) Participants from Kenya successfully used their own means to access the venue of the conference
- e) Some vehicles available used by VIPs should have been sourced in advance in order to induct the drivers on expectations.
- f) Some visitors arrived with airlines or terminals different from the one earlier indicated in the airport pick-up schedule
- a) Access to the airport VIP lodge to receive VIPs was not well coordinated and some delegates expressed disappointment with lack of warm welcome and support during arrivals

# Recommendations

- a) In future forums there is need to induct the protocol, security and team of drivers from other organizations on expectations for VIP guests.
- b) Police officer riders need to be on standby to escort VIPs
- c) A sign language interpreter need to be stationed to access points to support persons living with disabilities

# 1.4.6 Publicity, Communication, entertainment and Media

The communication team supported mainly the publicity, design of artworks, branding, media and entertainment. Publicity, awareness was created through correspondence to the public to more than 800 contacts targeting; Ministers of Education across Africa, Directors of Semi-Autonomous Government Agencies, Teacher management bodies, public and private teacher training institutions school principals and teachers through emails, letters, telephone calls, placement of the announcement and call for papers on various partner websites and activities.

Design of artworks and branding for COMSTEDA 17 promotional merchandise such as banners, gift bags, tote bags, roll up banners, polo shirts, social media artworks, sponsor and media banners were developed and printed. These were placed strategically in various rooms at the conference venue. All the paper presenters were issued with polo shirts, tote bags and book of abstracts, while the participants received tote bags and book of abstracts. Digital media was extensively utilized during the conference such as; <u>www.smase-africa.org/comsteda</u>, social media pages on Facebook, Twitter and LinkedIn accounts were created. Facebook and Twitter accounts were used specifically for promotional purposes to reach over 1,525 engagements and more than 10,000 people on Facebook. Twitter advert reached more than 5,000 people.

The conference attracted four (4) media houses who captured the opening ceremony and interviewed the chief guest, President, SMASE-Africa and Executive Secretary, SMASE-Africa. The opening ceremony was aired on SWITCH TV link <u>https://www.youtu.be4x5kBG\_mqO1</u> and <u>https://www.kenyanews.go.ke/nemis-had-provided-one-single-source-of-accurate-timely-and-</u>

<u>credible-data/.</u> The conference proceedings were captured mainly through videography and photography. Captured photos were uploaded on Facebook, Twitter and LinkedIn Accounts. Live streaming of the demonstrated STEM- physics lesson was done from the new dining hall and projected in the Sugiyama Hall. Entertainment was provided by Afrizzo group, CEMASTEA choir and a deejay.

#### Observations

- a) The varied media publicity created awareness of the conference and coverage of the proceedings for the three days attracted more participants
- b) Promotional merchandise and regular updates on COMSTEDA17 social media sites attracted likes and followers on Facebook and Twitter
- c) Live streaming of the STEM-physics lesson by Nairobi School students enhanced the conference in terms of quality and live Facebook streaming of the opening and closing ceremonies to attract more followers and likes on social media
- d) Lack of financial resources led to late promotion of social media pages and un-reliable supplier of branding.

**Recommendation**: There is need to invite media houses in advance to induct them on various SMASE-Africa programs and activities and build adequate capacity on social media publicity.

#### **1.4.7** ICT support services to the conference

ICT services played an integral role in the conference through provision of; Internet Services, Audio Visual setup and management, and ICT support.

#### Observations

- a) ICT ensured strong and reliable internet provision in the plenary hall, classrooms, dining hall and hostels as well as unlimited upload and download speeds. There was adequate and reliable ICT support personnel in all conference rooms.
- b) The plenary hall public address system and two microphones worked well through-out the event. However, there was no public address system in break-out rooms and the two microphones in the plenary room were inadequate.

- c) There were five working projectors and laptop, a set in the plenary hall and four in the breakaway rooms.
- d) Livestreaming services were provided and a live lesson was projected in the plenary hall, which saved on time and space.
- e) The provision of additional ICT equipment aided in the success of the conference e.g. 5 HDMI-VGA adapters, 3 Apple mini display for VGA, 3 USB-HDMI-VGA adapters, 3 64GB USB flash disks, 5 HDMI cables, 30 Power extension cables and 5 Wireless access points.

#### Recommendations

In the future, it is recommended that:

- a) Provision of a laptop and a projector in each room to aid in the projection and storage of conference presentations is necessary.
- b) Public address systems need to be made available in all conference rooms.

#### 2.0 CONFERENCE PROCEEDINGS

#### 2.1. Opening Ceremony chief guest Keynote Messages

Cabinet Secretary of Education, Kenya, Prof. George O. Magoha, CBS, represented by Dr. Belio

R. Kipsang, Principal Secretary, Early Learning, and Basic Education presided over the opening ceremony. In his remarks, he reiterated the importance of STEM education in enhancing national development. In order to realize the ambitions of the Global Sustainable Development Goals (SDGs), African Agenda 60, CESA objectives on STEM and other country-specific aspirations; the Chief Guest noted that there is need for change in the education system across the continent and more importantly to develop STEM capability and skills in children. The world needs children who learn things quickly with less supervision. The world needs children who graduate and have useful entrepreneurial skills and to design their career and employability pathways.



Figure 1: Chief Guest Dr. Belio R. Kipsang PS, Early Learning and Basic Education, MoE, Kenya marking opening remarks

The chief guest lauded the conference as an excellent platform for sharing practical and research outcomes or best practices in STEM education. He reiterated that most countries are aligning their education systems to Competency Based Curriculum (CBC) and challenged delegates to equip young people in STEM based skills in order to prepare innovators and creators of employment opportunities. In Kenya for instance, STEM education is one of the pathways in CBC designed to develop competencies, skills, knowledge for application in the society. To realize these, the chief guest highlighted teacher professional development and technology integration as an important ingredient. He expressed optimism that the conference was not an end to itself, but will create new networks for sharing of best practices and emerging evidence in STEM research, teaching and learning.

#### 2.2. Keynote speakers

PROFILE: Muavia Gallie (PhD) (Figure 3, Left) of Worcester, South Africa is a strategist and

founder of the School Turn around Foundation, South Africa. His presentation "*Re-engineering approaches in education systems and schools: Towards Model STEM Schools*" centered on the re-engineer



Figure 2: Which way equality?



Figure 3: Prof. M. Gallie with Mr. J Odhiambo, Conference Chair.

approaches in education systems to transform schools into institutions of excellence using the innovative 'School Turnaround Methodology'. It's a radical shift in the education space that

focuses on second-order change rather than superficial results-driven activities; personalized learning rather than a 'one-size-fits-all' teaching and learning approach; and influence and persuasion rather than authority and command relationships. It focuses on systemic solution generation and long-term impact rather than 'quick fixes'. During his presentation, he enumerated the principles of School Turnaround Methodology that include; all learners are created to be successful and none of them should fail and the academic ability should not be linked to economic, social and cultural status in society. He also argued that parents need to reconnect with the dreams of learners and the need to restructuring the current education models that are a result of dysfunctional-by-design and success-linked-to-social-status. He gave vivid examples on how the methodology is impacting on the schools in South Africa.

Genevieve W. Wanjala, PhD (Figure 4), is the Professor of Education in the department of

educational administration & planning, school of education, University of Nairobi brought to the forum her wide knowledge and experience in planning, design, monitoring and evaluation of educational program. She delivered her speech based on the wealth of research and published articles in relation to learning environments and the quality of technical education. She gave a Keynote speech on "STEM Education in Africa – Professional Experience." As a researcher, she opined that quality education can only take place in quality environments that are safe and supportive contributing to well-being and health, and ipso facto forming the basis for positive cognitive, affective and psychomotor engagements where everyone can reach their full potential. The learning environment is central to quality education and must be designed to support all students, teachers and education support staff.



Figure 4: Prof Genevive W. Wanjala

Dr. Purity Ngina (Figure 5), Strathmore University, Kenya delivered a motivational expose about



Figure 5 Dr. Purity Ngina making a presentation on professional experiences on

her journey to becoming one of the youngest PhD holders in the field of mathematics. On the topic, "STEM Education: Professional experiences", she build on the life principles of school turnaround strategies delivered by Prof. Gullie that all learners are created to be successful and their academic ability should not be linked to their economic, social and cultural status in society. Dr Purity indicated that despite of coming from a poor background, she defied all odds including poor school grades to achieve her dreams. She pointed out that STEM subjects and especially mathematics should take centre stage in education because they play a

critical role in understanding and dealing with global issues such as climate change, disease, technology, security and politics. She currently mentors students and especially girls on the need to step up efforts in STEM subjects. In order to succeed schools need to make learning of STEM subjects fun and teachers should embrace the culture of accommodating all learner ideas.

# 2.3. Highlights of Presentations

During the conference, Strand one attracted the highest number and Strand two recorded the lowest of papers presented. Table 4 shows papers that were reviewed and accepted for presentation in the conference under each strand, exhibitions and innovations by country.

NO	COUNTRY	Exhibition	Innovations	Poster	Strands					
				Poster	1	2	3	4	5	Total
1	Botswana				9	1	4	9	5	28
2	Kenya	3	1		13		7	9	17	51
3	Uganda				2			1	1	4
4	Zambia				8		1	8	2	21
5	Rwanda			1	1					2
6	Nigeria				1		1	1	1	4
7	South Africa				4	2	3		1	7
8	Malawi				1			1		2
9	Lesotho				3					3
10	Mozambique				1			1		2
11	Tanzania				1					1
	Grand Total			1	44	3	16	30	27	125

Table 4: Reviewed and Accepted Papers

# 2.4. Lesson Demonstration

Lesson demonstration was an integral part of the conference in terms of giving learners an opportunity to participate in a high-profile event and setting the tempo for the forum in terms of linking the theme to classroom practices. Two STEM science lessons (one primary and one secondary) were conducted in order to bring out the components of STEM education.

# 2.4.1 Primary Science Lesson

The primary five science lesson was on the topic, "Human Body" and sub-topic, "The Breathing

*System*" which lasted 35 minutes. The lesson emphasized the use of locally available materials to teach science concepts and develop manipulative skills in learners.

The teacher provided learners with a variety of materials



Figure 7: Pupils using locally available materials to develop a model of the

and required them to design (assemble) a breathing system



Figure 6 : Pupils of Mukarara Primary School

model in groups. The teacher used **problem solving approach** where leaners discussed and developed various designs of a breathing system model to illustrate the concept. Learners explained the process of designing and the aspects of STEM were brought out for delegates to deliberate on the

same. The teacher engaged learners on an *electro-quiz* of an assembled breathing system to identify

various parts of the breathing system by touching the parts in question. The buzzer would beep and light up when correct responses are identified. The quiz was used as part of lesson assessment and helped arouse curiosity and motivation among learners. This lesson was an example of how STEM could be demonstrated in a classroom scenario at primary school level using locally available materials in teaching science concepts.

#### 2.4.2 Secondary Science: Physics Lesson

The secondary physics lesson for Form 2 was on the topic, "Equilibrium and the center of gravity" and the sub-topic, "locating the center of gravity of a plane object" based on the Kenyan syllabus. The demonstration showcased a STEM lesson to enable delegates determine STEM aspects in a classroom situation. The lesson demonstration took an hour with the teacher engaging learners in a variety of hands-on activities while making reference to real life scenarios. The lesson used problem solving approach where the teacher designed problems prevalent in the society and gave them to students to solve in groups. Upon designing suitable solutions, the students were expected to explain how they came up with their proposed solutions and what they considered in arriving at solutions. The scenario was about motor vehicle accidents on Kenyan roads as documented in the media. The problem required learners to propose a solution on how to minimize accidents and save lives. Teachers used students' explanations to make linkage to the lesson content. Learners appreciate the content being taught and identified components of STEM in the process of designing solutions. This demonstration enabled conference attendees to view STEM components in a classroom scenario.

#### 2.5. Panel discussion on the STEM lesson demonstrations

The panel discussion on the two lesson demonstrations showcased a typical STEM lesson. The session moderator was Dr. Maguerite Miheso O'Connor and the panelists were: Mr. Patrick Kogolla, Kenya, Dr. Benson Banda, Zambia, Ms Caroline Taliba, Uganda, and Dr. Evanson Muriuki Muriithi, Kenya. The moderator asked three questions as follows; In your view, how do we actualize a STEM lesson? How can we prepare teachers to take STEM education to the continent? What is the way forward for STEM education in Africa? What should we do? How can we learn and move with STEM?

The discussions on the first question indicated that a STEM lesson need to develop 21<sup>st</sup> century skills in learners for living in a complex world and problem solving. The processes of delivering a STEM lesson are critical. Teacher preparation is an important underlying factor especially in new pedagogies to improve teaching. The panelists observed that teachers should give learners discovery learning activities that are well thought and logical. This requires adequate preparation on the part of teachers in terms of pedagogy, methodology and activities. On the second question, the panelist agreed that teacher preparation remains fundamental in enabling STEM education take root in schools. The school level teacher support was mentioned as a key factor. Lastly, all stakeholders need to appreciate STEM education by creating a supportive environment. STEM should aim at opening young people's eyes to see solutions from own perspectives and solve them.

### **2.6.** Paper presentations

# STRAND ONE: Teacher Professional Development in Africa: Developing Knowledge, Skills, and Values in STEM learning / teaching engagements

#### 1. The Innovative Teacher: A Pinnacle of the 21st Century Learner-Centred Teaching of

Science. A case of Kagiso Senior Secondary School, Botswana. *The paper was presented by Tawana Nancy Chaba.* This presentation focused on finding ways to unravel the lack of passion and curiosity among learners. This was promoted by the need to address performance in science double award among students in Botswana which for the past seven years was declining. This output hindered the students to pursue science-based careers which are the pillars for commercialization of innovative projects to create employment in Botswana. The learner-center approach was found to increase the academic performance. The results revealed linguistic, interpersonal learning styles and multiple intelligences as being predominant in school.

#### 2. Teacher Professional Growth in Zambia: A Case of SBCPD in STEM Teaching and

**Learning.** The paper was presented by George Chileya, Bessie Tembo and Benson Banda, Ministry of General Education, Lusaka, Zambia. This presentation focused on teachers' preparedness in adapting STEM pedagogical approaches in Zambia. This done by determining the characteristics of STEM integration in teachers' lessons. From the finding teachers lacked basic STEM education pedagogical characteristics which foster inquiring minds, logical reasoning, and collaboration skills. This implied that teachers were not able to facilitate the integration of the subjects into a cohesive learning paradigm based on real-world applications. The implication for STEM education was to initiate short and long term CPD packages in order to address these challenges. In this regard some teacher preparation institutions were to be identified to offer CPD programmes to STEM teachers.

#### 3. Effect of Teachers' Characteristics on Learners' Academic Outcomes in Secondary

**Schools: Focus on Lesson Study in Kenya.** *The paper was presented by Mr. Acharo Benard Otieno, St. Antony Nyandiwa Mixed Secondary School, Kenya.* This presentation focused on learners' academic outcomes performance, which continues to remain comparatively low, especially in rural and marginalized regions, despite interventions by many education stakeholders in Kenya. Even after several intervention including but not limited to Competence Based Curriculum (CBC). The study recommendations based on the findings are a useful guide when formulating and implementing teacher management policies for recruitment, posting, transfer and professional development in the light of the 21st century learning skills, to improve and stabilize the observed learners' academic outcomes

4. Promoting continuous teacher professional development through School Based INSET: The Dagoreti Lesson Study Model Approach. *This paper was presented by Paul Waibochi, of the Centre for Mathematics Science and Technology Education in Africa (CEMASTEA), Nairobi, Keny.* The paper emphasized the importance of school-based teacher professional development as exemplified through the Dagoreti Lesson Study Model Approach. In this study, the presenter argued that a teacher's career progression in mathematics can be done in a continuous way provided a conducive environment is created so that the teacher gathers and shares on their best classroom practices. Such teachers form a community of experts who plan and

utilize their wealth of experiences to share and build on one another's strengths. The Lesson Study approach was used by the mathematics teachers who utilized their afternoons as scheduled to improve their content, pedagogical and technological knowledge in a contextualized way. The presenter asserted that the model very effective, efficient and highly sustainable.

5. Enhancing Collaborative Activities among College of Education, Collaborating Schools and Education Support Teams in Zambia: A Case of IPeCK Project Experience in three target institutions. The paper presenters were Yumi Sekiguchi and Edward Tindi, National Science Centre, Ministry of General Education, Lusaka, Zambia. The paper focused on collaboration in two educational institutions in Zambia as a key enhancing teacher professional development (TPD), the institutions being Colleges of Education (COE), Collaborating Schools (CSs). In this set up the teacher becomes a facilitator as he/she parts knowledge and skills to learners. The teacher educators therefore need to be capacity build on Lesson Study so that as they train the teacher trainees, the aspect of Pedagogical Content Knowledge (PCK) in COEs is enhanced. This would be done by the revision of the college curriculum to conform to the school curriculum so that the COEs were expected to receive information and skills based on actual classroom practices so that they can assist themselves and teachers to improve their PCK through collaborative activity. The comparative analysis of the Base-line and End-line results showed an increase in the degree of collaborative activities between COEs and CSs and minimal collaboration between NSC and COEs/CSs. A key recommendation of the paper was that collaboration between COEs and CSs should be through the Zone Education Support Team (ZEST) structure.

Teacher Professional Growth in Zambia: A Case of SBCPD in STEM Teaching and 6. Learning. The paper was presented by George Chileya, Bessie Tembo and Benson Banda, Ministry of General Education, Lusaka, Zambia. This study investigated teachers' preparedness in adapting to the STEM pedagogical approaches in Zambia as the country adopted to introduce STEM education in selected secondary schools from January 2020. Questionnaires and individual interviews were used to gather data on the teachers identified. A total of 78 STEM teachers in Physics, Chemistry, Biology and Mathematics were sampled from selected schools through stratification and asked to prepare lesson plans which they later taught in Eighth Grade learners. This was to determine the level of STEM integration in their lessons. Data was analyzed using spreadsheets and common themes established and coded. These were triangulated using lesson plans and lessons observation data. The findings indicated that teachers were willing to adapt to the STEM pedagogical approaches, however, it was observed that the teachers' way of lesson planning and lesson delivery were compartmentalized and characterized with memorization, repetition, and recitation of correct answers. The teachers lacked pedagogical characteristics which foster inquiry based learning, for instance logical reasoning and collaboration skills. The study concluded that teachers in the STEM selected schools were unable to facilitate the adaptation of the STEM culture. The study recommended specific programmes and initiatives, both quick wins and long term CPD packages to address these challenges.

7. Use of modern approaches of STEM education instruction to match 21<sup>st</sup> century skills: A case study of the Experimento Program approach. *This paper was presented by Irene* N. Gisemba; Simon M. Kiganda; George Gichamba; Tobias O. Nagweya; Peter N. Ndunda; Mark Twara; Poulyne Muiruri; Joyce W. Njagi; Alice N. Njeru; Catherine N. Kimathi, Impacting Youth Trust and Siemens Stiftung, Germany. The paper examined how educational reforms have

minimally improved student performance in STEM Education. This was attributed to inadequate attention to what actually happens in the classrooms. The paper discussed key issues that impact learning of science negatively to include, culture, high enrollment, negative attitude of learners in science, teacher absenteeism, and poor teaching approaches. The paper focuses on changing teachers' classroom behaviors leading to improved performance. Teaching approaches such as the jigsaw, discovery learning, hands on approaches, group discussion and project work, which are more learner centered. The paper observed that science subjects have been taught theoretically without engaging learners actively in the lesson. Experimento program was initiated to provide learners an opportunity to actively take part in learning. The study observed that leaners are more resourceful, curious and positive towards the subject. The program realized great learner creativity and innovativeness when learners are provided with fully equipped science kits to approach science topics practically and make science more enjoyable by exploring talents and skills, use locally available materials and improvisations thereby reducing environmental pollution. It concludes by noting that Experimento programs enables teachers to practice what they learn for extended periods of time and provide an ideal environment for interaction.

# **STRAND TWO:** Role of Professional Associations in STEM Teaching and Learning Need to trace the rapporteur's reports for this section

8. Promoting Entrepreneurial Mindset Development amongst High School Learners in Kenya: A Pilot Project through Partner Organizations, Kenya & South Africa. A paper presented by Roselyn Marandu-Kareithi (PhD). Kenya: This presentation gave opportunity for a discourse on ways in which NGOs can use the education space to inculcate the culture and a mindset of entrepreneurial among high school learners. The presentation by the Allan & Gill Gray Philanthropy focused on a six-week pilot programme dubbed the Allan Gray Entrepreneurship Challenge (AGEC) done in Kenya in 2019. It is a response to tackling the challenge of unemployment that continues to escalate as more people graduate from universities, colleges, and technical institutes. One of the outcomes of the programme was the appreciation such an opportunity had on young persons to practice their ideas and the development of the confidence to practice after school. A key recommendation was the need to incorporate entrepreneur ideas in high school education.

**9.** The Traditional Characteristics of Professional Associations in the Environment of STEM Dynamics, Zambia. *Paper presentation by Sidney Nalube, Dr. Benson Banda, Zambia.* The presentation focused on a study aimed at analyzing the characteristics of Professional Associations in the environment of STEM Education. The research focused on five STEM related Associations' national conference activities based on data collected from documentation submitted by conference organizers as being programmes of the conferences. The researchers participated in such conferences as process observers in 2019. Data analyses revealed among other things disconnections among the conference programing and the intentions of STEM Education; that associations work in silos against cooperating in the STEM field and the associations mostly stuck to their traditional rigid frames of talk shows with less research presentations to deepen their practical wisdom. The implications of these research findings are that such disconnected Professional association activity organization for attainment of sustainable STEM learning delivery in Zambia. During the question and answer session it was mentioned that if the success

of the STEM program in Zambia can be replicated in other countries and that political goodwill is important in the implementation of new educational programmes. It was noted that STEM enables students get involved in projects that are STEM based and business oriented. In Kenya this has led to formation of STEM clubs where leaners makes products like liquid soap and mineral water for sale.

# STRAND 3: School Culture and Learning in STEM

10. Is Botswana education system inclusive of learners with special educational needs? A case study of four junior secondary schools. *The paper was presented by Ogla Taolo, Mmaphula Junior Secondary School, Botswana.* The objective was to ensure that Botswana education policy includes all learners with special needs. The concept of inclusive education is based on the fundamental right of all learners to have a quality and equitable education that meets their basic learning needs, and considers the diversity of abilities and increases learning opportunity. There are strong policy statements on the provision of special education in schools. Most provisions for children with special educational needs include the development of structures and availability of appropriate learning tools for particular categories of disability attached to ordinary schools. Some of the findings reported were; lack of aids such as hearing aids, magnifying glasses, wheel chairs. Teacher-centered classrooms, large class size, special needs learners are segregated in terms of assessment, for they are not exposed to exams as early as in form one and two but only in form three. The study recommended that educational policies incorporate inclusive education in order to integrate learners with special needs in the education system.

11. Influence of Politicism on Institutional Leadership in Public Secondary Schools in Kajiado County. The paper was presented by Dr. John Purdul, Country: Kenya. The objective was to investigate the influence of politics in institutional leadership. Culture and education are interdependent. Politics and education have a symbiotic relationship. Principals and Board of management seek politicians for assistance due to lack of physical facilities. The principal is the key human resource personnel as well as the public relations officer. In the region, the principals must be tactful in leading the schools. The education system, political institution and culture have a symbiotic liaison. The culture determines politics, politics determine education system. There should be mentorship training for incoming principals so as to blend in the society and be able to head schools in the region. Culture, politics and education system have a symbiotic relationship. Need to embrace the relationship so as to promote the school performance.

12. Women in leadership, Gender Bias in ICT leadership in Botswana Schools: The case of the Central Region. *The paper was presented by Ms Tshepo Sharon Leepile Baipusi, Mothamo Country: Botswana.* The objective was to show the extent of gender bias in the ICT leadership. To aspire ideas in curriculum so as to narrow down the gender gap in the ICT sector. Partiality includes unequal treatment in employment opportunities, male dominance in the fields of science and technology. Recommendations were that, Ministry of Education should offer flexible schedules for women, focus on productivity, not time, offer evidence based diversity training, and encourage sponsorship programs. Further, ICT leadership should offer flexible schedules for women, focus on productivity, not time, in ICT leadership. Motivate young female learners so that they can take up ICT related careers

**13.** School culture and learning in stem: creating space for in/out of school stem learning and application. *The paper was presented by Peter Ndiritu - Mt Kinangop Girls Secondary School, Science Department, Kenya.* School culture and learning in STEM can be facilitated by creation of space for in/out of school STEM learning and application. STEM learning space should be created and be accessible to learners to provide them an opportunity to acquire knowledge and skills at the same time. Activities done to promote STEM subjects, Creation of science week where learners conduct experiments, compose scientific songs for challenging concepts, participation in Kenya Science and Engineering Fair (KSEF), Young Scientists club where learners across the classes conduct peer teaching. The recommendations were that, teacher education forums should encourage teachers to use learner centered approach which will promote acquisition of 21<sup>st</sup> century skills such as creativity, critical thinking, collaboration and communication. This will help them advance in STEM related careers.

14. Enhancing STEM Education among Learners, Youth and Educators in Zambia. *The paper was presented by Anecetus Moonga, Hussein Mwale and Benson Banda: Country: Zambia*. Participants with significant knowledge in the application of Scientific, Mathematical and Technological principles in the design and construction of technical innovations hardly followed the standard format of writing scientific reports. Through Junior engineers, technicians, and scientists (JETS), teachers and mentors of the participants be capacity built in writing and presentation of research papers and technical reports. Moreover, holding JETS fairs, where learners, youth and educators share innovations and technological research innovations and paper presentations. The problems identified were; poor quality of scientific and technological research innovations and paper presentations, Inadequate scientific investigative skills. Most ideas are from the internet and textbooks with little original ideas. Capacity building needed in writing scientific papers and research papers. The recommendations were; Encourage learners, out-of-school youth and educators to come up with original ideas. Capacity-build them on how to present their innovative ideas in writing quality research papers and technical reports

15. Challenges Faced by Teachers in Teaching Science to Deaf Children in the Mainstream Schools in Developing Countries. The paper was presented by Ziphorah N. Katunga Teacher at a Special School for the deaf, Makongo, Adjunct Lecturer for Kenyan Sign Language at St. Paul's University (SPU) & Lay reader at Anglican Church of Kenya. Kenya. Teaching strategies of hearing impaired (HI) include; they should occupy the front seating positions, teacher should repeat clearly any question asked by the learners with hearing impairment, any videos or films used should be captioned, provide reading lists before the commencement of any course, identify alternative forms of assessment for the Hearing impaired. The recommendations were that, the Ministry of Education should appoint a sign language interpreter as well sensitize teachers to be empathetic towards learners with hearing impairment. The instructional media, proper infrastructure and learning facilities improve the teaching outcomes for learners with hearing impairment.

16. The constitution of a mathematics explanation in Botswana secondary schools, Ministry of Basic Education. The paper was presented by Chako G. Chako Ministry of Basic Education, Botswana. Country: Botswana. Teachers need opportunities to re-learn the Mathematics they teach, professional development. Has application of legitimation translated better performance in Mathematics? Teacher education is sponsored by the government to upgrade their knowledge and skills in Mathematics government at all levels. The recommendations were that; teachers need opportunities to relearn the Mathematics they teach. Professional development will help the teachers to articulate concepts in Mathematics better.

**17.** Colla-Petitive Strategy for Collaborative Learning Environment in Schools. *The paper waspresented by Cyrus Muigai Kihara – JKUAT – PhD Strategic Management, Kevie Otieno – Egerton University Msc Food Science, and Rose Masese, CEMASTEA, Country: Kenya.* Creating a Colla-petitive strategy- collaborative learning environment in schools. Learners who are unable to compete with the rest are demoralized, therefore the competition is unhealthy. In competitive learning, learners will not share information so as to remain at the top, creating academic rivalry, consequently smarter learners hold knowledge. Colla-petitive strategy blends collaboration and competition to get the best of both worlds. The recommendations were that Colla-petitive strategy blends collaboration and competition to get the best of both worlds.

18. Exploring Factors Affecting Students' Attitude towards Mathematics: A Case of Mayuge District in Uganda. The paper was presented by Marjorie S K Batiibwe<sup>1</sup>, Caroline Taliba<sup>2</sup>, Betty K Nannyonga<sup>1</sup>, Carla Puglia<sup>3 1</sup>Makerere University, <sup>2</sup>Uganda Ministry of Education and Sports and <sup>3</sup>International Science Programme. The objective was to establish learners' attitudes towards Mathematics; affective, behavioral, cognitive, and establishing associated challenges existing in teaching and learning of Mathematics. Teachers need to be supported, encourage active participation of learners, program mentoring sessions for the young people, strengthen Mathematics club in school. Collectively sensitize learners that Mathematics is not just numbers. Use peers to motivate peers in learning Mathematics. From the discussions, it came out that, learners have an undecided attitude towards Mathematics irrespective of gender. The recommendations were that learners should be encouraged to appreciate that Mathematics is not just about numbers and symbols, but applicable in real life.

**19.** Leadership for STEM Learning Environment: A Case of Transformation of Selected Schools in Zambia. The paper was presented by Hussein Mwale, Anecetus Moonga and Benson Banda, Country: Zambia. The objective was to ensure equipment are not underutilized, specify the expected products for the technical schools such as metal works, and make school uniforms. The success of any effective STEM school depends on an effective leadership and management amongst other aspects. The characteristics of leadership existing in Technical secondary schools showed poor management of infrastructure and resources, poor curriculum implementation, no standardized criteria for staff and learners' selection and no formal linkages with either institutions of higher learning or industries. The implication of the research findings is that if the status quo remains the education system may not realize the strategies prioritized in the 7NDP for the attainment of the vision 2030. It was recommended that there was need to strengthen leadership and management in technical schools so as to realize the transformation of the technical secondary schools into STEM schools.

# STRAND 4: STEM Curriculum Development, Implementation and Assessment

20. Analysis of the Level of Preparedness for Secondary School teachers of STEM for the Competency Based Education: A case of Bungoma County, Kenya. *The paper was presented* 

by Wakasiaka Eliud Mwichabe, and the other authors were; Sylvanus Watenga, Prof. Julius Maiyo and Dr. Jane Barasa). This presentation focused on the level of teacher preparedness for the implementation of the 21st century instructional practices among educators of Science Technology Engineering and Mathematics (STEM), in preparation for the Competency Based Education (CBE) in public secondary schools in Bungoma County (Kenya). The findings of the study indicated some teachers of STEM subjects still have challenges and negative attitude towards ICT and their overall integration of 21<sup>st</sup> century instructional practice of digital literacy is below average. The study recommends that concerted efforts by the Ministry of Education needs to adequately prepare the teachers of STEM subjects through workshops, seminars and short courses to equip them with requisite skills and attitudes to face the challenges of curriculum delivery in the new system of education. The universities and colleges training teachers in Science education also need to re-align their programmes towards inculcation of 21<sup>st</sup> century instructional practice to the teacher trainees.

**21. Pre-service mathematics teachers' attained knowledge of the tangent function.** *The paper was presented by Dr. P. Malambo University of Zambia.* This presentation focused on pre-service mathematics teachers' attained knowledge of the tangent function. The findings of the study postulates pre service teachers possessed superficial understanding of tangent function implying they do not attain relational understanding of school mathematics concepts. The study thus recommends therefore need to adequately supplement pre-service teachers' study of advanced mathematics with opportunities to explore school mathematics concepts.

22. Assessing Impact of revised curriculum on achievement-levels of grade twelve pupils in mathematics of five selected secondary schools in Lusaka province, Zambia. *The paper was presented by Chingi Samuel, Chalimbana University, Zambia.* The study focused on the impact of revised curriculum: the way in which curriculum is prescribed, implemented, and incorporated by pupils on achievement levels of grade twelve pupils in mathematics of five selected secondary schools in Lusaka Province, Zambia. The findings indicated that the revised curriculum has had no impact on the achievement-levels of grade twelve pupils in mathematics of five selected secondary schools in Lusaka Province, Zambia.

23. Rhetoric and Reality of Postmodernism in Mathematics Education: The Implementation versus Performance in the Botswana General Certificate of Secondary Education Mathematics Curriculum. *The paper was presented by Alfred Bhusumane Botswana Teachers Union, Botswana.* The study found out whether the Botswana General Certificate of Secondary Education Mathematics Curriculum (BGCSE) was properly implemented. The findings pointed out that lack of learner centred model of teaching mathematics contributes to poor performance in mathematics education.

**24. Difficulty in Syllabus objectives interpretation of Junior Certificate Science Syllabus.** *The paper was presented by Pelotlhomogi Modise, Botswana.* The study investigated the perspectives of teachers on factors contributing to low performance in the Junior Certificate Science Syllabus in six (6) Secondary Schools in Kgatleng Region, Botswana. The findings generally revealed that Interpretation of Some syllabus objectives is a challenge as teachers are not able to effectively interpret them. There is little or no School Based Continuing Professional Development activities and the Integrated Science syllabus is congested.

**25.** An Assessment of SMASE In-service Education Training on Teachers' and Pupils participation and Academic Performance in Mathematics and Science Education. *The paper was presented by Dr. Hafsat Lawal Kontagora, SMASE INSET Centre, National Teachers' Institute Kaduna, Nigeria.* The study purposed to determine the degree of usage of ASEI-PDSI approach in teaching and learning of Mathematics and Science education and pupil's participation in Mathematics and Science activities in teaching and learning. The findings indicated SMASE teachers did far better than the Non SMASE teachers in the implementation of the ASEI - PDSI approach and Pupils of SMASE teachers also demonstrated higher participation than the Non SMASE teachers' pupils.

26. Investigating the role of departmental heads as a crucial lever in effective curriculum delivery in South African secondary schools – the case for mathematics and physical science. *The paper was presented by Philip K. Dikgomo, South Africa.* The study investigated the extent to which departmental heads supervised the teaching of their subjects and how they perceived their role within school. Several key findings from the study included; 34% of the DHs had either not studied any Mathematics or Science at all, or have done so at significantly lower levels only meaning that a significant number of DHs, supervise subjects they had not (adequately) studied; female DH stood at 34 %; support the DHs do implement their programmes is not adequate. Policy and practice implications emerge from these findings included the need for recruitment practices that focus on Mathematics and Science qualifications at high levels. Need to better models for professional development, supervision and mentorship for DHs and the inclusion of more females in the departmental leadership.

27. Poor Performance In Biology: Is The Application Of ASEI/PDSI Principles The Solution? A Case of Secondary Schools in Taita Taveta County. *The paper was presented by Roseline M. Osugo PhD student Curriculum Development, Kenyatta University – Kenya.* The study investigated how SMASSE INSET influences the application of ASEI- PDSI principles and the extent of application of the principles in biology. The findings revealed most biology teachers had a low opinion towards the INSET and most of them preferred lecture methods in covering large content and avoided ASEI-PDSI methods.

**28.** A review of the lessons learnt from learners through the implementation of the Experimento program in low income public primary schools in Nairobi County-Kenya. *The paper was presented by Nyokabi Ms. Njuguna, Impacting Youth Trust, and Executive Director Siemens Stiftung, Country Director-Experimento program Kenya.* The purpose of the assessment was to gather data on the impact of the Experimento approach in support of the implementation of the country's 8-4-4 and competency-based curriculum. During the assessment, the team was able to identify lessons from the learners on the areas of attitude change, creativity, improvisation, inclusivity and importance of creating platforms for children to showcase their innovations. The findings revealed current standardized assessment methods in use have discouraged learners from having a positive attitude towards STEM. Advanced learners who stand out as highly gifted children fail to be identified within the system because of their poor academic performance. Learners if provided with the necessary materials at any level of basic education can explore 21<sup>st</sup> century skills to embrace STEM concepts and further solve community problems. The study thus, recommended further investments in learners who are strong in STEM through small grants can

greatly contribute towards a system that creates and nurtures innovators and entrepreneurs from primary schools.

29. Quantum Mechanics Symbology: How does it affect students' understanding of Introductory Quantum Mechanics concepts? The paper was presented by Kwaleyela Kwaleyela Mukuba University, Zambia. The purpose of this study was to investigate how students' conception of Introductory Quantum Mechanics' symbols affect their understanding of quantum mechanics concepts. The research findings indicated that Quantum Mechanics symbology directly affected students' understanding of Introductory Quantum Mechanics concepts, due to; instructors' failure to fully explain what most of these symbols mean; lack of adequate and updated textbooks in the libraries and bookstores; different textbooks using different symbols to mean the same things; failure by students to form visual images as communicated by most of the symbols; less time apportioned to quantum mechanics classes, despite it being counter intuitive in nature, abstract and challenging; insufficient resources to assist students grasp the meaning conveyed by symbols in different situations; and, pedagogical matters relating to its teaching and learning. The study thus recommends that instructors should spend enough time to fully explain the symbolism; employ conceptual models and teaching aids like PHETs simulations; procure enough, updated and modern textbooks; and the strengthening of pedagogical issues in dealing with the abstract nature of the field and its symbolism, would add value to promoting a quantum symbol friendly environment.

**30.** Examining students' connection between mathematics and physics concepts. Case of **12 students in 3 secondary schools of Malawi.** *The paper was presented by Justus Nkhata, Malawi*. This study examine how students connect mathematics and physics concepts using grade 12 students' responses. The study revealed that the students are unable to connect the mathematics and physics concepts on the same context. This might have implications on teachers' practice in mathematics and physics. Further examination will be carried to find out how teachers connect in the same context of mathematical and physics concepts in their practice.

**31.** Professional learning communities as a strategic lever for teacher development support *The paper was presented by Mr PK Dikgomo, South Africa.* This study investigated perspectives on teacher professional learning communities in South Africa. The learning communities are said to have yielded positive impacts in mathematics and science

**32.** Towards Sustainable STEM Learning Outcomes in Basic School Mathematics: A Case of Knowledge Co-creation Program in Africa. *The paper was presented by Chipo Sakala and Benson Banda, Zambia.* This study analyzed each Country's Mathematics Curriculum with Special Focus on General Objectives and Methodology; analyzed Lessons by Looking at Aspects of Lesson Planning, rationale, Key Question, Methodologies and analyze Lessons Implemented from the Mathematics Intended Curriculum. The findings revealed a disconnections among African Country's Visions and aspirations through Mathematics curriculum organization as well as lessons developed. Curriculum composition had weaknesses as it mostly was content biased and at variance with the constructivist view point that aspires to boost critical, creative and analytical thinking. Lessons developed from the curricula produced failed STEM lessons as they, to a large extent, ended up being traditional with the teacher dominating the process. Disconnected curriculum breeds disjointed STEM learning outcomes among learners which was worsened by

limited pedagogical content knowledge among teachers. The study, therefore recommends a critical look at Mathematics curriculum organization and effective teacher professional development.

# STRAND 5: ICT Integration in STEM Education

**33.** Evaluation of the success of African Digital Schools Initiative (ADSI) project in Science, Technology, English and Mathematics (STEM) teaching and learning in Transmara East ADSI schools. *The paper was presented by Leornard Kipkirui- Kenya*. The paper focused on the extent of the utilization of the ADSI ICT infrastructure by teachers in STEM teaching and learning, and highlighted the effectiveness of the training imparted on teachers. The study established that teacher training enabled the teachers to use computer learning applications in teaching and learning, and concluded that the training, infrastructure quality, and utilization of ICT tools made significant contribution to the success of ADSI project.

**34. ICT Integration in Teacher Professional Development, Shule Direct, Tanzania.** *The paper was presented by Berthasia R. Mwitory-Tanzania.* The paper focused on Shule Direct, a not for profit organization that provides a digital platform space for teachers to create their own content, use digital tools for classroom preparations, and coexist together in an online community where they share skills and experience. The presenter emphasized the importance of equipping teachers, with better ICT skills and understanding for them to improve classroom management and engagement.

**35.** Effects of ICT Integration on Teacher content delivery. *The paper was presented by Mr Mmoloki Dithebe, Makgadikgadi Junior Secondary School, Mosu, Botswana; Dr Spar Mathews, Ministry of Basic Education, Gaborone, Botswana*. The paper examined the role of ICT integration as an initiative to enhance delivery in the classroom in public schools at all levels in Botswana. The preliminary results from qualitative analysis of literature revealed that; (i) an effective teacher capacity building system improves teacher motivation and self-esteem, and (ii) countries, such as Kenya, Malaysia and Rwanda, where schools are supplied with relevant and adequate ICT integration enabling gadgets, resulted in teaching-learning process that was exciting for both the teacher and the learner. Such schools had been found to graduate quality learners who had collaborative, innovative, creative, and self-driven skills.

**36.** Integration of Technology in English Language Teaching and Learning in Secondary Schools in Kisumu County, Kenya. *The paper was presented by Molly A. Ogolla, Jaramogi Oginga Odinga University of Science and Technology, Kenya.* The paper explored the importance of integration of ICT in English language teaching and learning. The presenter underscored the the importance of English as a service language in the school curriculum which played a significant role in the country as an official language, and therefore teachers are required to instruct learners to meet the standards of the native speaking countries. The aim of the paper was to enlighten English teachers on the effective strategies to employ in teaching English, using multimedia technology to achieve global standards of English language.

**37. Student Involvement in Creating Learning Content for ICT Learning.** *The paper was presented by (Kellen Kawira Riungu, Department of Sciences, Muthambi Girls High Sch., Kenya.* 

The paper focused on how to promote student involvement in creating ICT content for use during learning. Students may be given topics according to their levels and requested to develop ICT content that they would present to other students or during inter school competition. Sharing of such content among different schools would promote cooperation among students and create a competitive culture that enhance quality learning.

**38. ICT integration best practice and the making of the iToya; Kenya.** *The paper was presented by Maxwell V. Kayesi, HSC, Kenya.* The paper focused on sharing experiences by an innovative teacher on his ICT integration journey. Lesson planning and design incorporating suitable ICT resources was the initial step in ICT integration. Design tools such as web quests, visual understanding environment and PowerPoint presentation, infographic and storyboarding helped learners to visualize, internalize, process and organize knowledge to enhance acquisition and retention. Deliberate reorganization of classroom environment by creating collaboration groups, and providing learners with open educational resources to carry out research on assigned projects, enabled students to prepare presentations, that would be used in the subsequent lesson.

**39. Demonstrating an ICT learning resource.** *The paper was presented by Elijah Kamau, Ndururumo high school, Kenya.* The paper presented an ICT resource called PROLAPE, which is a small projector and laptop detachable and convertible facility that can be used anywhere. The aim of coming up with this resource was to curb the problem of teachers retreating back to the old methods of teaching due to the high population in some schools, and there is no space for the table, laptop or the projector in class.

**40.** The Incorporation of GeoGebra as a Visualizations tool to teach Calculus in Teacher Education Institutions: The Zambian case. *The paper was presented by Lemmy Kangwa, Marc Schafer Rhodes University, Zambia.* The paper focused on a proposed PhD study that will investigate teacher educators' use of GeoGebra, to teach calculus in TEIs in Zambia to enhance conceptual understanding. The study draws on Technology Acceptance Model (TAM) and the Technological Pedagogical Content Knowledge (TPACK) model as enabling theoretical frameworks. The paper was presented with a view to elicit advice and recommendations.

**41.** Challenges facing the implementation of NEPAD pilot e-schools' initiative in Kenya. *The paper was presented by Kennedy wafula Mumali, St Andrews ACK Secondary School – Sirende Bungoma – Kenya.* The paper explored the level of expertise and skills possessed by teachers and students to utilize e-school ICT facilities, and the extent to which the e-School facilities were being accessed and used for classroom instruction during lessons. It emerged that majority of the teachers had not undergone in-service training in the field of ICT and therefore could not integrate the ICTs in the classroom lessons, most students and teachers were not accessing the e-materials due to restrictions in the schools and also most teachers and students lacked the expertise and skills to handle both hardware and software of the e-materials which hampered the use of these equipment during teaching and therefore teachers couldn't impart the same skills to students

**42.** Analysis of the level of ICT integration in STEM education in secondary school in Kenya Bungoma County. *The paper was presented by Watenga Sylavannus, Kenya.* 

Penetration of ICT integration in public schools is very low, largely due to the inadequate preparation of teachers during their pre-service training at college and universities, and the school policies that do not support ICT integration programs. The computer course remains an abstract course and teachers hardly use it for curriculum delivery. There is no ownership of the ICT integration in the classroom. Teachers should do everything within their reach to change the life of their learners, without blaming the system. Intrinsic motivation remains a fundamental aspect in every teacher if sustainable STEM learning outcomes are to be realized in Africa.

**43.** Through my lens: Portraits of pedagogy. *A photo exhibition by Thuo Karanja, CEMASTEA, Kenya.* The photo exhibition composed of photographs taken during the presenters

working tours where he documents the realities of our learning spaces. The use of word 'portrait' the instead 'photograph' was deliberate as to represent the exhibition as an 'expression and a display of the likeness, personality and even the mood' of the classrooms, and teachers' learning spaces. The exhibition was expected provoke pedagogical conversations not just through the brief descriptions of the photographs but also in dealing with the curiosity they visually arouse. As it were, photographs play an important role in people's lives. They connect us to the



Figure 8 Students reporting their group work during a lesson by writing out on the board. What is the pedagogical significance of such an activity during a lesson?

past and remind us of events, feelings, and stories (Share, 2015). The exhibition was an opportunity for conference participants to experience the power of photographic imagery in capturing and conveying pedagogical interactions, especially in the classroom.

#### All Work No Play

The African Fund for Endangered Wildlife (A.F.E.W.) Kenya was one of the sponsors of the



Figure 9 Conference participants and delegates spent an evening learning about giraffes

conference and a partner in CEMASTEA education for sustainable development programmes. AFEW accorded conference participants an opportunity to touch base with nature by visiting the Giraffe Centre, Karen. The Giraffe Centre is the creation of the African Fund for Endangered Wildlife (A.F.E.W.), a Kenyan non-profit organization whose main purpose is to educate Kenyan school children and youth on the country's wildlife and environment, as well as give local and international visitors to experience the world's tallest species, the

giraffe. The Centre hosts several Rothschild Giraffes.

#### **3.0 INNOVATIONS AND EXHIBITIONS**

The conference attracted a total of 50 displays, exhibitions and innovations from CEMASTEA,

Kenya Science Engineering Fair (KSEF) students and Entrepreneurial/NGO exhibitors. The innovations showcased the strides Kenya has made towards promoting STEM. The participants interacted with exhibitors in a quest for innovation insights. Approximately 250 participants visited the innovation rooms. Secondary school students. who performed exemplarily during the national Kenya Science Engineering Fair (KSEF) competition, were invited to demonstrate their STEM artifacts. The innovations showcased the strides Kenya has made towards promoting



Figure 10 Exhibitors demonstrating various Innovations and Improvisations to Participants i.e. robotics among others.

STEM education. Participants interacted with exhibitors in a quest for each innovation insights. Approximately 250 participants visited the innovation and the exhibition area. It was notable that students who presented the projects had great communication skills; they were able to articulately connect the content as learnt in class to their projects. The integration of ICT in their projects added great value to their presentations. Learner presentations were organized in a logical flow from problem statements, research methodology, findings, conclusions and recommendations revealed a sense of research skills. Learners also showed a grasp of STEM as multidisciplinary with relationship of concepts in various STEM showing up in one project. Learners too were aware of existing problems in society and this drives them to be more innovative and look for solutions.

While all the exhibitions at the conference were from Kenya, it was noted that other countries had similar initiatives that give learners opportunity to show and present STEM projects and innovations. This included Zambia, Namibia and Malawi where science fairs for the junior schools and senior schools students are encouraged and challenged to think beyond the classroom and incorporate global skills into their projects. Ministries of education are in charge of such STEM fairs. In Kenya, Science and Engineering Fair (KSEF) and is run by a team mandated by the Ministry of Education (MOE) and runs from zonal, regional culminating at the National level.

#### 3.1 Suggestions for further improvement on innovations and exhibitions

a) There is need for educators to help students turn innovations into commercial ventures. This could be achieved by the invitation of investors to partner with conference organizers. This will help upscale STEM projects to entrepreneurial and commercial ideas.

- b) There is need to promote the interdisciplinary approach to learning of STEM subjects in order to capitalize on the relevance to real life.
- c) There is need to assist learners to publish their works to ensure progress and protection of rights beyond the exhibition fair.

#### 4.0 EMERGING OPPORTUNITIES & FURTHER RESEARCH

#### **4.1 Emerging Opportunities**

The deliberations of the conference, brought to fore emerging opportunities:

- a) One was on the inclusion of the learners both as presenters of lessons and exhibitors of their science and engineering innovations. The presence of learners gave contextual relevance to the conference and the presentations. Student lessons and exhibitions enabled the conference link theory and research to practice and the real world application of STEM. Participants were challenged to establish possibilities for deliberate systems and policies that allow student innovations to progress toward patenting and commercialization.
- b) There are possibilities for collaborative cross national research among member countries in areas such as lesson study and ICT integration.

#### 4.2 Further Research

It was evident that the conference attracted a wide range of researchers and presentations relevant to the conference theme from the diversity of the education sub sector. Except for strand two that attracted only two entries all other strand attracted a sizeable number of entries. One notable highlight was that most of the presentations were collaboratively done. While COMSTEDA conferences strands remain relevant and might not change much in form and structure there are areas that researchers could be persuaded to focus on. They include the role of school leadership in the context of STEM, how STEM learning could change in the context of the uptake of competency based curriculum across the continent; How to make school invitational to STEM learning. There were also not many entries in the area of inclusive education, special needs education and gender responsive pedagogy in relation to STEM.

#### **5.0 CONFERENCE OVERALL EVALUATION**

#### 5.1 Introduction

An evaluation was conducted to assess the overall ratings of the conference. Participants evaluated the forum on five aspects; conference theme, strands covered, materials, experience, presentations, and meals on a rating scale of 0 - 4 with the following descriptors; 0: very poor, 1: poor, 2: satisfactory, 3: good and 4: very good. participants were also asked to make general comments on the conference. This chapter presents the analyzed responses, interpretation and conclusion.

# **5.2 Conference Overall Evaluation**

Participants filled a questionnaire that evaluated the general organization and experience of the conference. Overall, participants indicated that the organization and implementation of the conference was good with a mean rating of 3.19. They agreed that the theme was relevant and strands were appropriate, with a mean rating of 3.60 and 3.14 respectively. They further agreed that the conference programme and presentations were well organized, with ratings of 3.09 and 2.96 respectively. Some participants however, noted that some strands were congested while others had few presentations. Participants were also satisfied with the conference materials with ratings of 2.82. However, some complained that T-shirts were not included in the package, delays in issuing materials, and others pointing out their disappointment with the quality of bags. Participants enjoyed their meals and had a good conference experience with ratings of 3.27 and 3.46 respectively.



**Figure 11 Overall Evaluation** 

#### **5.3 Areas of Improvement**

The following are areas of improvement suggested by participants:

a) Allocate more time for paper presentations and improve on time management so as to avoid rushing some sessions

- b) Conference materials to be given during registration including the conference T-Shirts
- c) Invite more guest speakers

#### **5.4 Conclusion**

The evaluations revealed that the objectives of the conference were achieved and participants were satisfied to a larger extent. This is reflected in the overall mean of 3.19 which can be interpreted as "good".

#### 6.0 CLOSING CEREMONY MESSAGES & NEXT FORUMS

The closing ceremony messages entailed mainly the discussion on the resolutions and recommendations in form a communique. Each of the delegates were expected to indicate what they were to implement as a result of lesson learnt in the forum.

The Executive Secretary SMASE-Africa / Director CEMASTEA, Mrs Jacinta Akatsa (Host), indicated she was delighted to successfully host the participants and hoped they enjoyed their stay in the institution. She congratulated the leadership of SMASE Africa led by the President, Dr Banda, the Cabinet Secretary, Ministry of Education (MOE)-Kenya for planning and hosting the continental forum, the Executive Committee, JICA represented by Ms Mika Okamura and Prof Malonza the CEMASTEA Board of Management member. She further thanked the African governments represented for engaging in very constructive discussions. She noted that the key messages that emerged from the conference were aimed at shaping the course of STEM education in Kenya. She urged the participants to strengthen their country based STEM programs towards sustainable development in Africa.

The Chief Guest, the President SMASE-Africa, Dr Benson Banda, expressed his gratitude for holding a successful conference. He thanked the Government of Kenya for hosting the forum. He stressed the importance of focusing on teacher preparation towards liberating Africa in the area of STEM education. He presented the conference communique and led the delegates to adopt the resolutions and recommendations. The following countries accepted to host the conference in the subsequent years as follows:

a)	Mozambique	COMSTEDA 18 to be held in 2020
b)	Uganda	COMSTEDA 19 to be held in 2021
c)	Malawi	COMSTEDA 20 to be held in 2022
d)	Nigeria	COMSTEDA 21 to be held in 2023

#### 6.1 Resolutions & Recommendations

#### 6.1.1 Resolutions

We SMASE Africa Association Executive Committee, delegates, and conference participants now re-affirm our commitment to adopt the following priorities into the member countries national programs, and use them as a measure of progress in the next steps towards successful enhancement of STEM Education in African countries

- 1. Encourage learning from each other and work together to address common challenges
- 2. Enhance inter-agency collaboration, including professional associations in the delivery of programs to create synergy and avoid duplication.
- 3. Embrace an all-inclusive education to integrate the learners with special needs in STEM

education

- 4. Expand space for in and out of school STEM learning application by encouraging educators, learners, and out of school youths to come up with original ideas through STEM fairs, STEM weeks, STEM Community outreaches, and STEM clubs
- 5. Leverage on the relationship between culture, politics and education systems to have a symbiotic relationship to promote STEM education and school performance
- 6. Strengthen pre-service and in-service training to position them to equip teachers better to implement STEM education
- 7. Develop, implement, access, and evaluate STEM policy and practice framework through the resolutions and recommendations.
- 8. Increase access to STEM Education and management of STEM schools by expanding space for in and out of school STEM learning application by encouraging educators, learners, and out of school youths to come up with original ideas, capacity-build them on how to present their innovative ideas through STEM fairs, STEM weeks, STEM Community outreaches, and STEM clubs.
- 9. Promote transformative leadership and management of schools for full exploitation of the potential and resources lying within our schools for more effective delivery of STEM education.
- 10. The design of programs should place the teacher at the centre to create ownership.
- 11. Foster assessment practices that motivate all learners to excel without alienating weaker students. There is a need to explore ways of conducting assessments without demotivating learners through blending collaboration and competition to realize the best of both worlds
- 12. Enhance cooperation and consultations between country curriculum and assessment bodies
- 13. Strengthen collaboration between in-service and pre-service teacher training to ensure correlation in terms of subject matter and pedagogical skills.
- 14. Repackage teacher training curriculum and content to focus more on preparing them to deliver school level content. Enrich teacher-centered methods that fail to equip learners with critical thinking and problem-solving skills
- 15. Exploit the full potential of ICT technologies to improve the quality of education by expanding and improving infrastructure, internet connectivity, capacity building of teachers, and creating local content
- 16. Retain the structure of COMSTEDA forums to enhance STEM education practices in member countries
- 17. Appoint a Minister responsible for education on a rotational basis to serve as an ambassador championing the STEM education agenda in Africa.

# 6.1.2 Recommendations

We SMASE-Africa make the following recommendations to our respective Governments, organizations, and partners:

- 1. Institute a clear policy on teacher deployment, status, working conditions, the work load for facilitating high-quality teaching standards in STEM education
- 2. Strengthen the link between pre-service and in-service education to equip teachers to implement STEM education
- 3. Develop, implement, access, and evaluate STEM policy and practice framework through the resolutions and recommendations.
- 4. Exploit the full potential of ICT technologies to improve the quality of education by expanding and improving infrastructure, internet connectivity, capacity building of teachers and creating local content
- 5. Establish and integrate the STEM culture and curriculum that promotes early identification of talents through the establishment of STEM centers of excellence, science amusement parks, and museums
- 6. Regularize the process of identification and documentation of indigenous knowledge systems; provision of opportunities for community service learning; and establishment of STEM clubs and maker spaces in schools
- 7. Enforce professional development of teachers and use it in upgrading, and renewal of teaching license
- 8. Prioritize preparation in STEM education to ensure that teachers have the much-needed skills, and benefit from supportive leadership and linkage with the industry
- 9. Develop policies to support and encourage education innovation, while safeguarding intellectual property rights
- 10. Teacher motivation should include; working and living conditions, celebration and reward commitment, creativity and innovation
- 11. Institutionalize policies that identify and reward student's creativity and innovation in STEM education.

# 7.0 ANNEXES

# Annex 1: Organizing Committees

Name, Organization	Name, Organization				
1. Dr. Sylvester Mulambe, MOE, Chair	2. Dr. Sam Ngaruiya, Ministry of Education				
3. Dr. Miheso O'Connor, Kenyatta University	4. Ms. Winfred M. Sila, KEPSHA, National Office				
5. Ms. Caroline Muteti, Impacting Youth Trust & Siemens Stiftung	6. Ms. Nyokabi Njuguna, Impacting Youth Trust & Siemens Stiftung				
7. Mr. Charles Omboto, KISE	8. Mr. Gabriel Mathenge, TSC				
9. Mr. Ezekiel Tumbo, TSC	10. Ms. Caroline Aura , Ministry of Education				
11. Mr. Daniel Juma Omondi, Global Peace Foundation	12. Ms. Diana Kwamboka, Global Peace Foundation				
13. Ms. Aurelia Adhiambo, Global Peace Foundation	14. Ms. Teresia Nyawira, NACOSTI				
15. Prof. George Orwa, JKUAT	16. Mr. Martin Mburu, Kenya Private Schools Ass.				
17. Mr. Charles Kimathi, Standard Media Group	18. Mr. Edwin Wanjala, Standard Media Group				
19. Ms. Margaret Kamau, Edn Development Trust	20. Dr. Evanson M. Muriithi, University of Nairobi				
21. Ms. Shirley Koriana, AFEW Kenya	22. Ms. Cynthia Kantai, Interswitch				
23. Mr. Alex Magu, Play Point Education	24. Ms. Ann Kabengi, Educate Kenya				
25. Ms. Diana Mwai, Educate Kenya	26. Ms. Margaret Muigai, Juja Preparatory Schools				
27. Ms. Nancy W. Chege, Juja Preparatory Schools	28. Ms. Rose Ndaana, KNEC				
29. Dr. Roselyn Marandu, Allan & Gill Philanthropy	30. Mr. Richard Bikko, Global Minimum Inc				
31. Ms. Vanessa Inziani, Young Scientists Kenya	32. Mr. Christopher Kenana, KCAA-EASA				
33. Capt. Mercy Makau, YACA	34. Ms. Beatrice Otieno, KESSHA				
35. Ms. Ruth Agesa, Ministry of Education	36. Mr. Zachary Ouma, Dragonfly Limited				
37. Mr. Kelvin O. Onchong'o, FAWE					

# **COMSTEDA 17 Secretariat Members**

Name, Organization	Name, Organization
1. Mrs. Lydia Muriithi, Deputy Director, CEMASTEA	2. Mr. John Odhiambo, Chair, Host Committee, CEMASTEA
3. Mr. Thuo Karanja, V/Chair Host Committee, CEMASTEA	4. Mr. Patrick A. Kogolla, Head of Training, CEMASTEA
5. Mr. Martin Mungai, CEMASTEA	6. Mr. Philip Maate, CEMASTEA
7. Ms. Priscilla Ombati, CEMASTEA	8. Mr. Daniel Matiri, CEMASTEA
9. Mr. Joseph Ogwel, CEMASTEA	10. Mr. Simon Mugo, CEMASTEA
11. Ms. Mercy Macharia, CEMASTEA	12. Mr. Francis Kamau, CEMASTEA
13. Mr. Isaac Gathambiri, CEMASTEA	14. Mr. Paul Lomosi, CEMASTEA
15. Ms. Lydia Kang'ara, CEMASTEA	16. Mr. Ben Mwangi, CEMASTEA

17. Ms. Zeveline Kathure, CEMASTEA	18. Mr. Robert Aura, CEMASTEA
19. Mr. Michael Terer, CEMASTEA	20. Mr. Athana Wanjala, CEMASTEA
21. Ms. Faith Muchiri, CEMASTEA	22. Ms. Mary Namunyak, CEMASTEA
23. Mr. Brandon Sila, CEMASTEA	24. Ms. Sarah Shompa, CEMASTEA
25. Mr. David Maina, CEMASTEA	26. Ms. Miriam Delaila, CEMASTEA
27. Ms. Catherine Maina, CEMASTEA	38. Ms. Winfred Magu, CEMASTEA
39. Mr. Gregory Njogu, CEMASTEA	40. Mr. Osckin Gankoue, CEMASTEA
41. Mr. Nicholas Muguna, CEMASTEA	42. Ms. Mercy Mbugua, CEMASTEA

#### Annex 2: Conference Program

#### ARRIVAL - 14<sup>th</sup>/15<sup>th</sup> Dec., 2019

Day/Date/ Time	Activity	Section / Person in Charge
08.00 - 17.00	Arrival and Registration	House Keeping
	PRE-CONFERENCE EVEN	TS - 16 <sup>th</sup> Dec, 2019
8:00 - 8:30	Registration	Registration Team
8:30 - 10:30	Impacting Youth Trust / Siemens Stiftung: ECD STEM-	Partner Organization
	Based Innovations	
10:30 -11:00	Health Break	
11:00 -13:00	Education Development Trust: Primary & Secondary	Partner Organization
	STEM-Based Innovations	
13:00 -14:00	LUNCH BREAK	
14:00 - 16:00	PlayPoint: Robotics	Partner Organization

#### CONFERENCE SESSIONS DAY ONE [17<sup>th</sup> December, 2019] MORNING

07:30-08:00	Registration	Registration Team
08:00 08:45	STEM Lesson 1 Demonstration	Session Moderator: Mr. Martin Mungai
08.00-08.45	Mr. Isaac Ondieki, Nairobi School	
08.45.00.35	STEM Lesson 2 Demonstration	Session Moderator: Mr. Philip Maate
00.43.09.33	Teachers Joyce & Symon, Mukarara Pry School	
		Session Moderator: Dr. Maguerite Miheso
09:35-10:05	Panel discussions on lesson 1 and 2	Panelists: Prof. George Orwa, Dr. Evanson Muriithi, Ms. Magret Kamau,
		Ms. Margret Mungai, Ms. Teresia Nyawira, Mrs. Mary Sichangi, Mr.
		Patrick Kogolla, Mr. Kelvin Onchong'a, and Dr. Benson Banda
10:05 - 10:30	HEALTH BREAK	
10:30-10:55	Opening Ceremony	Dr Silvester Mulambe, Director Policy, Partnerships and East Africa
		Community, MOE
		Mrs. Mary W. Sichangi, Head – Partnerships and Linkages,
		CEMASTEA - Kenya

10:55 - 11:05	Photo session	Registration Team
11:05-12:35	Ministerial Round Table	Moderator: Dr. Beatrice Njenga, Rtd Head, Education Division African
	STEM Education in Africa: Policy and practice	Union Commission
12:35 - 13:10	Key Note Address: "Re-engineering approaches in	Dr. Muavia Gallie, School Turn Around Foundation – NPC, South Africa
	education systems and schools: Towards Model STEM	
	Schools"	
13:10-14:00	NETWORKING LUNCH	

<b>DAY ONE</b>	[17 <sup>th</sup> ]	December.	2019	AFTERNOON
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	14:00-14:30	Teacher Innovations		s: Life experiences		Mr. Peter Tabichi, Keriko Secondary School Global Award Winning Teacher			econdary School g Teacher	
	14:30 - 14.40	40 Guidelines on Break-A			vay Sessions	Mr. John O. Odhiambo; Chair, Hosting Comm			Hosting Committee	
				PA	RALLEL SESSIONS					
			J	IMI	E: 14.40 – 15.40 [1 Hour]					
STRA	<b>ND 1:</b> Teacher	STRAND 2: Role of			RAND 3: School Culture	STRAND 4: STEM			RAND 5: ICT	
Profes	ssional Development	Pro	fessional Associations in	and	Learning in STEM	Cu	riculum Development,	Inte	egration in STEM	
in Afr	rica: Developing	ST	EM Teaching and Learning			Im	plementation and	Edu	ucation	
Know	vledge, Skills ,and					Ass	sessment			
Value	es in STEM									
learni	ng/teaching									
engag	gements									
Venue	e: SUGIYAMA HALL	Ve	nue: MATHEMATICS	ATICS Venue: CHEMISTRY		Ve	nue: PHYSICS ROOM	Ve	nue: BIOLOGY ROOM	
Moderator:		RO	OM	ROOM		Mo	Moderator:		Moderator:	
Rapporteur:		Mo	derator:	Moderator:		Rapporteur:		Rapporteur:		
		Rapporteur: Rapporteur:								
1. <b>E</b>	sther S. Kibga:	1.	Roselyn Marandu-	1.	Kipkoech Kitur and	1.	Wakasiaka Eliud	1.	Gilbert Gift Siima:	
N	lurturing Chemistry		Kareithi (PhD):		Wanyonyi S. Kisaka:		Mwichabe, Sylvanus		Locally Developed	
L	earners' Curiosity in		Promoting Entrepreneurial		School Culture And		Watenga, Prof. Julius		Content is Key for	
a	Hands-On Learning		Mindset Development		Learning in STEM		Maiyo and Dr. Jane		Effective Integration	
E	invironment,		Amongst High School		Leadership for		Barasa: Analysis of the		of ICT in Education,	
	niversity of		Learners In Kenya: A Pilot		Learning: Case Studies		level of preparedness for		Uganda	
	Kwanda.		Project Through Partner		on Support and		secondary school teachers	2.	Leonard Kipkirui:	
2. K	Airimi Newton		Organizations, Kenya &	2	Supervision, Kenya		in STEM teaching for the		Evaluation of the	
K	logora: Influence	2	South Africa	2.	Olga Taolo: Is		Competency Based		success of African	
0		2.	Signey Nalube & Benson		Boiswana education		Education: A case of		Digital Schools	
le	earning strategies		<b>Danua</b> The Traditional		system inclusive of		Bungoma County,		Initiative (ADSI)	
u	sed by the teacher		Characteristics of		learners with special	2	Kenya.		project in Science,	
01	n students admittes		Professional Associations		educational needs? A	2.	Byusa Edwin, Dr		recnnology, English	
11	n public secondary		in the Environment of		case study of four junior		Kampire Edwige, Dr.		and Mathematics	
SC	cnools in Buuri East		STEM Dynamics, Zambia		secondary schools in the		Mwesigye Kwekaza		(SIEM) teaching and	

Sub County, Meru County in <b>Kenya</b> <b>3. Bokani Mbakile:</b> Effects of Students Teacher Ratio on Academic Achievement: A case of Selected Government and Private Schools in North-East Region, <b>Botswana</b>		Serowe Palapye Sub Regions, <b>Botswana</b> 3. Michael K. Mhlolo: Conceptualizing an ideal Inclusive Classroom for the 21st Century: Implications for Teachers of Mathematically Gifted Learners [MGLs], South Africa	<ul> <li>Adrian: Competence- based curriculum implementation in chemistry: Head teachers' perception on teaching technique, Uganda</li> <li>Chingi Samuel: Assessing Impact of revised curriculum on achievement levels of grade twelve pupils in mathematics from five selected secondary schools in Lusaka province, Zambia</li> </ul>	<ul> <li>learning in Transmara East ADSI schools, Kenya</li> <li>3. Maureen K Kanchebele- Sinyangwe: Exploring the perceptions of secondary school learners about social media for learning Mathematics in Kabwe District, Zambia.</li> </ul>		
	HEA	LTH BREAK – TIME: 15.40 -	- 15.50			
	PARALLEL SES	SIONS: TIME: 15.50 – 17.00 (	(IHR, 10 MINS)			
STRAND 1: Teacher	STRAND 1: Teacher	STRAND 3: School Culture	STRAND 4: STEM	STRAND 5: ICT		
Professional Development	Professional Development in	and Learning in STEM	Curriculum Development,	Integration in STEM		
in Africa: Developing	Africa: Developing		Implementation and	Education		
Knowledge, Skills ,and	Knowledge, Skills ,and Values		Assessment			
Values in STEM	in STEM learning/teaching					
learning/teaching	engagements					
engagements						
Venue: SUGIYAMA HALL	Venue: MATHEMATICS	Venue: CHEMISTRY	Venue: PHYSICS ROOM	Venue: BIOLOGY ROOM		
Moderator:	ROOM	ROOM	Moderator:	Moderator:		
Rapporteur:	Moderator:	Moderator:	Rapporteur:	Rapporteur:		
	Rapporteur:	Rapporteur:				
1. Paul Waibochi:	1. Acharo Benard	1. Grace Onyebuchi,	1. Anthony S. Mabele and	1. Patrick Tlalelo		
Promoting continuous	Otieno Effect of	<b>Obim Ify Evangel:</b>	Sarah N. Likoko:	Mmokele: Challenges		
teacher professional	Teachers'	Facilitating STEM	Modeling Simulations on	of teaching Computer		
development through	Characteristics on	education for	Individualized Learning	Aided Design (CAD)		
School Based INSET:	Learners' Academic	Vulnerable School	in Chemistry Structure	and Computer Aided		
The Dagoretti Lesson	Outcomes in Secondary	Children through	and Bonding Curriculum	Manufacture (CAM)		
Study Model Approach,	Schools: Focus on	Library Outreach: the	on Students'	in Senior Secondary		
Kenya	Lesson Study in Kenya.	Children Centre	Achievement in Bungoma	Schools, Botswana.		
2. Tawana Nancy	2. George Chileya,	Linkages, Nigeria	County, Kenya	2. Onesmus Gicheru:		
Chaba: The Innovative	Bessie Tembo and	2. Bulukanin Mmongwa:	2. Dr Priestly Malambo:	Effects of Open		
Teacher a Pinnacle of	Benson Banda:	Challenges faced by	Pre-Service Mathematics	Educational Resources		

Γ		the 21st Century		Teacher Professional		standard six teachers in		Teachers' Attained		(OERS) Videos In A
		Learner-Centred		Growth in Zambia: A		teaching science in		Knowledge of the		Blended Physics
		Teaching of Science		Case of SBCPD in		primary school: A case		Tangent Function		Classroom Kenva
		Potemono		STEM Topobing and		of Tutuma wast		Tambia	2	Mr Mmalalri Dithaha
	~	Dotswalia		STEW Teaching and		of futurne west	~		э.	WIT WINOIOKI DILIIEDE
	3.	Mamocheta Makara <sup>1</sup> ,		Learning, <b>Zambia</b>		inspectorate area,	3.	Kaone Bakokonyane,		and Dr. Spar
		Nkoja Khechane:	3.	Onalenna Masi		Botswana		Mojwadi Gosiame,		Mathews: A survey
		Effect of Lesson Study		Sithole, Shanah	3.	John N. Purdul:		Judith Mokgoko:		on ICT Integration
		on Students'		Mompoloki Suping:		Influence of Politicism		Factors contributing to		implementation: A
		Performance: The case		Teacher Professional		on Institutional		failure of topic time in		case of Schools in
		of secondary		Development:		Leadership in Public		mathematics in rural		North East Regional
		mathematics students in		Equipping Science		Secondary Schools in		primary schools of		Operations for
		the rural-mountainous		Teachers with		Kajiado County, <b>Kenya</b>		Botswana: A case of		Education, Botswana
		area, Lesotho		Necessary	4.	Ms Tshepo Sharon		Gamodubu Pry School,	4.	Molly A. Ogolla:
	4.	Mudenda Vincent: An		Constructivist		and Leepile Baipusi:		Botswana		Integration of
		Evaluation of the		Classroom Skills,		Women in leadership,	4.	Mungalu Arthur and		Technology in English
		Humanizing Effect of		Botswana		Gender Bias in ICT		Ndhlovu Zanzini:		Language Teaching
		Lesson 'Study' Practice	4.	Caroline Noel Amunga:		leadership in Botswana		Exploring Lecturers'		and Learning in
		by Science Teachers in		Intersection of Religion		Schools: The case of the		understanding of		Secondary Schools in
		Kabwe district,		and Science: The		Central Region		Outcomes-Based		Kisumu County,
		Zambia		Influence of Christian		Mothamo Junior School		Mathematics Education		Kenya
				Values on STEM,		Botswana		Syllabus in selected		
				Kenya,				Colleges of Education,		
								Zambia.		

#### DAY TWO (18<sup>th</sup> December, 2019)

08:00-08:15	Registration Preliminaries: • Prayers • Briefing on revised	program	Registration Team John Odhiambo		
08:15-08:30	Teacher STEM-Based Innova	ations:: life experiences	Erick Ademba, Continental teac	her award winner	
08:30-09:15	<b>Key note Address</b> : STEM Education in Africa –	Professional Experiences	Prof. Genevieve Wanjala, Catholic University of Eastern Africa		
		PARALLEL SESSIONS TIME: 09.15 – 10.45HOUF	RS		
STRAND 1: Teacher	STRAND 1: Teacher	STRAND 3: School Culture	STRAND 4: STEM	<b>STRAND 5</b> : ICT Integration in	
Professional Development in	Professional Development	and Learning in STEM	Curriculum Development,	STEM Education	
Africa: Developing	in Africa: Developing		Implementation and		
Knowledge, Skills ,and	Knowledge, Skills ,and		Assessment		
Values in STEM	Values in STEM				
learning/teaching	learning/teaching				
engagements	engagements				

Venue: SUGIYAMA HALL Venue: MATHEMATICS Venue: CHEMISTRY		Venue: CHEMISTRY	Venue: PHYSICS ROOM	Venue: BIOLOGY ROOM						
Moderator:	ROOM	ROOM	Moderator:	Moderator:						
Rapporteur:	Moderator:	Moderator:	Rapporteur:	Rapporteur:						
	Rapporteur:	Rapporteur:								
1. Ms. Lillian Mosweu:	1. Mamocheta	1. Peter M. Ndiritu:	1. Phillip Dikgomo:	1. Mr. Leonard Kipkirui:						
Enhancing the teaching	Makara, Nkoja	School culture and	Investigating the role of	Teaching and Learning						
and learning of	Khechane: Effect of	learning in stem: creating	departmental heads as a	with Technology:						
Mathematics in junior	Lesson Study on	space for in/out of school	crucial lever in effective	Effectiveness of ICT						
secondary schools in	Students'	stem learning and	curriculum delivery in	Integration in Science,						
Botswana using STEM	Performance: The	application, <b>Kenya</b>	south African secondary	Technology, English and						
learning, Botswana [15	case of secondary	2. Michael K. Mhlolo:	schools – the case for	Mathematics (STEM) in						
minutes	mathematics students	Conceptualizing an ideal	mathematics and physical	ADSI Schools in Narok						
2. Edward TINDI,	in the rural-	Inclusive Classroom for	science, South Africa	County, <b>Kenya</b>						
Remane SELIMANE,	mountainous area in	the 21 <sup>st</sup> Century:	2. Alfred Bhusumane:	2. Christiana F. Ozokeraha,						
George CHILEYA:	Lesotho.	Implications for Teachers	Rhetoric and reality of	Application of Information						
Panel Discussion on the	2. Dr Josephine N.	of Mathematically Gifted	postmodernism in	Communication						
theme, "Clues to Foster	Ojiambo: Influence of	Learners, South Africa	Mathematics Education:	Technology Resources: Its						
Students' Mathematics	Smasse on the Quality	3. Ziphorah N.	The implementation	Effect on Science,						
and Scientific Literacy	of Teaching and	Katunga: Challenges	versus performance in the	Technology, Engineering						
in Sub-Sanaran Africa :	Learning of	Faced by Teachers in	Botswana general	and Mathematics Learning						
Experience of Technical	Mathematics and	Teaching Science to	certificate of secondary	in Selected Public						
Cooperation Projects of	Sciences in Public	Dear Children in the	education mathematics	Polytechnics in Edo and						
JICA in <b>Mozambique</b> ,	Secondary Schools in	Mainstream Schools	curriculum, Bolswana	Delta States of Nigeria.						
Kwanda and Zambia	Bungoma County,	in Developing	3. Lillian Wosweu:	3. Molly A. Ogolla:						
[40 minutes]	Kenya	Countries, Kenya	Facilitating or	integration of Technology						
	3. Snatnani rejoyce	4. Anecetus Moonga,	strengthening STEM	In English Language						
	orapeleng: The	Hussein Mwale and	teaching for student	Learning and Learning in						
	preparedness of	Benson Banda:	Colleges of Education	Secondary Schools in						
	stam skills at higher	Education among	Coneges of Education,	A Kannada W Manalia						
	stem skins at higher	Loomana Vouth and	Bolswana A Dolotikomogi Modigo	4. Kennedy w Mumali:						
	Betawara	Educators in <b>Zambia</b>	4. Pelotinomogi Moulse, Rekastlet Difficulty in	Implementation of Napad						
	Dolswalla		Syllabus objectives	Dilot E. Schools' Initiative						
	4. Ocnieng Obonyo:		synabus objectives	in Konyo						
	Integrated Approaches		Contificate Science	III Keliya						
	in Physics Pedagogy;		Syllabus Potewana							
	Active Leanning		Synabus, <b>Botswana</b> .							
		 IFAI TH BBEAK TIME, 10.,	15 _ 11.15							
	, and the second s	DADALLEL SESSIONS	75 - 11,15							
		TIME: 11:15 13:15								
	TIME: 11:15 – 13:15									

S	<b>FRAND 1:</b> Teacher	ST	<b>FRAND 1:</b> Teacher	ST	<b>RAND 3</b> : School Culture	ST	TRAND 4: STEM	ST	<b>RAND 5</b> : ICT Integration in
Pr	ofessional Development in	Pr	ofessional Development	and	d Learning in STEM	Cu	rriculum Development,	ST	EM Education
A	frica: Developing	in	Africa: Developing			Im	plementation and		
K	nowledge, Skills, and	Kı	nowledge, Skills, and			As	sessment		
Va	alues in STEM	Va	alues in STEM						
lea	arning/teaching	lea	arning/teaching						
en	gagements	en	gagements						
V	enue: SUGIYAMA HALL	Ve	enue: MATHEMATICS	Ve	nue: CHEMISTRY	Ve	enue: PHYSICS ROOM	Ve	nue: BIOLOGY ROOM
Μ	oderator:	R	DOM	RC	DOM	M	oderator:	Mo	derator:
Ra	apporteur:	Μ	oderator:	Mo	oderator:	Ra	pporteur:	Raj	oporteur:
		Ra	apporteur:	Ra	pporteur:				
1.	Yumi Sekiguchi	1.	Paul Odundo:	1.	George Nyongesa: Why	1.	Dr. Lawal	1.	Rose Khamusali
	and Edward		Influence of digital		STEM needs Philosophy,		Kontagora: An		Okwemba: Effects of
	Tindi, Enhancing		content in biology		Kenya		Assessment of		ICT Integration in STEM
	Collaborative		education in	2.	Marjorie S K,		SMASE In-service		Education as Resource
	Activities among		secondary education,		Batiibwe, Caroline		Education Training on		and Solution in learning
	College of		Kenya		Taliba, Betty K		Teachers' and Pupils'		Among Secondary
	Education,	2.	Isabella P.		Nannyonga, & Carla		participation and		Schools in Kenya
	Collaborating		Ntsabane-		Puglia: Exploring		Academic	2.	Messiah Matsapa: The
	Schools and		Makgatswana;		Factors Affecting		performance in		effects of computer
	Education Support		Science trainee		Students' Attitude		Mathematics and		simulated experiments
	Teams in <b>Zambia</b>		teachers' voices		towards Mathematics:		Science Education,		on students conceptual
2.	Dr. Lucy A.		during Teaching		A Case of Mayuge		Nigeria		understanding of Acids
	Wakiaga and Dr.		Practice: Case of		District in Uganda.	2.	Roseline M. Osugo		and Bases: A case of two
	Beatrice Ndiga <sup>1</sup>		Molepolole College	3.	Dr Rose Atieno Opiyo:		and Dr. Ephantus		form 2 classes in South
	Undrowning high		of Education,		Female Participation,		M. Kaugi		East Region, Botswana
	school female		Botswana		Progression and		ASEI/PDSI Principles	3.	Elijah M. Kamau:
	students' voices in	3.	Ngeny K.E:		Achievement in STEM		on Biology Subject in		Demonstration of
	the quest to		Symposia as		Require Education-System		Taita Taveta County,		an ICT learning
	promulgate STEM		avenues for		and Career Mentorship		Kenya		resource, Kenya
	education, Kenya		teachers to reflect		Improvement, Kenya	3.	Mamocheta Makara:		
3.	End Salani: Junior		on their practice,				Effect of Lesson Study		
	secondary school		Kenya				on Students'		
	teachers' pedagogical						Performance: The Case		
	practices in teaching						of Secondary		
	algebraic equations: A						Mathematics Students in		
	case of four schools in						the Rural- Mountainous		
	South East Region,						Area in <b>Lesotho</b>		
	Botswana								

<b>STRAND 1:</b> Teacher Professional Development in Africa: Developing Knowledge, Skills ,and Values in STEM learning/teaching engagements Venue: SUGIYAMA HALL	STRAND 1: Teacher Professional Development in Africa: Developing Knowledge, Skills ,and Values in STEM learning/teaching engagements Venue: MATHEMATICS ROOM	STRAND 3: School Culture and Learning in STEM Venue: CHEMISTRY ROOM	STRAND 4: STEM Curriculum Development, Implementation and Assessment Venue: PHYSICS ROOM	STRAND 5: ICT Integration in STEM Education Venue: BIOLOGY ROOM
Venue: SUGIYAMA HALL Moderator: Rapporteur:	Venue: MATHEMATICS ROOM Moderator: Rapporteur:	Venue: CHEMISTRY ROOM Moderator: Rapporteur:	Venue: PHYSICS ROOM Moderator: Rapporteur:	Venue: BIOLOGY ROOM Moderator: Rapporteur:
<ol> <li>Dr. Grace N. Orado, Dr. Njoroge, J. M, Akatsa, J. L: Education for sustainable development through teacher professional development: lessons from the SMASE program of Kenya</li> <li>Siima Gilbert: Locally Developed Content is Key for Effective Integration of ICT in Education, Uganda</li> <li>Bettie Rantshabeng: An investigation on the teaching and learning of science in primary schools: A case study of three selected schools in Molepolole-one, Botswana</li> </ol>	<ol> <li>Harris M. Kariuki: The formula for the image point (p,q) of the object point (a,b) in the mirror line y = mx + c, Kenya</li> <li>Remane Selemane, Yuma Takebe, Ryuichi Sugiyama: Pre-service Teacher Education in Mozambique: For Effective Natural Sciences Teacher Development, Mozambique</li> <li>Bessy Tembo, George Chileya &amp; Benson Banda: Teacher Professional Growth in Zambia: A Case of SBCPD in STEM Teaching and Learning, Zambia</li> </ol>	<ol> <li>Chako G. Chako: The constitution of a mathematics explanation in Botswana secondary schools, Ministry of Basic Education, Botswana</li> <li>Cyrus Muigai Kihara, Kevine Otieno, and Rose Masese: Colla- Petitive Strategy for Collaborative Learning Environment in Schools, Kenya</li> <li>Benardicto Ng'oma: Issues relating to inadequate girl-child participation in STEM learning and related activities in Zambia, Kwame</li> </ol>	<ol> <li>Masiliso Kabui, School Based Continuous Assessment in Chemistry Practical Learning: A Case Study of Zambian Education System, Zambia</li> <li>Cedric Mpaso: The Effect of Microscale Experiments on Secondary School Science Teachers' Self- efficacy in Malawi</li> <li>Nyokabi Njuguna: A review of the lessons learnt through the implementation of the Experimento program in low income public primary schools in Nairobi County, Kenya.</li> </ol>	<ol> <li>Sylvanus Watenga, Wakasiaka Eliud Mwichabe, Prof. Julius Maiyo, Dr. Jane Barasa: Analysis of the level of ICT integration in STEM Education secondary schools in Kenya: A case of Bungoma County, Kenya</li> <li>Lemmy Kangwa: The Incorporation of GeoGebra as a Visualizations tool to teach Calculus in Teacher Education Institutions: The Zambian case, Zambia</li> <li>Kellen Kawira Riungu: Student Involvement in Creating Learning</li> </ol>

			Nkrumah University, <b>Zambia</b>				Content for ICT Learning, Kenya
	I	LUN	CH BREAK – TIME: 13.1	5 – 1	4.00		
			PARALLEL SESSIONS TIME: 14.00 – 16.00				
<b>STRAND 1:</b> Teacher Professional Development in Africa: Developing Knowledge, Skills ,and Values in STEM learning/teaching engagements		<b>STRAND 3</b> : School Culture and Learning in STEM		STRAND 4: STEM Curriculum Development, Implementation and Assessment		ST ST	<b>RAND 5</b> : ICT Integration in EM Education
Venue: SUGIYAMA HALL Moderator: Rapporteur:		Vei RO Mo Raj	nue: CHEMISTRY OM derator: oporteur:	Venue: PHYSICS ROOM Moderator: Rapporteur:		Ve Mo Raj	nue: BIOLOGY ROOM oderator: pporteur:
<ol> <li>Paul Odundo: Influence of on implementation of skill b on technical, vocational and</li> <li>Joyce adjekukor; BLESSI of Methods and Materials i Learning of Mathematics in Schools in Ethiope West Lo Delta State, Nigeria</li> <li>Irene N. Gisemba et al: Us of STEM education instruct skills: A case study of the E approach, Kenya</li> </ol>	<sup>2</sup> multimedia technologies based education: focusing l education training, <b>Kenya</b> <b>NG OMOKARO</b> : Problem n the Teaching and n selected Secondary bocal Government Area, se of modern approaches ion to match 21st century experimento Program	<b>1.</b> 2.	Hussein Mwale, Anecetus Moonga and Benson Banda: Leadership for STEM Learning Environment: A Case of Transformation of Selected Schools in Zambia Michael Gaotlhobogwe & Mojwadi L. Gosiame: Causal factors and impact of workplace injuries on teachers' performance: The case of Design and Technology in Botswana, Botswana Hamankolo M.Ngulube: An Examination of the "Situation" of Real Life Application Component of the Rationale during Mathematics Lesson Delivery, Zambia	1. 2. 3.	Kwaleyela Kwaleyela: Quantum Mechanics Symbology: How does it affect students' understanding of Introductory Quantum Mechanics concepts? Zambia Mwape John: Procedural and Conceptual Understanding of Specific Concepts by First Year Mathematics Students' at The University of Zambia Justus Nkhata: Examining the Connection between Mathematics and Science at the Secondary School Level in Malawi: Focusing on the Level of Integration, Malawi	1. 2. <b>3.</b>	Berthasia R. Mwitory: ICT Integration in Teacher Professional Development, Shule Direct, Tanzania Maxwell V. Kayesi; ICT integration best practice and the making of the iToya; Kenya Rachel Kapeko; Reginald Oats; Understanding mobile learning in sub- Saharan Africa: applying and extending the technology acceptance model, Botswana
16:00-16:15	HEALT	H BF	REAK		CEMASTE	A Ho	ospitality

	16:15	15 TOUR TO GIRAFFE CENTRE								
	DAY THREE (19 <sup>th</sup> December, 2019)									
08.	00-08-15	Registration	Registration Team							
00.	.00-00.13	Brief on revised programme	Mr. John Odhiambo							
08.	15 - 08.45	STEM Education: Professional	Dr. Purity Ngina, Strathmore University							
00.	.13 00.+5	experiences								
08.	45 - 09.15	African Union Commission	Mr. Stephens Caseley Olabode							
		Agenda 2063 & CESA (2016-	2016-							
		2025)								
		AUC CESA STEM Cluster,	Mrs. Mary W. Sichangi							
09.	15-10.30	ADEA ICQN-MSE and SMASE-								
		Africa Updates and global position								
			Z TIME: 10 20 11 00 House							
		DAD	A – THATE: 10.50 – 11.00 HOURS							
			ME: 11.00 - 12.00							
ST	RAND 1: Teacher	STRAND 3: School Culture and	STRAND 4: STEM Curriculum	<b>STRAND 5</b> : ICT Integration in STEM						
Pro	ofessional Development in	Learning in STEM	Development, Implementation and Education							
Afr	rica: Developing Knowledge,	e e e e e e e e e e e e e e e e e e e	Assessment							
Ski	ills ,and Values in STEM									
lear	rning/teaching engagements									
Ver	nue: SUGIYAMA HALL	Venue: CHEMISTRY ROOM	Venue: PHYSICS ROOM	Venue: BIOLOGY ROOM						
Mo	oderator:	Moderator:	Moderator:	Moderator:						
Raj	pporteur:	Rapporteur:	Rapporteur:	Rapporteur:						
1.	Prof Kgomotso G.	1. Ivy Bweupe: Challenges	1. Michael Gaotlhobogwe &	1. Sheila.O. Amuko: Students'						
	Garegae; Mr Ofentse P.	Faced by Integrated Science	Mojwadi L. Gosiame: Causal	Attitude towards Learning						
	Phale: Profiling STEM	Teachers in Zambian	factors and impact of workplace	Measurement Concepts; A case						
	teachers' qualifications in	Secondary Schools (A Case	injuries on teachers'	study of Ndii-ini Primary School,						
	Botswana: a fundamental	Study of Kabwe District),	performance: The case of Design	Ruiru sub-county, Kenya. Kenya						
	step to implementing	Zambia 2 Duncen Denkie Segeher	and Technology in Botswana	2. Clemence Chikiwa, Bernard J.						
2	SDG4, Bolswana Chanda Sichular	2. Duncan Darkie Segado: Exploring the use of	2. Sungae, S. S., Son: The Case of	in conceptual teaching of word						
۷.	Integration of learning	Exploring the use of	Konvo	problems in grade 0 mathematics						
	areas in lesson Planning $\Delta$	an Inclusive Junior	A Chino Namakau Sakala and	classes South Africa						
	critique on innovative	Secondary School Science	Benson Banda: Towards	<b>3.</b> Daniel N. Nieru: The Use of a						
1	STEM lessons conducted at	Classroom: Case of	Sustainable STEM Learning	Recommender System in Placement						
	Junior Secondary Schools	Ditheiwane School.	Outcomes in Basic School	of Students in STEM Learning.						
	during KCCP International	Botswana	Mathematics: A Case of	Kenva						
	conferences in Zambia;	3. Daniel Juma, The Nexus	Knowledge Co-Creation Program	<b>v</b> •••						
	Zambia	between STEM, Social	in Africa, Zambia							

		Stability & Develop <b>Kenya</b>	oment.				
					TIME, 10 20 11 00		
Tour of exhibitions		Tour of Exhibitions	ALIH BR	2.	<ul> <li>TIME: 10.30 – 11.00</li> <li>Clara K. Namayanga and Benson Banda, Challenges of Implementing STEM Education in Africa: Experiences of Teacher- Curriculum Reflux in Basic School Science, Zambia</li> <li>Nkoja Khechane and Mamocheta Makara: Do Primary Teachers' Assessmen Practices in Lesotho inform learners' learning of Mathematics? Lesotho</li> <li>Prof Kgomotso G. Garegae; Ma Salome M. Mogotsi: A Comparative study on teacher education systems and practices in SADC countries: implications for SADC teacher education protocol Botswana</li> </ul>	d of n  c d d o t n of s s A s r n or l,	<ol> <li>John Chumo: Utilization of Teaching Models to Support Integration of ICT During Teaching and Learning of Science, Technology, Engineering and Mathematics, Kenya</li> <li>Phillip M. Kalanke: Use of Cell phones as Learning Devices by Schools, Botswana</li> <li>Paul Odundo: budgetary implications on utilization of information communication technologies in biology education in secondary schools, Kenya</li> </ol>
12.00 - 12.30pm			Compilation	n of t	the communiqué	Rap	porteurs
12.30 – 13.00pm			Discussion	and a	adoption of the actionable	Dr.	Benson Banda and Mrs. Mary W.
		T		AK	TIME: 13.00 - 14.00	Sich	laligi
14.00 - 15.00	Closing Cerem	ony	Mi     CH     Mi     CH     Mi     CH     SM     CH     SM     Dr     Af	rs Ly EMA rs. Ja EMA MASI r. Bei frica.	dia Muriithi, Deputy Director, STEA. cinta L. Akatsa, HSC, Director STEA/Executive Secretary, E- Africa. nson Banda, President, SMASE-		<ul> <li>Mrs. Mary W. Sichangi, Head – Partnerships and Linkages, CEMASTEA – Kenya.</li> <li>Mr. John Odhiambo, Chair, Host organising Committee</li> </ul>
15.00 - 16.00	Tour of exhibit	ions and innovations	All delegate	es			
17.30	Reception Dini	ner	Hospitality	Tear	n		

# **Annex 3: List of Participants**

No.	Country	Number of Participants	Paper presenters
1.	Botswana	15	14
2.	Ghana	3	0
3.	Kenya	215	23
4.	Malawi	2	1
5.	Namibia	1	0
6.	Niger	1	0
7.	Nigeria	10	2
8.	South Africa	5	2
9.	Tanzania	1	1
10.	Zambia	15	14
11.	Uganda	4	3
12.	Mozambique	1	0
	TOTAL	273	60

Table below shows distribution of **ALL participants** per country

# The table below shows the list of Paper presenters

NO.	Surname	Other Names	Country	Organization	E-MAIL
1	Baipusi	Tshepo Sharon	Botswana	Ministry of Basic Education	tshepoleepile2014@gmail.com
2	Bhusumane	Alfred	Botswana	Botswana Teachers Union	bhusumanca@gmail.com
3	Chaba	Tawana Nancy	Botswana	Ministry of Basic Education	chabatn16@gmail.com
4	Chako	Chako G.	Botswana	Ministry of Education	chakog@gmail.com
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213	Mdladla	Phathumusa	Rsa	Sci-Bono Disc Center	
214	Zulu	Vincent	Rsa	Sci-Bono Disc Center	vincentzulu@sci.bono.co.za
215	Mkhwane	Fezeka	South africa	Rhodes University	f.mukhwane@ru.ac.sa

# Annex 4: Hospitality

DEPARTMENT	REPORT SECTIONS	ACTUALS
ACCOMMOD-ATION	Number accommodated in CEMASTEA on,	Expected number of participants: 47pax. @ USD. 26
	Dinner, Bed & Breakfast	Actual Participants:
		1day X 1pax =26
		2days X 3pax =156
		3 days X I pax =78
		4 days X10pax=1040
		5days X5 pax = $650$
		6days X 18 pax=2,808
		7day X 2pax=364
		Total paid = USD 5,122
		Interpreters: 4 Pax x 5days x USD 26=
		USD 520
		Security:
		2pax X 4 nights
		@450.00
		3600.00= <b>USD 36</b>
		Drivers:
		10pax X 26 X 6 Days= <b>USD. 1,560</b>
		TOTAL: USD. 7,238
	27 Guests were accommodated in the various hotels	Guests were accommodated in the listed hotels below:
	of their choice.	Corat Africa- 16 Pax
		Weston – 2 Pax
		Acacia- 2 Pax

		Dimesse, Inay
		Janorsh anatmente 2 pay
		Caribu Inn 1 nav
DAV CONFEDENCE		Monarc $-3$ pax
DAY CONFERENCE	Number of participants on day conference package	Expected number of participants: 250pax @ 35 USD
	per day	Day 1: 16/12/19
		CEMASTEA Staff: 89 pax
		Actual Participants :161pax
		Students:41 pax
		Drivers: 20 pax
		Security:10 pax
		Usher: 6pax
		Casuals: 20 pax
		Minister: 1 pax
		Protocol officer: 1 pay
		340 Pox ¥ 35- USD 12 215
		547 1 ax A 55- 05D. 12,215
		Day 2, 17/12/10
		Day 2.17/12/12
		CEMASTEA Stati .07 pax
		Actual Participanis: 95 pax
		Chief guests & LEAM: 4 pax
		Entertainment: 10 pax
		Media:15pax
		Casuals: 20
		Partners: 20 pax
		Ushers: 6 pax
		Students:41 pax
		Drivers:25 pax
		Security:10 pax
		Protocol officer: 1 pax
		Ministers: 3pax
		337 Pax X 35= USD.11.795
		Day 3: 18/12/19
		Staff: 89 pax
		Actual Participants: 135 Pax
		Partners: 20 Pax
		Students: 15nax
		Drivers 25nay
		Sacurity (Doay
		Unborge
		Convolution 20
		Protocol officer: 1 Pax
		Minister: 2 Pax
		323 Pax X35= USD. 11,305.
		$D_{m}$ 4, 10/12/10
		Duy 4, 17/12/17 Staff: 90 Day
		Stat1. 07 Fax

		Actual Participants: 98 Pax
		Partners: 20pax
		Students:15pax
		Drivers :25 Pax
		Security:10
		Chief guest: 1 pax
		Protocol officer: 1 pax
		Minister: 1 pax
		260 X 35= USD. 9,100 +
		entertainment @ 200
		= USD. 9,300
		Day 5: 20/12/19
		CEMASTEA Staff: 89 Pax
		Drivers: 22 Pax
		111 X 35=USD 3,885
		TOTAL DAY CONEFENCE: USD. 48,500
	Reception Dinner	Food: 260 Pax @ USD.40 =
	*	USD. 10,400
		Drinks: 12 Boxes of white and red wine @ USD.40=
		USD. 480
		Subtotal: USD. 10,880
EXCURSION: TRIP TO		Packed lunch
MAGADI		95 Pax @ USD. 5= <b>USD. 455</b>
		(1 Full 52 seater bus.
		1 Full 33 seater bus,
		1 chase car= 8pax)
		Subtotal: USD. 455

#### **Points to note:**

- 1. Accommodation =USD. 7,238
- **2.** Day conference = **USD. 48,500**
- 3. Reception Dinner = **USD. 10,880**
- 4. Excursion: Trip to Magadi= **USD. 455**
- 5. CEMASTEA catered for the accommodation of 3 guests. (Two (2) from the African Union Commission & One (1) from Kenya

	<b>8 a a a b a b a b b b b b b b b b b</b>							
Country	Name	Category	Flight	Terminal	Accommodation	Departure Date	Departure Time	Driver
Zambia	Benson Banda	President,	ET 306	1C		21-Sec-2019		Omondi
		SMASE-Africa						
Mozambique	Sarifa Abdulmajilde Fagilde	Vice President,	KQ741	1A	CORAT	21-Dec-19	16:15 hrs	Rose
		SMASE-Africa						
South Africa	Fezeka Felicia Mkhwane	Participant	KQ 761	1A	Bankhouse retreat,	19-Dec-19	07:45 hrs	Robert
					Karen			

#### Annex 5: Logistics (Transport), Security, and Protocol

							0 - 0 0 4	
Uganda	Kabuye Batiibwe Sara Marjorie	Participant	RwandaAir 464	1A	CEMASTEA	19-Dec-19	05:00 hrs	Chate
Tanzania	Mwitori Berthasia Richard	Participant	KQ 481	1A	CEMASTEA	20-Dec-19	18:15 hrs	Patricia
South Africa	Phillip Dikgomo	Participant	SA 184	1A		20-Dec-19	15:45 hrs	Chate
Zambia	Kangwa Lemmy	Participant	KQ 727		CEMASTEA	20-Dec-19	08:30 hrs	Evans
Uganda	Caroline Taliba	Delegate	RwandaAir 464		CEMASTEA	20-Dec-19	05:00 hrs	Brian
Zambia	Malambo Priestly	Participant	KQ706	1A		20-Dec-19	13:40 hrs	Olekima
Botswana	Ms Tawana Chaba	Participant	KQ763	1A		21-Dec-19	07:45 hrs	Timothy
Botswana	Mr Pelotlhomogi Modise	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Ms Masi Onalenna Sithole	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Mr Moagedi Kereeditse	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Ms Tebogo Molebatsi	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Ms Tshepo S. Leepile-Baipusi	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Ms Olga Taolo	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Mr Mmoloki Dithebe	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Mr Phillip M. Kalanke	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Mr Ndondo Koolese	Delegate	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Dr Spar Mathews	Delegate	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Dr Shana Suping	Participant	KQ763	1A	CORAT	21-Dec-19	07:45 hrs	Timothy
Botswana	Chako Gaothobogwe	Participant	ET 318	1C	CORAT	21-Dec-19	05:00 hrs	Gakuru
Nigeria	Mashat Margaret Emmanuel	Participant	WB464 (Operated by Rwandair Express)		CEMASTEA	21-Dec-19	21:00 hrs	Brian
Nigeria	Nathaniel Enock Olusola	Participant	WB464 (Operated by Rwandair Express)		CEMASTEA	21-Dec-19	21:00 hrs	Brian
Nigeria	Olaoye Emmanuel Oluwafemi	Participant	WB464 (Operated by Rwandair Express)		CEMASTEA	21-Dec-19	21:00 hrs	Brian
Nigeria	Egemba Udochukwu Gabriel	Participant	WB464 (Operated by Rwandair Express)		CEMASTEA	21-Dec-19	21:00 hrs	Brian

Nigeria	Adekoya Seidino Hamza	Participant	WB464		CEMASTEA	21-Dec-19	21:00 hrs	Brian
		-	(Operated by					
			Rwandair					
			Express)					
Nigeria	Ahmed Isa	Participant	Ethiopian		CEMASTEA	21-Dec-19	19:15 hrs	Omondi
Migonio	Mahammad Halraam	D-stigingent	Airlines ET 518		CEMASTEA	21 Dec 10	10.15 hrs	Omandi
Nigeria	Мипаттеа накеет	Participant	Airlines ET 318		CEWIASTEA	21-Dec-19	19:15 nrs	Omondi
Niger	Alhousseini Mamane	Delegate	Ethiopian Airlines ET 308	1C	CEMASTEA	21-Dec-19	05:00 hrs	Robert
South Africa	Gallie Muavia	Delegate	South African Airways SA184	1A	CORAT	21-Dec-19	15:45 hrs	Olekima
Zambia	Kwaleyela Kwaleyela	Participant	Ethiopian Airlines ET50		CEMASTEA	21-Dec-19	06:15 hrs	Koskei
Zambia	Bessie Tembo	Delegate			CEMASTEA	21-Dec-19	07:00 hrs	Nicodemus
Zambia	Anecetus Moonga	Participant			CEMASTEA	21-Dec-19	07:00 hrs	Nicodemus
Zambia	Clara Namayanga	Participant			CEMASTEA	21-Dec-19	07:00 hrs	Nicodemus
Zambia	Chipo N. Sakala	Participant			CEMASTEA	21-Dec-19	07:00 hrs	Nicodemus
Zambia	Hussein Mwale	Participant			CEMASTEA	21-Dec-19	07:00 hrs	Nicodemus
Zambia	Chileya George	Participant	KQ 706	1A	ACCACIA	21-Dec-19	13:40 hrs	William
Zambia	Sekiguchi Yumi	Participant	KQ 706	1A	WESTON	21-Dec-19	13:40 hrs	William
Zambia	Tindi Edward	Participant	KQ 706	1A	ACCACIA	21-Dec-19	13:40 hrs	William
Zambia	Samuel Chingi	Participant	ET 50		DIMESSE	21-Dec-19	07:00 hrs	Nicodemus
South Africa	Vincent Nkosinathi Zulu	Participant	SA 184	1A		21-Dec-19	15:45 hrs	Olekima
South Africa	Emmanuel Phathumusa Mdladla	Participant	SA 184	1A		21-Dec-19	15:45 hrs	Olekima
Ghana	Sackey Patrick	Participant	KQ505		JANORAH APARTMENTS	21-Dec-19	08:10 hrs	Chate
Uganda	Nannyonga Kivumbi Betty	Participant	RwandaAir 464	1A	CEMASTEA	21-Dec-19	05:00 hrs	Robert
Botswana	Alfred Bhusumane	Participant	ET 308	1C	CORAT	21-Dec-19	05:00 hrs	Gakuru
Malawi	Alfred Kamoto	Delegate	ET 050			21-Dec-19	07:00 hrs	Nicodemus
Ethiopia	Caseley Olabode Stephens	Delegate	KQ403	1A		21-Dec-19	07:05 hrs	Nicodemus
Nigeria	Taiwo	Participant	WB452	1A	Qaribu Inn, Loresho off waiyaki way	21-Dec-19	21:00 hrs	Brian
Malawi	Justus Nkhata	Participant	ET 050			21-Dec-19	07:00 hrs	Nicodemus
Nigeria	Hafsat Lawal Kontagora	Participant	Rwandair WB 452	1A		22-Dec-19	21:00 hrs	Evans
Nigeria	Ibrahim Sani	Participant	Rwandair WB 452	1A		22-Dec-19	21:00 hrs	Evans
Namibia	Leopoldine Mwitidhandje Nakashole	Delegate	South African Airways SA180	1E	CORAT	22-Dec-19	08:35 hrs	Kiuna

South Africa	Clemence Chikiwa	Participant	SA 180	1E		22-Dec-19	08:35 hrs	Kiuna
Ghana	Ayikwei-Awulley Adokwei	Participant			JANORAH			
					APARTMENTS			
Ethiopia	Mich Seth AU	Participant						

**Annex 6: Conference Communique** 

# THE 17<sup>TH</sup> CONFERENCE ON MATHEMATICS, SCIENCE AND TECHNOLOGY EDUCATION IN AFRICA (COMSTEDA 17)

# CEMASTEA, KAREN-NAIROBI, KENYA ON 16 – 20 DECEMBER, 2019

**THEME:** "Teacher Professional Development In Africa: Knowledge, Skills, Values & Attitudes In Stem Learning Environments"

#### PREAMBLE

The Strengthening of Mathematics, Science and Technology Education in Africa (SMASE-Africa) in collaboration with the Ministry of Education – Kenya through the Centre for Mathematics, Science and Technology Education in Africa (CEMASTEA) successfully organized the 17<sup>th</sup> Conference on Mathematics, Science, and Technology Education in Africa (COMSTEDA 17) in Nairobi, Kenya. COMSTEDA17 provided a platform for educators to interrogate issues, share ideas on best and promising practices, challenges relating to teaching and learning of mathematics, science and technology education in respective countries and contexts to improve the quality of education.

**OPENING CEREMONY**: The opening ceremony was graced by the Minister of Education, Kenya represented by Dr. Belio R. Kipsang, the Principal Secretary, Early learning and Basic Education. In his opening remarks, he reiterated the importance of STEM education in enhancing national development. He noted that the conference provided an excellent opportunity for sharing practical and evidence-based research outcomes, and best practices. He said that STEM-based innovations control social economic status and Africa is in the process of adopting it. He challenged delegates to equip young people in STEM education because it will ensure that they become job creators. Most countries are aligning their education systems to competence based curriculums. In Kenya for instance CBC is designed to develop competencies, skills, knowledge, core values and application to real life situations and STEM is one of the pathways.

**KEYNOTE SPEECHES**: The keynote speakers were slotted for each of the conference days as follows

1. Dr. Muavia Gallie – School Turn around Foundation, South Africa, on the topic: "Reengineering approaches in education systems and schools: Towards Model STEM Schools".

- 2. Prof Genevieve Wanjala University of Nairobi, Kenya, on the topic: "STEM Education in Africa – Professional Experience"
- 3. Dr. Purity Ngina Strathmore University, Kenya on the topic; "STEM Education: Professional experiences".

**PARTICIPATION**: The conference was attended by ministers and directors in charge of education, educators, policymakers, researchers, teachers, NGOs, public/private sector stakeholders drawn from African countries and other internationals. The delegates drawn from 12 counties namely: Kenya, Botswana, Namibia, Malawi, Nigeria, South Africa, Uganda, Zambia, Mozambique, Niger, Tanzania, and Malawi numbered 208 out of expected 250 which was 83.2% turn out. The ministers of education included; Hon Dr. John Chrysostom Muyingo, Minister of Higher Education, Uganda; Hon Makwinja Tebogo, Assistant Minister of Basic Education - Botswana; Hon. David Mabumba, Minister of General Education - Zambia. Other organizations represented in the conference were; African Union Commission Head Quarters - Ethiopia, Siemens Stifftung - Kenya, Coalition of Concerned Teachers – Ghana, Education department of the Ministry of Defence Army – Nigeria, Snaplify, Allan and Gill Philanthropy, Sci-Bono Discovery Centre - South Africa, Science Equipment Production Unit – Kenya, AFEW – Kenya, Public and Private Universities, Global Minimum, Global Peace Foundation - Kenya, and Shule Direct – Tanzania.

**SMASE-AFRICA NETWORK:** Started in the year 2001 as an initiative for addressing challenges facing mathematics and science education in Africa. SMASE-Africa regional secretariat is hosted at CEMASTEA with offices inside the University of Nairobi - Kenya Science Campus. Officials of the network include the SMASE-Africa President, Dr. Benson Banda (Zambia), Vice President, Prof. Sarifa Fagilde (Mozambique), Executive Secretary, Mrs. Jacinta L. Akatsa (Kenya) and the treasurer Mrs. Mary W. Sichangi (Kenya). The Patron is the Minister of Education, Kenya. SMASE-Africa is a member of the African Union Continental Education Strategy for Africa's (CESA) Teacher development and STEM education clusters. The Conference on Mathematics, Science and Technology Education in Africa (COMSTEDA) is one of the SMASE-Africa programs designed as an annual continental platform since 2001-2013 formerly SMASE-WECSA regional conference which was changed to COMSTEDA in 2014. COMSTEDA 14, (2016) was held in Kenya; COMSTEDA 15, (2017) in Zambia; COMSTEDA 16, (2018) in Botswana and COMSTEDA 17, (2019) in Kenya.

This is to acknowledge and laud the commitment of the Governments of Africa towards improving STEM Education, and commend the tremendous and significant efforts by member countries to enhance the quality of education. This is mainly through curricula reforms and building STEM capacities by way of teacher professional development programs, and ICT integration in teaching and learning. Some countries have introduced model STEM Centers of excellence to spur uptake of related careers. ICT integration programs have led to enhanced teachers' pedagogical skills and knowledge. Member countries that started similar programs with support of development partners have since established strategies to sustain the programs.

# SYNDICATE PAPER PRESENTATIONS

**COMSTEDA 17** provided an opportunity for delegates to discuss various aspects of STEM education under the five strands below:

- Strand 1: Teacher Professional Development in Africa: Developing Knowledge, Skills, and Values in STEM learning/teaching engagements
- Strand 2: Role of Professional Associations in STEM Teaching and Learning
- Strand 3: School Culture and Learning in STEM
- Strand 4: STEM Curriculum Development, Implementation and Assessment
- Strand 5: ICT Integration in STEM Education

**COMSTEDA 17** forum received one hundred and eighteen (118) papers on topics related to the conference theme and strands, out of which one hundred and thirteen (113) were accepted for inclusion in the conference proceedings. The papers were of high quality and scholarly presented. Informed by evidence, we note that despite the progress made so far, some challenges still need to be addressed.

**RESOLUTIONS**: We SMASE Africa Association Executive Committee, delegates, and conference participants hereby re-affirm our commitment to adopt these priorities into the national programs, and use them as a measure of progress in the next steps towards successful enhancement of STEM Education in African countries

- 1. Encourage learning from each other and work together to address common challenges
- 2. Enhance inter-agency collaboration including professional associations in the delivery of programs to create synergy and avoid duplication.
- 3. Embrace an all-inclusive education to integrate the learners with special needs in STEM education
- 4. Expand space for in and out of school STEM learning application by encouraging educators, learners, and out of school youths to come up with original ideas through STEM fairs, STEM weeks, STEM Community outreaches, and STEM clubs
- 5. Leverage on the relationship between culture, politics and education systems to have a symbiotic relationship to promote STEM education and school performance
- 6. Strengthen pre-service and in-service education to position them to better equip teachers to implement STEM education
- 7. Develop, implement, access and evaluate STEM policy and practice framework through the resolutions and recommendations.
- 8. Increase access to STEM Education and management of STEM schools by expanding space for in and out of school STEM learning application by encouraging educators, learners, and out of school youths to come up with original ideas, capacity-build them on how to present their innovative ideas through STEM fairs, STEM weeks, STEM Community outreaches, and STEM clubs.
- 9. Promote transformative leadership and management of schools for full exploitation of the potential and resources lying within our schools for more effective delivery of STEM education.
- 10. Design of programs should place the teacher at the centre to create ownership

- 11. Foster assessment practices that motivate all learners to excel without alienating weaker students. There is need to explore ways of conducting assessments without demotivating learners through blending collaboration and competition to realize the best of both worlds
- 12. Enhance collaboration and consultations between country curriculum and assessment bodies
- 13. Strengthen collaboration between in-service and pre-service teacher training to ensure correlation in terms of subject matter and pedagogical skills.
- 14. Repackage teacher training curriculum and content to focus more on preparing them to deliver school level content. Enrich teacher-centered methods that fail to equip learners with critical thinking and problem solving skills
- 15. Exploit the full potential of ICT technologies to improve quality of education by expanding and improving infrastructure, internet connectivity, capacity building of teachers, and creating local content
- 16. Retain the structure of COMSTEDA forums with a view to enhance STEM education practices in member countries
- 17. Appoint a Minister responsible for education on a rotational basis to serve as an ambassador championing STEM education agenda in Africa.

**RECOMMENDATIONS:** We SMASE-Africa make the following recommendations to our respective Governments, organizations and partners:

Item	Recommendations
1.	Institute a clear policy on teacher deployment, status, working conditions, work load for facilitating
	high quality teaching standards in STEM education
2.	Strengthen the link between pre-service and in-service education to equip teachers to implement
	STEM education
3.	Develop, implement, access and evaluate STEM policy and practice framework through the
	resolutions and recommendations.
4.	Exploit the full potential of ICT technologies to improve quality of education by expanding and
	improving infrastructure, internet connectivity, capacity building of teachers and creating local
	content
5.	Establish and integrate the STEM culture and curriculum that promotes early identification of talents
	through establishment of STEM centres of excellence, science amusement parks and museums
6.	Regularize the process of identification and documentation of indigenous knowledge systems;
	provision of opportunities for community service learning; and establishment of STEM clubs and
	makerspaces in schools
7.	Enforce professional development of teachers and use it in upgrading, and renewal of teaching license
8.	Prioritize preparation in STEM education to ensure that teachers have the much needed skills, and
	benefit from supportive leadership and linkage with the industry
9.	Develop policies to support and encourage education innovation, while safeguarding intellectual
	property rights
10.	Teacher motivation should include; working and living conditions, celebration and
	reward
11.	Institutionalize policies that identify and reward student's creativity and innovation in STEM
	education

Mission: To promote effective classroom practices in Science, Technology, Engineering and Mathematics education through research, fostering relevant policies, networking, collaboration, advocacy and capacity building in Africa