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EDITORIAL

STEM Journal of Anambra STAN (STEMJAS) is a publication of **Science Teachers Association of Nigeria, Anambra State Chapter**. STEMJAS is developed to disseminate information on Science, Technology, Engineering and Mathematics (STEM) to teachers, teacher-trainers, researchers and other interested persons. Articles that are of relevance to STEM education are published in this journal.

We are grateful to the contributors and hope that our readers will enjoy reading these contributions.

Prof. Rita N. Nnorom

Editor-in-Chief



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**CONTAINING THE IMPACTS OF COVID-19 PANDEMIC: A STEP
TOWARDS SUSTAINING BASIC SCIENTIFIC AND TECHNOLOGICAL
SKILL ACQUISITION IN THE SOCIETY**

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Abstract

The study discussed how to contain the impacts of COVID-19 pandemic: a step towards sustaining Basic Scientific and Technological skill acquisition in the society. The global emergencies caused by covid-19 and how it has affected educational systems of developing nations were explored. The crisis has exposed the inadequacies and inequities in educational systems of the world; and necessitated greater research on content delivery models that rely on mixed modes. Rationale for Basic Science and Technology skill acquisition by learners and impact expected on society were highlighted respectively. Implications of COVID-19 pandemic for the development of the total person and the development of scientific methods, processes, attitudes and products were pointed out. Some ways of controlling the impact of COVID-19 pandemic were outlined with particular mention of measures proffered by Global Campaign for Education. Recommendations were made accordingly which among others include the need for stakeholders of science, technology, engineering and mathematics (STEM) to work in synergy with technical and vocational education and training (TVET) to design new learning platforms and innovative applications meant to provide virtual learning experience and society members being prepared to improve their lives on coping with the emerging crisis.

Keywords: Impacts, COVID-19, Pandemic, Sustainable BST, Skill acquisition



Introduction

The impacts of COVID-19 on nations of the world since its outbreak in 2019 have been monumental, devastating and still reverberating globally. Though some countries were hit much harder than others, the entire global community was impacted by humanitarian crisis and emergencies. Millions have been infected; and hundreds of thousands have died based on global statistics. The adverse effects of the Pandemic worsened the already existing problems besieging nations which include unemployment, poverty, natural disasters, chronic diseases, rising crime wave, gender-based violence, terrorism, armed conflicts, famine and environmental problems. Nations are presently grappling with consequences of the pandemic regarding economic, social recovery and survival strategies. Virtually all sectors were affected by lockdown including the educational sector. As affirmed by Global Campaign for Education (GCE, 2020) and Su Jeong and Gonzalez- Gomez (2021), the teaching-learning systems of the world have been critically hit with havoc wreaked by the pandemic. Teaching and learning techniques, educational institutions (primary/ basic education, secondary /high schools, colleges and tertiary institutions of different kinds) and learners were adversely affected.

The United Nations' Educational Scientific and Cultural Organization (UNESCO, 2021) reported that learners in hundreds of millions all over the world were thrown out of classes due to implementation of social distancing and localized schools' closure. The weak resilience in educational systems of developing nations led to total school closure at various levels and times. Learners in disadvantaged backgrounds were shut out of learning due to schools' shut down. The inadequacies and inequities in the education systems were exposed – from access to the broadband, supportive environment and computers needed for on-line education. It also exposed teachers' non-acquisition and lack of preparedness to support digital learning (Schleicher, 2020). The need to equip young adults with creative sustainable skills and entrepreneurship became more glaring with the pandemic situation. The cost of schools' closure on learners' health and well- being have been terrific and difficult to quantify. Though courses were provided on national radio and television stations for pupils and students in final year and examinations classes in some countries, particularly the developing countries, the effectiveness was questionable (not significantly felt.). Sufficient contingency arrangements (have not been) were not made on how to ensure the right to education of learners even in the midst of recovery from the crisis. Granted that the right to education is central to every child's development, safety and well- being,



resources and expertise are not enough to address the impact of covid-19 on education (UNICEF, 2021). There is an urgent need for synergy to find appropriate solution and mitigating measures to children's right to education in these challenging times.

Rationale for Basic Science & Technology (BST) Skill Acquisition by Learners

Transition to a resilient and inclusive recovery of nations hit by the covid-19 crisis can be facilitated and strengthened through science, technology, engineering and mathematics (STEM) education on one hand working in synergy with technical and vocational education and training (TVET) on the other hand. The need for developing nations to leverage on multi- pronged approach spurred on by scientific and technological innovations and collaborations cannot be treated with levity (Bilombo Bazedimba, 2021). BST education is an interdisciplinary approach targeted at offering students the best opportunities for making sense of the world holistically and engendering research outputs. As defined by Okafor and Ndunachi (2016), science, technology, engineering and mathematics (STEM), like BST is a concept that covers the actions of critical thinking, analysis and collaboration used by learners to incorporate the actions and ideas of the real world. It is an approach to learning that puts together the four disciplines as one unified teaching and learning concept with aims of removing the conventional barriers that separate the four disciplines. It is seen by Agu and Isei (2018) as a unique approach to teaching and learning which develops creative thinkers, problem solving skills and resilience to meet the challenges of the real world.

Impacts of STEM is evident in the manufacture of new products urgently needed to contend with the pandemic crisis, such as the hydro- alcoholic gel, personal protective equipment (PPE), face shields using 3D printing technology, ventilators, tele-work solutions and retail mobile applications. Learners' acquisition of critical thinking skills and processes at all levels of STEM education; particularly at the Basic education level becomes imperative. Once these skills are mastered, they can be transferred among content units to form the basis for further study of STEM, as well as basis for preparation of new products.

In recognition of the relevance of STEM at all levels of Nigerian education sector, the National Policy on Education of the Federal Republic of Nigeria prescribed the inculcation of the spirit of inquiry and creativity through the exploration of the environment (FRN, 2014). The philosophy of Science and Technology Education (S &



TE), Federal Ministry of Education (FME, 2018) offered the guidelines, objectives, structures, standards, strategies and management for actualizing the national goals of S &TE in Nigeria. It is meant to be operated within the framework of the National Policy on Education (NPE) and other bilateral agreements and international treaties that affect S &TE to which Nigeria is a signatory.

STEM plays a critical role in sustaining research efforts geared towards solving myriads of problems confronting humanity of which COVID-19 is no exception. In other words, the relationship between scientific attitudes, science process skills and STEM education research is intimate. It is therefore no coincidence the government efforts in containing COVID-19 pandemic particularly in developed countries were directed at scientific researches and development. Hence, vaccines, hydro- alcoholic gel, personal protective equipment (PPE), face shields made using 3D printing technology, ventilators and numerous other STEM- based laboratory interventions were being made handy to contain the pandemic. It was perhaps, in this regard that Anaekwe and Ezeuchu (2015) asserted that in the teaching- learning of basic science subjects, (such as Basic Science and Technology at Basic education level and Physics, Chemistry and Biology at the Senior Secondary school level), it is expected of the teacher to facilitate the acquisition of science process skills by:

- Exposing students to hands-on demonstration experiments,
- Using examples derivable from real life situations, the homes, industries and immediate environment,
- Encouraging students' active participation in the instructional process, and
- Enabling learners become problem- solvers, innovators, self- reliant, logical thinkers and technologically literate individuals. Through guided discovery approach, learners are provided with continuous experiences in skills of defining problems, recognizing assumptions, critical thinking, hypothesizing, collecting and recording data, testing and evaluating evidence, manipulating variables, generalizing and applying generalizations, all of which are critical components of science process skills.

Basic Scientific and Technological Literacy and Society

Scientific literacy is the basic knowledge of the systematic procedure which scientists adopt in carrying out investigations about the natural phenomena and changes made to the natural world through human activity (Onoja &Toryem, 2017). Students become



enlightened on scientific literacy as they learn concepts in the Basic Science and Technology subject. Apart from learning about scientific processes, they also acquire the attitudes of scientists and apply them in everyday life's activities. Similarly, through inter- personal relations, useful scientific traits are internalized by other members of the society. Integrating socio- scientific issues in BST provide an ideal context for enhancing students' and teachers' understandings of the nature of science (Otuka & Uzoечи, 2014).

COVID-19 pandemic provides a classical scenario for advocating the need for Science and Technology in Society (STS), which is a primary goal of BST. This is because it helps to foster scientific literacy in the society at this troubled times. A scientifically literate populace would have stronger understanding and high perception based on ideas derived from science to be able to navigate decisions being made due to the crisis. It would also enable them adjust wisely to changing situations and guidelines for healthy living in the society. Again, concepts, values, critical thinking skills and processes derived from science, according to Sadler (2021) would help members of the society make responsible decisions to navigate and make sense of the uncertainties presented by the pandemic era.

Connections that exist between global issues and the students themselves are envisioned by students. Science Literacy might help students and their teachers develop a better foundation for understanding traditional science content, in addition to enabling students and the general public to be better informed decision- makers and consumer of STEM products and services.

Implications of COVID-19 Pandemic for the Development of the Total Person

Total person in the context of this paper refers to the development of human person that is adequately versed in the cognitive (head), psychomotor (hand) and affective (heart) dimensions of learning. In other words, the person is comprehensively amenable to all dimensions of human development. The underlying goal of science to society and individual members in the community is basically to produce useful models of reality targeted at solving problems facing humanity in the environment, such as the current one posed by covid-19. Related hypotheses are formed and analyzed based on observations made of the world; from the hypotheses, general theories are formulated for the benefit of the society and solution to human problems (Otuka & Uzoечи, 2014). In this regard, the cognitive process of critical thinking sees to sound and critical



reasoning in the direction of the cause, symptoms, spread pattern, control and preventive measures towards the pandemic. The affective dimension derived from scientific attitudes enables the scientifically literate citizenry to imbibe positive attitudes towards patients or victims of the pandemic. This will as well enable the citizenry appreciate the happenings and be enlightened that events have cause and effect. Superstitious beliefs are dispelled and mysteries behind the impacts and prescriptions being advocated to control and mitigate the effects of the pandemic (such as vaccination and other protective/ preventive measures being suggested) are easily understood.

The third dimension of human development which is useful in a pandemic era is the psychomotor domain which strives towards skill acquisition. Scientific skills inculcated into learners find useful application during the pandemic era. Members of the populace can be better equipped to be able to navigate through the uncertainties occasioned by the crisis. Conventional ways of doing things are being replaced by innovative and creative approaches due to the exigencies of the era. Psychomotor skills play useful roles to aid experimental investigations.

Implications of COVID-19 Pandemic for the Development of Scientific Methods, Processes, Attitudes and Products

Scientific method asserts that students ought to be active learners in the classroom and beyond. Problems to be investigated must somehow be linked to students' experiences within their intellectual capacity. Dewey's popular motto, "Learning by doing" as captured by Wolske (2015) strives to engage students in hands- on activities with objects, materials, phenomena and ideals to make them draw meaning and understanding from those experiences. Laboratory strategy requires students to become active participants instead of being passive learners whose role is only to sit and listen to lectures. This strategy, according to Liga and Emaikwu (2015) has the potentials to be useful especially in the acquisition of science process skills. Virtual learning recommends that Content delivery models that would rely on mixed modes including prints, audio, visual, and audio- visual. This is to adequately cater for the individual differences in teaching and learning approaches. Similarly, on-line or virtual learning approaches consisting of both synchronous and asynchronous models are useful BST teaching approaches popularized by the COVID-19 pandemic especially in developing countries.



Science processes skills are various mental and motor skills which the scientist usually display and use to arrive at a new knowledge (Asim, 2012). The ways, means and techniques of gathering knowledge or information about the environment with a view to solving problems are referred to as scientific processes (skills). Acquisition of science process skills is of critical importance in learning and application of science concepts and principles, thereby helping learners in making discoveries, solving problems, producing new products and advancing the STEM enterprise. They are very important determinants of students' success in science especially the practical aspect. Such processes (skills) include: observing, measuring, identifying and controlling variables, counting, hypothesizing, experimenting, manipulating, classifying, comparing, collecting data, controlling variables and reporting. Others are analyzing, drawing conclusion, inferring, interpreting data, verifying, predicting, generalizing, communicating and raising questions. The process skills can be grouped into two – the basic processes and the integrative processes (Anaeke and Ezeuchu 2015). The teachers' expertise in effectively enriching classroom instructions with hands-on and manipulative activities as well as utilizing efficacious instructional techniques has a lot of role to play, irrespective of subject- area of specialization.

Scientific attitudes are predispositions developed by scientists to act or behave in particular ways (Otuka & Uzoechi, 2014). These attitudes have become code of conduct for scientists in scientific investigations and research. The extent or degree to which these attitudes are manifested while carrying out scientific investigations and experiments determines the level of accuracy of results obtained and the significance of the discoveries made. The scientist is inquisitive, curious minded, eager to recognize new changes in the environment and able to speculate about the natural world. In course of the pandemic era, scientific attitudes of honesty, self- criticism, curiosity, sound judgment, skepticism, patience, objectivity, analytical attitude, open- mindedness, suspended judgment, self- control, idea sharing, rationality, critical mindedness, discipline, parsimony and persistence are critical indices for containing the pandemic through effective study of BST. It is expected that BST teachers in the post COVID-19 era should give due attention to these traits.

Scientific products are many and varied. They are the tangible outcomes of scientific investigative processes and endeavours. In the face of containing the pandemic, vaccines were developed as a result of intensive laboratory researches and analysis. Medications of assorted types- (gel, injections, syrups, tablets, etc) have been developed and aimed at boosting immunity of the body to fight the virus. It is only



expected that adequate fund be made available to sustain the tempo of researches to produce more medications to contain the pandemic.

Controlling the Impact of COVID-19 Pandemic:

Mitigating measures for COVID-19 pandemic in the society need to be collectively devised by governments of nations, civil societies, communities, professionals, socio-cultural groups and individuals at large. The following measures have been proffered (Global Campaign for Education/ GCE, 2020):

- Include education in the initial phase of covid-19 emergency response policies.
- Ensure the mapping out of proper financial, material and technical/ human resources for education.
- Expand the horizon of various supports to education in the crisis recovery strategies. Future of the next generation is dependent on it.
- Reduce the pressure on teachers, schools and educational systems that volunteer to render extra help in form of concessions.
- Create conducive environment for the operation of civil society movements and concerned stakeholders that define and promote free quality and public education as fundamental human right and a key to sustainable socio-economic development and health improvement of the citizenry.
- Ensure speedy return to in- person learning and access to remote learning of children.

Conclusion

Priority on STEM education might help in re-shaping the entire educational system and re-orientating it towards skill acquisition, job creation and making it a life- long process. Young school leavers need to be equipped with high quality tools and skills to make them self- reliant and useful in the job market. Diversification will be made easy for workers in case of future disruption in work process due to emergencies occasioned by the likes of covid-19. The gap created in digital enlightenment among citizens of the global community can be bridged through STEM education and recovery process fastened up. Access to digital infrastructure and broadband knowledge acquisition can be made affordable and reliable through teaching –learning driven by STEM. The different challenges posed by covid-19 can be transformed into opportunities through



STEM education. In addition to various e-learning models, on-line and virtual teaching resources being advocated alongside with the information and communication technologies (ICTs) that allow flexible and relevant student- focused education, the inculcation of science processes skills and attitudes will help students and society members navigate decisions relating to the pandemic era.

Recommendations

Based on foregoing discussions, it is suggested that:

1. Stakeholders in STEM and TVET need to design new learning platforms and innovative applications meant to provide virtual learning experiences.
2. Individual members of the society should be prepared for responsibility to improve their lives and cope with the emerging crisis.
3. Efforts geared towards recovery in post- covid-19 era and a frontline approach to mitigate the effects of the pandemic including the use of augmented reality, artificial intelligence, robotics and automation should be well funded by government for sustainability.
4. At the economic level, government should liberalize the mobile money payment system to ease sending remittance with a tendency for cashless economy via the recently launched e- naira system (CBN, 2021).
5. As new job opportunities and socio- economic problems emerge due to the pandemic era, up-coming graduates and school leavers need to make themselves saleable in the competitive job market by embracing the acquisition of intensive soft- skills.



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