International Journal of Education, Learning and Development
Vol.7, No.1, pp.1-11, January 2018
Published by European Centre for Research Training and Development UK (www.eajournals.org)

SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) EDUCATION: A CATALYST FOR ENTREPRENEURSHIP AND ECONOMIC GROWTH IN NIGERIA

Dr. Akano Benedict Ubawuike

Department of Physics, Federal College of Education, Kontagora

ABSTRACT: *Equipping learners with the 21st century skills is the current pursuit of nations of the world wishing to maintain global leadership and cutting-edge economic competitiveness. These nations now see Science, Technology, Engineering and Mathematics (STEM) education as an option for equipping their up-coming generations with problem solving skills and potentials for becoming innovators and entrepreneurs of tomorrow. This paper explains the concept of Nigerian economic recession and its remote causes. It also explains the STEM education as a meta-discipline which is taught as an integrated subject abroad but is yet to take root in Nigeria. The author presents STEM education as the foundation for innovation, entrepreneurship and work place skill required to boost the economy of Nigeria so as to diversify her economy from oil dependence and combat youth unemployment. It concludes with suggestions of what Nigeria ought to do at this time to reposition STEM education to achieve economic recovery.*

KEYWORDS: Economic Growth, Science, Entrepreneurship, Technology, Engineering, Mathematics Education

INTRODUCTION

Economic recession is a period of an economic downturn or decline in a nation and it is characterised by fall in the Gross Domestic Product (GDP), high rate of inflation, unemployment and decline in income, etc. According to the Investopedia (2017) the National Bureau of Research NBER defines economic recession as ‘’a significant decline in a nation’s economic activity which spreads across the economy, lasting more than a few months and normally visible in real GDP, income, employment, industrial production and wholesale-retail sales’’. The Gross Domestic Product according to the Wikipedia (2017) is defined as the total monetary value in dollars of all finished goods and services produced within the boarder of a particular country during a period of one year or a quarter. It is like a barometer for gauging the health of the economy of a country.

A recession in specific terms therefore occurs when a country’s Gross Domestic Product diminishes in two consecutive quarters. The Nigerian Economy was therefore said to have officially gone into recession on the account of her GDP declining in two consecutive quarters. The report of the National Bureau of Statistics according to the Vanguard Newspaper of 31st August, 2016, revealed that the GDP in the second quarter of 2016 recorded -1.5%, which was 1.7% lower than a negative growth rate of -0.36% recorded in the preceding quarter. With this report, the die was cast and the final official nail driven to the casket of an ailing and long bedridden economy that has solely depended on oil generated revenue.

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Some of the major immediate causes of the recession as noted by Noko (2016) and Orode (2016) are due to;

- ❖ Poor economic planning which manifested in budget delays and bad exchange rate policy;
- ❖ Fiat implementation of the Treasury Single Account (TSA);
- ❖ Government crackdown and cancelation of pipeline contracts which escalated militancy in the Niger Delta region and this implies a concomitant reduction in oil production and export;
- ❖ Nigeria's over dependence in foreign finished goods and services;
- ❖ Poor economic management of the Nigerian economy by CBN and other members of our economic team etc.

To discerning Nigerians, the recession has not come as a surprise, but was a disaster going to happen. Firstly, based on its early indicators such as unemployment, inflation, non-payment of teachers' salaries, the recession was not a surprise at all and besides, the Nigerian economy has been on the watch list of the IMF and CNN. The signs of a recessed economy have been among the numerous economic woes Nigerians have experienced since the military era. It was like a child's play when teachers were owed several months of unpaid salaries by the state and local governments and everybody thought it was just poor teachers affair. Today things have grown worse as people in secured employments; even bankers now have salary cuts and some, out-rightly losing their jobs on a large scale. Thanks to the Minister of Labour and Productivity who tamed the tide by his threat to revoke the licence of banks that go on retrenching their staff.

Government unwillingness to diversify the economy right from the period of the oil boom in the seventies to the last few years when the oil price fell to all time low value of $30 a barrel. This recession was therefore seen as a self-fulfilling prophecy because the economy has for all these years depended on only one product- the crude oil. Nigeria before this time had multiple cash crops like Cocoa in the west, palm oil and coal in the east and the famous groundnut pyramids in the north. There were a lot of other resources and abundant food supply from agriculture. However, these were all gone with the discovery of oil. No doubt many see the discovery of oil in Nigeria as a curse rather than a blessing. Hence, Babalola (2016) has rightly put it that an economy largely dependent on oil and coupled with a high cost of running and maintaining an elephant political structure was always a recipe for disaster.

There is hunger and poverty ravaging the Nigerian landscape in the face of abundant resources. In fact today over 46% of Nigerians live below the poverty line of one dollar a day, with more staggering higher percentages recorded in the northern parts of Nigeria as remarked by Emir of Kano in a recent speech in Kaduna. It is for this reason that Chinua Achebe (1983) has written that Nigeria is indeed not a great country but one of the most unpleasant places on earth. While this is sad to note, it is however not totally bad, since Kuln (1970) noted that crises could be viewed with much optimism as an essential element of a change process. The recession is now causing the Government and well-meaning Nigerians to look inwards and think of ways to revamp and diversify the economy. What is needed at this time is to diversify our economy from crude oil export to industrialisation and food

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

production. It's a high time we started processing our raw materials to either finish or semi-finished products for export and for our industries through cutting edge skills from STEM education. This period of economic down turn should encourage STEM education.

Again, the world is becoming more and more complex; it is also becoming clearer that the emerging world's problems do not readily lend themselves cheaply to solutions from single disciplinary subject areas but from multidisciplinary subjects like STEM. In view of this, nations of the world wishing to maintain global leadership and cutting edge economic competitiveness now see STEM education as an option for equipping their youths with knowledge and skills for the solution of difficult problems.

Science Technology Engineering and Mathematics Education in Nigeria

STEM is the acronym for science, technology, engineering and mathematics, a term said to have been coined by Dr Judith Ramaley of the American National Science Foundation. In its early use, it was more or less a short hand for the four subjects in the acronym, but in recent years however, the definition has changed beyond being an acronym. STEM now describes a 'meta discipline' which is a creation of other disciplinary knowledge into a new 'whole', achieved by bridging the gaps in the subjects' boundaries. There are several definitions of STEM in literature coming from educators within and outside the STEM family. The difference in the definitions arises from the fact many do not share same view in the interdisciplinary and unified understanding of STEM (Breiner, Harkness, Johnson and Koehler,2012, Brown, Brown, Rearden and Merrill, 2011) . A few of the definitions will be considered here such as;

Morrison (2006) sees STEM as an interdisciplinary approach to learning where discrete subject areas such as science and technology are taught by incorporating engineering and mathematics into their curriculum and this presents a paradigm shift from the traditional teacher centred classrooms which treat these subjects in bits and pieces. Another frequently cited definition of STEM is that of Tsupros, Kohle & Hallinen (2009), which defines STEM as the

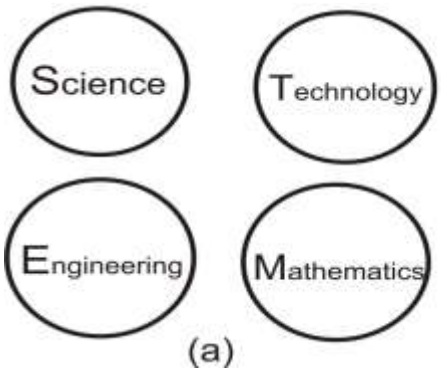
> ''interdisciplinary approach to learning where rigorous academic concepts are coupled with real world lessons as students apply science, technology, engineering and mathematics in context that make connections between school, community work and global enterprise, enabling the development STEM literacy and with it the ability to compete in the economy''

Rider-Betrand (2006) also defined STEM as an intentional and meta disciplinary approach to teaching and learning in which students uncover and acquire a cohesive set of concepts, competences and dispositions of science technology, engineering and mathematics that they transfer and apply in both academic and real life contexts in order to be competitive in the 21st century. These definitions mention the use of integrative approach in the teaching and learning of the subjects rather than presenting them as separate subjects and real life application of STEM, and the cultivation of 21st century skills for solving life equations.

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Every well-conceived STEM program is therefore expected to have some degree of integration and a holistic presentation of concepts, competencies and dispositions of science, technology engineering and mathematics in solving real life problems. The American Ex-President, Barack Obama, had this view about STEM when he in a 20 minutes speech at the fifth white house science fair remarked that STEM is ‘’more than a school subject, or the periodic table or the properties of waves. It is an approach to the world, a critical way to understand and explore the world, and have the capacity to change it and share the accumulated knowledge …’’ (White House, 2015)

This is however far from the conception and practice of STEM education in Nigeria, where science, technology, engineering and mathematics are still been studied at all levels of education as single and separated disciplines without any form of integration or emphasis on connections across the disciplines. In other words, what we have in Nigeria is S.T.E.M. and not STEM. The difference is that while STEM presents a commonality of knowledge among the disciplines, S.T.E.M. presents single disciplines separately taught as the STEM subjects. For example, you will find below a diagrammatic illustration of the difference between the two.



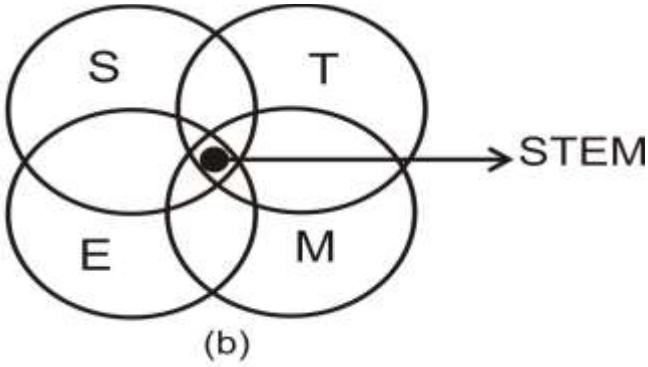


Fig1a. Silo STEM (S.T.E.M.) **Fig 1b. Integrative STEM**

In fig 1a, we see what we have called the separated or silo STEM. In this approach each of the four subjects are taught as single subjects with the view that the synthesis of disciplinary knowledge would later be applied. This is what Anderson (2017) has referred to as the ‘Silos’. Owen (2017) remarks that just like the farmer uses silos for storing and separating grains, so do silos separate teachers, subjects and thought processes. Teaching STEM as silos makes students less proficient in the area of critical thinking, problem solving and acquisition of team building skills developed in integrating STEM as a discipline. In fig 1b, we see an integrated STEM (iSTEM) education where is the subject barriers are removed thereby creating a new whole discipline.

The Science Teachers’ Association of Nigeria is the largest science teachers’ association in Nigeria and has put so much effort in popularizing STEM for over two decades now, but despite these noble efforts to popularize STEM, her usage of the term still remains at the level of mere acronym which makes one uncomfortable as to whether she actually

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

understands STEM as an integrative multidisciplinary subject. In the earlier STAN conferences, the themes were limited to S&T, later STM, with the 'E' excluded and more recently STEM with the 'E' added. It can therefore be concluded that the term STEM is yet to be understood in Nigeria, and its implementation is still very poor as well.

This paper is therefore is of the view that;

- So far there is neither STEM education nor STEM curriculum in Nigerian Schools especially in its integrative form, either for the Primary, Secondary or the Universities;
- 'STEM education' in the secondary schools does not yet incorporate engineering and technology. Only science and mathematics are taught in silo manner approach in the primary and secondary schools;
- Cutting edge STEM skills (key and soft skills) for competitive 21st century workforce is missing at all levels of Nigerian education. This results in our graduates being unemployable, simply because they lack employable skills;
- There are no teachers qualified as 'STEM teachers' in Nigeria for now and no Universities training STEM teachers.
- Skeletal STEM activities such as workshops, seminars and trainings are been organised in Nigeria, such as the ones of benignantsteminnov.org, WAAW Foundation, the Brainiacs STEM & Robotics, and a few other NGOs coming from the diaspora.

The United States of America and other developed countries that have come to realise the need for interdisciplinary approach in the preparation of the oncoming generation with skills for competitiveness in the 21st century have started to implement integrative STEM (iSTEM) in their K-12 educational system i.e. from kindergarten to 12 years. In this program there is a high level of integration and a holistic presentation of concepts, competencies and disposition of science, technology, engineering and mathematics. They emphasise the use of projects and other hands on activities. Pupils are engaged in designs of projects geared towards solving life problems.

Levels of Integration in STEM

The integrative approach is one method that is strongly recommended for an efficient STEM education. In the US, several educators, reformers and authors involved in STEM education have emphasised integrative approaches and indeed STEM integration is rooted in the early works of the American progressive movements and those of the socio cognitive research movement. (Dewey, 1938 & NRC, 2000)

Three levels of STEM integration approaches proposed by Drake and Brain (2004) and Vasques (2014) are the disciplinary, multidisciplinary, inter-disciplinary and trans-disciplinary levels of integration which they suggested to fit an integration continuum that begins with disciplinary at the bottom and ends with trans-disciplinary approach at the top. Disciplinary approach to integration therefore involves students learning concepts and competencies in separate subject areas, while in multidisciplinary level of integration students are made to learn concepts and skills separately in each discipline but with reference

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

to a common theme. In the interdisciplinary approach students learn concepts from two or more disciplines that are tightly connected together so as to view to deepen their knowledge and skills, while in the trans-disciplinary level students undertake real world problems by applying knowledge and skills from two or more disciplines.

Innovation, Entrepreneurship and Stem Skills

There is a nexus between innovation, entrepreneurship and STEM education. STEM education supplies the required skills, knowledge and competencies that drive innovation and entrepreneurship and the creation of a competitive edge in knowledge based economies. The businessdictionary.com defines innovation as a process of translating ideas into replicable goods and services that have monetary value. An innovation therefore involves the following;

- A new product, process or service;
- It has impact on the society in the now and the future;
- It improves what is already existing in an incremental or transformational scale;
- It has monetary value;
- It involves other people; hence it is often a team activity.

Innovation as a team activity begins with creativity. This is so because creativity enables one to generate novel ideas, while innovation helps one to translate the idea to a useful application. In many occasions the innovator may be the owner of the idea that drives the innovation, but at times he may work with an idea generated by another person. The Entrepreneur is also part of the innovation team however; he is the last man in the innovation chain. When an innovator creates a new product, process or service that has societal value, his effort will not be rewarded until it gets to the market. This is where the entrepreneur comes in as the one who takes it to the market thereby giving it a market value.

The entrepreneur therefore takes considerable initiatives and risks in the start-up and management of his business, and very often can also be seen as an innovator of new ideas and business processes (Investopedia, 2006). The value of innovation is therefore realised by the entrepreneur, hence the World Bank (2015) has recognised innovation and entrepreneurship as key players in addressing developmental challenges of nations of the world. For innovation and entrepreneurship to impact the economy, the required key and soft skills required must come from STEM education. These are the set of skills graduates of science, technology, engineering and mathematics are expected to possess which are required in today's workplace and they include the following skills;

- Problem solving skills. Problem is solved when they are broken down from complexity to simpler components by recognising the cause and effect relationships amongst the various parts.
- Analytical skills for research, project planning and drawing inference from research results.
- Mathematical skills for measurement and calculations.

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

- Communication and cooperative skills to present ideas relate with customers and interact with partners.
- Leadership skills to lead projects and help customers.
- Technical skills to trouble shoot source of problems and to repair machines or debug operating systems, and to stay abreast of new soft wares and equipment.

The importance of these skills cannot be overemphasized as it is the avenue for youths and our country to compete globally, create employment and ensure the wellbeing of her citizens. With youth unemployment in Nigeria at 25%, it is ironical to know that there are large numbers of jobs that are unfilled. These jobs require high skills and knowledge backgrounds in the science, technology, engineering and mathematics and cannot be occupied by just any applicant. Employers of labour in this country are today in deep frustration because our graduates are unemployable. All over Africa, the story seem to be the same because most STEM jobs are been done by multinationals from China, India and the US. According to Jamme (2015), 87 construction teams came to Kenya in 2014 from China for the construction of the Standard Gauge Railway, while the Kenyans were left out of the job.

Research by DiaBden, Oni and Adekola (2000) have come up with the result that Nigerian graduates lack employable skills which are synonymous with STEM skills. There seem to be some disconnect between what our institutions are teaching and what the industries are looking for. Even the large volumes of thesis and projects undertaken by students in Colleges and Universities and Research Institutes remain at the library shelves, simply because the industries cannot use them. There ought to be some sought of synergy between the Colleges, Polytechnics, Universities and Private Sector in order to ensure the type of collaboration that will result in Research and Development.

Repositioning STEM Education for Innovation, Entrepreneurship and Economical Growth

From the foregoing, it has been established that an effective and integrative STEM education is essential for the knowledge, skills and competencies required for competitiveness in the 21st century economies. STEM education is what we need at this time when our economy is struggling and youth unemployment is increasing every day. According to the theme of this conference, STEM education in Nigeria could be repositioned to achieve the noble goals of the integrated STEM education that will result in an economic recovery in Nigeria. The way forward therefore is to realise that the national policy on education has established that education in an instrument par excellence for effecting national development and to see the numerous examples of other countries that have effectively utilized education through the ages to solve their national problems, and to have the moral and political will to do same.

For instance, in October, 1957 Russia has not only overtaken the US in space science by launching the Sputnik into space, but the thought that she could use the expertise in dangerous weaponry to hurl thermonuclear warheads on American cities caused strong feelings of fear, anger and insecurity amongst Americans. The Sputnik made it abundantly clear to the Americans that it was in their own national interest to reform their education. Part of the strategic response to deal with this psychological panic taking hold of the people by the Federal Government was to prioritise education through increased funding and the National

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Defence Act of 1958 passed by the American Congress to reform the curricula of mathematics and rocketry science and physics. (Powell, 2007).

These efforts continued till 1961 when President J.F. Kennedy challenged Americans in a speech '' I believe this nation should commit itself to achieving the goal before this decade is out, of landing a man in the moon and returning him safely to earth'', and in just few years the result was phenomenal because in July 20, 1969, American astronaut, Neil Armstrong walked on the moon as the first human to do that. This singular example without mentioning others reveals how education can be utilised to achieve national objectives. We must note that this great achievement came through education and we can do the same.

The state of education, especially STEM in this country is still in a sorry state and nothing can be achieved through our educational system except there is a serious reform, a reform of the type endangered Americans undertook at the wake of the Sputnik. The concern is therefore high among the public and science professionals that the traditional teaching methods still persists in our classrooms, despite the fact that age long theories of learning emphasize the necessity for learners to construct their own knowledge. It is also most frustrating to note that while the English speaking western countries have since the beginning of late 1960s and early 1970's opted for the inquiry and student centred learning methods which has helped them achieve scientific breakthrough, not only in improving their standards of living but in putting their flags on the moon, Nigeria after decades of independence and huge financial investments in educational and curricula reforms still have didactic methods: chalk and talk, rote learning and memorization as dominant methods of instruction in her science classrooms.

For instance, Okebukola (1997) captures this scenario well when he remarked that the average Nigerian STEM class begins with a brief chat as an introduction by the teacher and is followed by the reading of notes to the students and ends with the teacher leaving some notes behind for the class captain to copy for his mates during any available free period. The prevalence of use of traditional teaching is very common everywhere in Nigeria and has been labelled as one of the reasons for students' poor performance and low enrolment in the School Certificate Science Examinations (Ugwu, 1989; Okebukola, 1997; Ogunmade, 2005). The use of obsolete and traditional methods of instruction has not only resulted in students' poor performance, low motivation and an aversion for science, but has given the common impression that STEM is hard, dull and very boring to learn.

The fact therefore remains that our STEM education has not functioned adequately in view of multifaceted problems bedevilling the system and the poor performance of students in science examinations being recorded locally and internationally (STAN, 1992). The way forward therefore is that concerned educationist, the public and private sector and the Government ought to at this time begin to re-examine and re-conceptualise new ways of teaching STEM that are both pragmatic, skill centred and integrative. This rethinking should call for a paradigm shift from the STEM education based on silo approach to one that emphasizes integration, hands on activities and encourages problem solving, innovation and entrepreneurship at least in the nursery and primary schools.

What must we do?

The following are a number of things that is required in repositioning STEM education in Nigeria for economic recovery;

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Curricular reform in STEM education

The government and educational authorities should introduce STEM curriculum and instructional materials as part of curricula reforms that addresses the current economic crises in the country. This curriculum must integrate innovation and entrepreneurship education into the STEM program and the emphasis should be to raise young generation of people with STEM skills that will be the future innovators and entrepreneurs of tomorrow. Case studies of innovators and entrepreneurs like Steve Jobs, Bill Gates, Dangote etc. should be part of the curriculum. Okpala (2014) has suggested that the following elements should be the integral part of the design of STEM curriculum that seeks to initiate innovation;

- To be trans disciplinary in approach;
- To be driven by standards that compliment trans disciplinary philosophy
- To be problem- based and performance based;
- To be digital in format, coupled with digital technologies etc
- To be linked to the real world challenges

Increased funding for STEM education

To realise an effective STEM education, there is the need for increased funding. The Government should borrow a leaf from the response of the US to the Sputnik and see to it that sufficient fund required training teachers to use the right strategies that get more students interested in STEM and the provision of instructional gadgets and textbooks are provided. The Government should also seek partnership with of the private sector as the government cannot do it all alone. The US government under the Obama administration apart from spending $3m annually on STEM education announced in 2015 of over $350 million as a private sector commitments to inspire and prepare more boys and girls to excel in STEM.(The White House, 2015). We need to see this quantum of funding coming from the government and the private sector in Nigeria.

Hands-on STEM Pedagogue should be encouraged

STEM education is about hands- on experience as the path to learning is open- ended as long as time and resources permit. Government should encourage use of hands-on learning approaches which involves the process of developing ideas and experimenting to see what works the best as part of problem solving skills students should learn. STEM lessons should focus on the real life issues and problems which should be guided by engineering design process. Activities such as Robotics, building computer apps, web designs and three D printing, young engineering projects and Science fairs are a must for effective STEM education.

Create opportunities for students to participate in innovation and entrepreneurial contests

Another way of encouraging active engagement on hands-on is by allowing students participate in regular innovation, entrepreneurship and creativity contest. This can be a way to set our students in the path of creativity and innovation and business start- ups. The use a

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

science clubs, junior engineers, science week for science fairs and exhibitions should be encouraged.

Changing students' mind-set from seeking employment after graduation to thinking ownership of companies through possibility thinking

It is very true that our students graduate from school thinking of working for X Y Z companies, and little do they think of becoming employers of labour themselves. Part of the work of educationist should be to motivate students to think big and see the sky as not just the limit but the beginning. Exposing students to career talks and motivational talks from successful entrepreneurs and innovators could serve as spring boards to catapulting them beyond the walls of mediocrity and poverty. We must remember that much of America's success stories of wealth creation and industrialisation have come from the efforts of the positive and pragmatic thinkers like William James, Norman Vincent, Napoleon Hill etc. Through innovation, entrepreneurship and STEM education repositioning, we can have owners of industries and business like Bill Gates and Steve Jobs, etc, arising from our schools with sufficient motivation and encouragement.

CONCLUSION

In this paper, effort has been made to define STEM education and how its integrative approach can result in the inculcation of knowledge, high level skills and competencies required in the 21st century work place. It has also been shown that STEM education in its integrative form is yet to take root in Nigeria and that the STEM subjects are taught as separate sciences still lack inquiry, hands-on experiences and digital gadgets that should motivate, interest and draw more students to STEM. So far it does not seem our Government is making concerted efforts to use STEM education as an instrument par excellence for building a new generation of innovators, business leaders and scientist for 2ist century and beyond. A number of suggestions have been given as a way forward which may help to reform STEM education in Nigeria. All stakeholders in education should make efforts to ensure STEM education is given its rightful place so that Nigeria and the African continent will not continue to lose out to the developed countries.

REFERENCES

Achebe Chinua (1983). *What is wrong with Nigeria*? Enugu, Fourth Dimension Publishers

Anderson J. (2016) *Implementing STEM Approaches in diverse secondary contexts*. Retrieved on 20th April from stemdcon.deakin.edu.au.sites.

Babalola, A.A. (2016) Nigeria and economic recession; Way out. *Vanguard Newspaper*. December 7, 2016

Breiner,J.M. Harkness,S.S., Johnson,C.C. & Koehler, C.M. (2012).What is STEM? A discussion about conceptions of STEM in education and partnerships; School Science and Mathematics, 112(1) 3-11

Brown, R., Brown, J., Reardon, K., & Merrill, C. (20011). Understanding STEM; current perceptions, *Technology and Engineering Teacher*, 70(1), 5-9.Retrieved from http;/www.iteaconnect.org//publications/TTTarticleindex13.htm

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Clark,D. (2014). Disciplinary inclusivity in educational research design; Permeability and affordances in STEM education; Keynote address presented at STEM Education and our planet; Making Connections Across context 12 July

Dewey, J. (1938) *Experience and education;* London CollierBooks

DiaBden, A. Oni,B & Adekola A. (2000). *Labour market Prospects for university graduates in Nigeria*. Washington, D.C. World Bank

Investopedia (2006). What is an entrepreneur? Retrieved from www.jnvestopedia.com/../e...

Jamme, M. (2014) Africa's future depends on STEM. The Blog News; Retrieved 12 April 2017 from www.Huffington.com

Kuhn,T.S. (1970). *The structure of scientific revolutions*; Chicago University of Chicago Press.

Morrison J.(2006). *TIES STEM education monograph series attributes of STEM education. National Research Council (2010). Preparing teachers; building evidence for sound policy.* Washington,D.C National Academy Press

National Research Council. (2000). *How people learn: Brain, Mind, Experience and School*. Academy Press

Noko, J.E. (2017). Economic recession in Nigeria, causes and solution. EduCainfo. Retrieved 7th April 2017 from Educainfo.com

Ogunmade, T.O. (2005). *The status and quality of secondary science teaching and learning in Lagos state*, Unpublished Doctoral Degree of University of Edith Cowan University.Perth, Australia

Okebukola,P.A.O. (1997).*The state of science education in Nigeria*. Paper presented at the ELLSA- British Council Forum, Kaduna, Nigeria

Okpala P.N. (2014). Reforms in Science, Technology, Engineering and Mathematics Education.

Orodo A.,(2016). *Possible causes of Nigeria's economic recession*. Cash range. Retrieved 2 April 2017 from Cashrange.com/possible-causes of ni

Owen (2017) Tearing Down the Silos in K-12 Curricula. Retrieved from *inservice.ascd.org/tearing-down-the-silos…*

Powell, A.(2007) How Sputnik changed education. Retrieved from *News.harvard.edu/…/how-sputni*

STAN. (1992). *Raising the standard of performance in pubic examinations in Science, Technology, and Mathematics*. *Position Paper No 4*, Ibadan; STAN

Tsupros, N. Kohler, R and Hellinen J (2009). *STEM education; A project to identify the missing components*, intermediate Unit1 and Carnege Mellon, Pennsylvania

Ugwu, D.U. (1996). *Acquisition of science process skills among senior secondary school students in Enugu State;* Unpublished M.Sc.Ed Thesis, Enugu, ESU

Vasquez, J.A. (2014). STEM- Beyond the acronym. *Education Leadership* 72(4)

White House (2015). Remarks by the President at the white house science fair. Retrieved from *http://obamawhitehouse.archives.gov*.

Wikipedia (2017). Gross domestic product. Retrieved 12th May 2017 from *https://en.m.wkipedia.org*

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)