
Repositioning Science and Technology Education (STE) for Research and Innovation.

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Abstract

Over the years, the responsibility of management, funding and supervision of education has solely been vested on the government which has hindered Nigeria from attaining the modern day advancement in Science and Technology Education (STE). Presently, STE advancement is far from satisfactory. There are educational challenges from lack of funding to the problem of curriculum that is yet to meet the aspirations of the populace. Public Private Partnership (PPP) in education can be a promising venture in repositioning STE for power and self employment. The paper looks at how a meaningful and realizable STE can be achieved through research funding, the input of PPP in the form of University-Industry relationship and curriculum upgrade for sustainable development. Typical cases of University-Industry Partnership (UIP) are sighted and Research and Development frameworks also; so that government and stakeholders can key in as there are lessons to be learned.

Key words: Curriculum, Public Private Partnership (PPP), Science, Technology, Research and Innovation

Science is knowledge or a system of knowledge covering general truths or the operations of general laws especially as obtained and tested through scientific method .Such knowledge or such a system of knowledge is concerned with the physical world and its phenomena. (Merriam-Webster Online Dictionary).

Science is the systematic study of the empirical world in order to understand and control it. Science is that organized body of knowledge which ensures the ability to acquire skills. It is a search of meaning or exploration of events in nature. It can be defined in terms of its methods and process, that is what scientist do. It can also be

defined in terms of products that are knowledge in the form of facts, principles, concepts, attributes, laws and theories (Ibrahim, 2016).

Modern science is a discovery as well as an invention. It was a discovery that nature generally acts regularly enough to be described by laws and even by mathematics; and required invention to devise the techniques, abstractions, apparatus, and organization for exhibiting the regularities and securing their law-like descriptions."(Heilbron 2003, p.7).

The term "Technology" is wide and everyone has their own way of understanding the meaning of technology. We use technology to accomplish various tasks in our daily lives, in brief; we can describe technology as products, processes or organizations. We use technology to extend our abilities, and that makes people as the most important part of any technological system. Technology is also an application of science to solve a problem. But what you have to know is that technology and science are different subjects which work hand-in-hand to accomplish a specific task or solve a particular problem. (Ramey, 2013, para.1).

Technology is the application of scientific knowledge for practical purposes, especially in industry. It is a branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science (dictionary.com, 2010).

Science and Technology Education

Science and technology education (STE) which is innovation and entrepreneurship driven should be key ingredients in the economic development of Nigeria .There is the need to realize that Nigeria would only be able to embrace the knowledge economy and sustainable development if it strengthens its capacity for innovation. STE should aim at building knowledge and skills necessary to develop and practice innovation and entrepreneurship across all sectors of the economy (private, public and social). It is in line with this that a new National Science Technology and Innovation (STI) Policy was launched in 2012 with an enhanced engagement on developing new businesses and advancing sustainable development.

The specific objectives of the STI Policy are:

1. to facilitate the acquisition of knowledge to adapt and diffuse technologies for the growth of SMEs, agricultural development, food security, power generation and poverty reduction;
2. to support organizations and institutions within a virile National Innovation System (NIS);
3. to promote the creation of innovative enterprises using Nigeria's indigenous knowledge;
4. to support the promotion of locally developed technologies for the production of globally competitive goods;

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5. to facilitate the creation and maintenance of a reliable database on Nigeria's ST&I resources and activities;
6. to create sustain reliable mechanisms for adequate funding of ST&I activities; and
7. to strengthen international cooperation in science, technology and innovation across all economic sectors. (Nacetem, 2010)

Curriculum Upgrade and Implementation

According to Akudolu (2010) curriculum is concerned with the why, what and how of instruction. In other words, it is concerned with the goals and objectives of instruction, the content, organization and evaluation. Modern and dynamic curriculum should contain elements that form the beacon for the development and implementation of entrepreneurship education. Entrepreneurship driven curriculum should constitute a core curriculum for every learner at all levels of education in Nigeria. The Consortium for Entrepreneurship Education (2004) maintained that it is a lifelong learning process starting from elementary level to other levels of education and spanning to adult education. (p. 6). In 2000 Brown among other educationists shared this view and opined that "the principles of entrepreneurship are increasingly considered valuable for students at all levels". (as cited by Akudolu, 2010, p.6.).

A curriculum should reflect the need and aspirations of a society. In Nigerian context there is the vision 20:2020 which its objectives are geared towards becoming one among the twenty largest economy of the world. These aspirations are realizable if there is clear cut implementable science and technology frame work that would be fully integrated into the national development socio-economic process. The issue of national development is not realizable without an educational policy. In this regard 6-3-3-4 system of education is in operation. Eddie (2000) said "the actual consummation of what the national policy on education are brought to focus are at the stage of curriculum implementation. (as cited by Umar, Ibrahim and Clement, 2015, p.227).

Offorma (2006) in Hafiz (2015) view Curriculum implementation as the practical action oriented phase process of the curriculum, that is the trying out stage of the identified objectives, content, or subject matter, learning experiences and evaluation of all materials selected at the planning stage. (p.154). In 2007 Rogan clearly outlined guidelines for sustainable curriculum implementation. It involves;

- Local stake holders' involvement to sustainably implement curricular in cultural educational context
- Developing adjustment strategies, anticipating on the role of culture in curricular development and implementation process and outcomes in educational context
- Strong involvement of curricular developers who can increase the cultural relevance and appropriateness of the curricular and also facilitate sustainable

curriculum implementation within cultural educational context.(cited in Hafiz, 2015, p.155).

In its broadest interpretation curriculum defines all the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school. The term appropriate emphasizes the extent to which the formal course structures and resources attempt to achieve the intentions of the Gateway project, that is, are they suitable for achieving the Gateway goals of equipping the next generation with the skills and knowledge to make the transition from school to further education or work and fill the skilled jobs of the future. Curriculum which is appropriate for facilitating school to work transitions would incorporate the following:

- 1 a clear and consistent focus on applied learning in terms of approaches to teaching and assessment processes
- 2 a clear representation of the workplace practices of the trade concerned
- 3 a strong focus on embodied, embedded, encultured and encoded knowledge related to the trade, alongside the required embrained knowledge.

Government had taken many initiatives to provide a framework for the development of science and technology (S&T) and its integration into the mainstream of development strategies. There is, therefore, a need to integrate S&T in national development as curriculum upgrade should be a continuous process of development. (Watters and Christensen, 2014).

A draft report on University- Industry linkage (UIL) by (Sá,2007.) of the African Association of Universities on the opportunities for UIL and benefits to be derived have come up with an initiative that will benefit graduate student. It is a Corporate Graduate Link initiative launched with the aim of bridging the gap between the university graduates qualification and the needs of the industry. Some of the objectives of the program are:

- To develop post-graduate curricula approved by Industry (e.g. Chambers of Commerce and Industry) in order to produce graduates that satisfy the requirements of the Private Sector Job market and counteract the "brain drain" effect.
- To identify and strengthen existing post-graduate courses through input from Industry where students are attached to work on issues affecting the Industry, making them responsive to private sector job market.
- To develop faculty - chambers research agendas that answer to Industry's research development and innovation.
- Building corporate image of the universities by establishing relations with government, by answering to government's development plans, policies, strategies and Visions.
- To develop faculty – public research agendas that answer to regional development plans

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- To identify public service opportunities through building of dialogue networks, research and business incubation centres in universities, as one stop centres to attract Chambers partners.

This initiative when adopted locally can help in rapid acceleration in (STE) and also encourage innovation because stake holders in both education and industrial sector are involved. It will encourage cross fertilization of ideas at intellectual capacity.

University-Industry relationship

Relationships between academy and industry are nearly always somewhat contradictory. The former relies on long-term research and education process while the latter needs. Immediate solutions and narrowly, however, deeply educated employees. Overcoming the gap between the two parties is by no means easy if the right framework is put in place and religiously implemented.

The traditional funding of discrete research projects most especially by government is tasking and is now becoming outdated due to cost of running government. Universities and industry have been collaborating for over a century, but the rise of a global knowledge economy has intensified the need for strategic partnerships. World-class research universities are at the forefront of pioneering such partnerships. They are designed to run longer, invest more, look farther ahead and hone the competitiveness of companies, universities and regions. In short, they transform the role of the research university for the 21st century, anchoring it as a vital centre of competence to help tackle social challenges and drive economic growth. (Koekoek and Balfield, 2012).

It is now recognized that scientific and technological development is a collective endeavor that is facilitated by interactive collaboration. Stakeholders other than the government now play new roles in facilitating the developmental processes. To achieve the desired goals in university-industry partnership (UIP), Nigeria needs to look around and find clear cut examples and the framework put in place by such kind of collaborations.

The University-Industry Demonstration Partnership (UIDP) has collected 10 Case Studies of engagements that provided benefits and insights to the engaged parties. These partnerships have inspired new high-value, high-return partnerships and also raise awareness of such collaborations, building on the UIDP's Partnership Continuum work, as well as share lessons to be learned. (University-Industry Demonstration Partnership, 2006). Two examples of such cases include:

The International Food Safety Training Laboratory: A Partnership that Improves the Safety of Food Globally

The International Food Safety Training Laboratory (IFSTL) is a partnership between the University of Maryland and the Waters Corporation. Signed in 2010, this alliance led to the creation of a training facility dedicated to analytical methods for food

safety in microbiology and chemistry where subject-matter experts from the United States Food and Drug Administration (FDA), United State Department of Agriculture (USDA), Environmental Protection Agency (EPA) and academics from the University collaboratively deliver hands-on training. This resource has benefited food laboratory professionals from many countries in its 18 months of operation and contributed significantly to the FDA's international capacity building plan aiming at strengthening laboratory capacity domestically and internationally to improve food safety globally. U.S. consumers have benefited since much of the food consumed in the U.S. is now imported and improving food safety in other countries benefits U.S. market.

Forming a Strategic Alliance: Kansas State University and Abaxis, Inc.

This case study presents the events leading to the formation of a strategic alliance and a successful collaboration between a Land Grant University and a major corporation in the animal health arena, and represents a model that exemplifies an Industry-University relationship that respects the mission, goals and culture of each entity. Three components make this strategic alliance unique: (1) Different from most university/industry linkages, this does not involve the transfer of intellectual property [IP] or the establishment of a research relationship [with IP issues contractually resolved]. Rather, it involves the merging of Kansas State University (K-State) capabilities with industry growth needs. (2) The entrepreneurial enterprise at K-State involves not only the university, but a K-State controlled organization [K-State Institute for Commercialization – KSU-IC] which could negotiate the final package. (3) The strategic alliance was made possible by a three-way discussion between KSU-IC, several entrepreneurial investors in the animal health arena, and a company having the need to diversify.

In January 2011, Abaxis, Inc. and K-State created a unique Industry-University alliance to form a new laboratory division called Abaxis Veterinary Reference Laboratory (AVRL). Previously, Abaxis had been a product oriented company, and was developing a strategic plan to expand its business to include diagnostic services, thus providing a broader offering to its clients. Abaxis needed a partner with expertise and credibility in veterinary diagnostic services. K-State had been exploring options for growing the companion animal portion of its animal disease diagnostic capabilities. K-State needed a partner to leverage its capabilities outside of the Midwest.

The advantage of University- industry partner is that it helps in enriching undergraduate and graduate education with the real world experience; also helping student understand the applicability of their knowledge. In a very real sense, increased collaboration between industry and higher education has brought the creative engine of knowledge economy to rest on the shoulders of academic researchers. (Klawe, n.d. p. 32). Also when companies and universities work in tandem to push the frontiers of knowledge, they become a powerful engine for innovation and economic growth.

Research Funding

According to African Innovative Outlook (AIO, 2010) South Africa spends 8.5 times more on R&D than Africa's most populous country, Nigeria. As a result of few or no R&D activities in the business sector in Nigeria, it is assumed that government and higher education sector performed 35.1% and 64.9% of the national R&D respectively. Also government provides funds up to 96.4% for national R&D while the business sector and higher education only provides 0.2% and 0.1% respectively. Certainly this is not encouraging for any scientific and technological advancement.

Bogoro (2014) believes investment in research and development (R&D) is a key to the generation of knowledge. However, in Nigeria, and until recently, R&D has been largely a government affair, with very little private sector participation. The transformation agenda recently introduced in Nigeria has witnessed a gradual shift of the national economy from a largely public-sector led and administratively controlled economy to a private-sector led and market-oriented economy. The emergence of TETFUND in Nigeria is a response to the voice of the academic community led by the university academic union, ASUU for increased private sector participation in the development process of Nigeria.(p.3).

An analysis of R & D expenditure by source of funds shows that more than half (55.0 %) of the total expenditure in 2012 within the EU-28 was funded by business enterprises, while one third (32.8 %) was funded by government, and a further 9.7 % from abroad (foreign funds). Business-funded R & D accounted for 76.5 % of total R & D expenditure in Japan (2011 data), 74.0 % in China and 59.1 % in the United States. (Eurostat, 2015).

For Nigeria to achieve macroeconomic development and assume its rightful position among the committee of emerging economies; it need to reorder its priorities by committing more funds to R&D activities to meet UNESCO standard of having at least 1% of GDP committed to R&D as well as creating a National R&D Fund(Siyinbola,2011). This can be made possible through the involvement of public private partnership in terms of provision of funds to encourage the research. As part of commitment to be in conformity with the global trend in R&D the TETFUND Board of Trustee (BOT) has approved a 5-year plan 2014-2019 vision which seeks to deepen and focus on academic content quality and excellence. Part of this vision, is a new Department of Research and Development/Centers of Excellence (R&D/CE) created with the main objective to institutionalize R&D in tertiary institutions that will interface between research findings and industry which are to patronize the appropriate research outputs to be developed as products and technology relevant to local and national needs. (Bogoro, 2015 p 2).

Stanford shares a relationship with Silicon Valley unlike any other university on the planet. Stanford faculty and students have made notable achievements across disciplines; their role in shaping the epicenter of The Age of Innovation is perhaps one of the top — if not the most unique — distinguishers. Stanford's engineering school

has had a strong hand in building the tech boom that surrounds it today. It's not only witnessed, but also notoriously housed, some of the most celebrated innovations in Silicon Valley.

As the world's eyes fixate on the booming tech scene in Silicon Valley, Stanford's affiliation shines brightly in the periphery. (Triakha, 2015).

There is need to develop home grown, community driven technology. In line with the present trend in technology, if the likes of famous Stanford University can partner with Silicon Valley there is need for Nigerian Universities to partner with industrialized areas. There are several industrialized areas in different geopolitical zones in Nigeria with so many potentialities. The likes of Agbara industrial Estate in Ogun State (South West), Nnewi Industrial Estate in Anambra State (South East), Panteka Industrial Village in Kaduna(North West). To mention but a few in South West Nigeria there is Obafemi Awolowo University, South East; Nnamdi Azikiwe University and in the North West Ahmadu Bello University.

Nnewi people had an earlier trade link with Japan in the late 1950s for the importation of motor parts. In the 1980s, Taiwan took over with their low-priced products as exchange rate movement dislocated businesses. The Taiwan flexible trading practice was more acceptable and Taiwan also became a source of technology acquisition and training. This early trade link with the foreign community contributed to the gradual migration from trade to motorcycle assembly to manufacturing (Nzewi, 2016). Using these decades of Nnewi experience in partnership, similar kind of partnership can be extended to the nearest indigenous University like Nnamdi Azikiwe University in Anambra state.

Like wise Panteka in Kaduna houses artisans involved in different crafts, including carpentry, aluminum windows, roofs and metal doors, gold smiting, building materials, traditional medicine and herbs, key cutting, paints sellers, chemicals for perfume and soap making to mention but a few. Household materials ranging from candle, candle stands, kerosene lamps, cooking stoves, and utensils to industrial materials like shovels, rakes, diggers and working tools are produced in the market. It was also gathered that, automobile parts are produced in the market.(Bello,2015). Ahmadu Bello University, Zaria is one of the Universities equipped with the man power closest to Panteka.

Conclusion

Considering the potentials and prospects in STE; upgrading the school curriculum to focus on realizable UIP devoid of unnecessary bureaucracy and commitment in R&D funding will help bridge the gap in modern day technological advancement. There is the need for Nigeria to adopt the strategies of developed economies in UIP and global best practices by appreciating and encouraging local inventions. This will help make a difference in the level of development. What makes the difference is the level of commitment by stake holders involved which include the

government, Universities and other higher institutions of learning and the private sector.

Recommendations

The following recommendations have been proffered in order to provide the needed goal in Science and Technology Education in Nigeria.

- Curriculum should be up to date
- Increase collaboration in such a way that innovation groups can be subsidiaries of Universities.
- Redefining the role of research in higher institutions of learning.
- Partnership should put the right people in charge.

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