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Innovative Science Education Curriculum: The Needed Skills for Competitiveness in the Global Economy

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ABSTRACT
Despite the fact that science influences all parts of our lives and decision making processes, but it seems that science education in Nigeria sits at the crossroads. Despite public and policy emphasis on the importance of science and technology, there still exist wide disparities in participation in science education in all levels of our educational system. This paper discusses some of the main curriculum issues involved that should help citizens acquire the necessary knowledge of and about science to participate actively and responsibly throughout their lives. This include the following: That science education should focus on competencies, Placing emphasis on quality teaching, teacher induction, pre-service preparation and in-service professional development, collaborating between formal, non-formal and informal educational providers, Promoting responsible research and innovation and discussing the findings and consequences. This is hope will bring about more inclusive forms of science education and help reduce disparities.
Keywords: *Innovation, Science Education, Curriculum, Competitiveness, Global Economy.*

INTRODUCTION
As the world becomes more inter-connected and competitive and as research and technologies know-how expands, new opportunities along with more complex societal challenges arise. Overcoming these challenges will require all citizens to have a better understanding of science and technology if they are to participate actively and responsibly in science informed decision-making and knowledge-based innovation (Moedas, 2015). It will involve input from user groups, specialist and stakeholders groups. Professionals, enterprise and industry have an important role to play. In this way, everybody learns and benefits from the involvement. At the moment, Nigeria faces a shortfall in science-knowledgeable people at all levels of the society and the economy (Hazelkon, 2015). Over the last decades, there has been an increase in the number of students leaving the formal education with science qualifications (Hazelkon, 2015). But there has not been the parallel rise in the numbers interested in pursuing science related careers or have we witnessed enhanced science-based innovation or any increase in entrepreneurship.

Modern society is characterised by the increasing role of science and technology in all aspect of development. The industrial revolution made a significant contribution to improving living standards in most Nations. Science education research, innovation and practices must become more responsive to the needs and ambitions of the society and reflect its values. They should reflect the science that citizens and society need and support people of all ages and talent in developing positive attitudes to science. We must find better ways to nurture the curiosity and cognitive resources of children. We need to enhance the educational process to better equip the future researchers and other actors with necessary knowledge, innovation and sense of societal responsibility to participate

actively in the innovation process. This paper discusses some issues that will help all citizens acquire the necessary knowledge of and about science to participate actively and responsibly in the society throughout their lives. It sets out the challenges we face and how science education can help Nigeria meet their goals and equip citizens enterprise, industry in Nigeria with the skills and competences needed to provide sustainable and competitive solutions to these challenges.

Science Education should focus on competences: success in the 21st century depends upon acquiring competences rather than simply learning facts. Being able to collaborate, listen to the ideas of others, think critically, be creative and take initiative, solve problems and assess risk and take decisions and constructively manage emotions are interdependent. They are considered essential for success in adult life and the basis for further lifelong learning (OECD, 2012). They also contribute to active citizenship at local, national and global level. Conventionally, science education has focused on learning in the context of science and mathematics. OECD makes a distinction between knowledge of science and knowledge about science. Knowledge of science includes understanding fundamental scientific concepts and theories; knowledge about science includes understanding the science as the human activity as the power and limitations of scientific knowledge (OECD, 2009). As the world faces these complex challenges, our ability to resolve this issues on our own or within our own field of knowledge shrinks. Due to their scale of complexity, these major social and economic problems transcend borders and disciplines and necessitate new ways of thinking and methodological and organisational frameworks. Social innovation takes place in daily life, in social relationships and in the home and may be focused on new service and new ways of organizing the society, work and ourselves (Mumford, 2002). Making connections between STEM and all other disciplines- What is often referred as STEAM-pushes beyond the boundaries of science to embrace the potential of linking the art, scientific inquiry and innovation.

Innovative new ideas and creating solutions often emerge at the interface between disciplines that involve societal actors. Innovation is linked, directly or indirectly, to human experience, needs and problems. This can occur through engaging in art- playing or listening to music, dancing, experiencing or creating arts, watching and creating video or firm or being involved in designing and making. Linking arts and humanities with science, technology, engineering and mathematics brings the scientist, engineer, entrepreneur, artist and designer into dialogue to offer the widest range of opportunity and academic and societal insight for experimentation and innovation (Wilson, 2002). Successful learning in the 21st century depends open "horizontal connectedness across areas of knowledge and subjects as well as to the community and the wider world" (Graff, 2012) it emphasizes the facts that knowledge and technologies do not exist in isolation. Interdisciplinary innovation is primary about team-work, where members of the team bring different skills and perspective" which together bring added benefit. People learn in formal, in-formal and non-formal spaces, at home, in the community and in activities linked with large pace enterprises. These developments require people with the competences to apply learning to the real-life problems and find effective solutions. People who are comfortable working collaboratively and interdisciplinary which span organisations and national boundaries are more prepared for their future roles as

innovators. This has implications for the way in which students learn science and teachers teaches across the educational continuum and link education with employability. Because creativity is the key competence that differentiates innovators from non-innovators, the learning environment matters. Students of all ages should be inspired to be innovative and entrepreneurial in their approach to generating and applying them to solving problems and helping develop sustainable responses to society's challenges.

Improving the quality of teaching, teacher induction, pre-service and in-service professional development: Educational quality and outcomes are key factors underpinning personal accomplishment and contributing to innovation and competiveness. Nigeria should make a shift towards learning outcomes: what the learner knows understands and is able to do with what they learn (Hazeekorn, 2015). Because our future depends on the quality of our education systems, society wants to know that the learning outcomes achieved by students meet society's expectations (Hazelkon, 2013). Since quality education and learning outcomes are the bedrock of the future society, we must aim to bring about systemic to teacher induction and pre-service professional development as well as what happened in the classroom. We need to shift the focus to how students and teachers teach and learn together. The quality of an education system cannot exceed the quality of its teachers (FRN, 2004) However, some "systems face teacher recruitment problems, especially in areas like mathematics, science and ICT". EC (2013) Studies shows that the highest performing systems internationally have teachers who are seen as important members of their communities and attract high-achieving and committed students into science teacher education.

This helps ensure teaching is undertaken by teachers with the appropriate disciplinary, pedagogical and professional competences underpinned by suitable incentive structures and continuous professional development. Schools and science teachers do not work in isolation. Where change is conducted with the support of others, through collaboration networks of educators, students, science education researchers and stakeholders, it is likely to be more invigorating and successful for everyone (Hargreaves and Fullan, 2012). More opportunities should be provided to collaborate enterprise with civil society and bring real life problems into science education preparation and Continuous Professional Development (CPD). Research also shows innovation and job satisfaction are not mutually exclusive; teachers become more satisfied when they are directly involved (Bolam,et all,2005). By translating research outcome into challenges in classroom practice, teachers develop into more effective professionals (Fielding, 2013). Closing the gap between what we have learned from science education research and classroom practice are vital. Inquiry-oriented science education can produce positive result, but this requires reform in classroom practice, including a shift towards Assessment for Learning (AFL). Embedding the outcomes of science education research into teacher preparation, curriculum development and continuing professional development offer rich possibilities. Science educators also have a responsibility to embed concepts of Responsible Research and Innovation (RRI) directly into their teaching. For example, no teacher sets out to show that science is only for boys and men, yet some people draw this conclusion from how they learn and the examples and pictures that are used. Innovative science education encourages a view of science and scientist that is inclusive in terms of gender,

social, economic and cultural diversity. Undergraduate and post-graduate students can also practice responsible citizenship through option modules in community-based research and volunteering. These opportunities should be available to all students and teachers. Given the importance of science education in Europe's goals, there is a case to be made for adapting the lessons of the Bologna process to establish European Standards and Guidelines for science education in Nigeria. These would emphasize the range of outcomes expected for science education, both science specific competences and more genetic transversal competences.

Collaboration between formal, non-formal and informal educational providers: Despite the depth of the recent economic cries, demand for skilled labour in the Nigerian knowledge-based of the future will outstrip supply. Future skills forecast show that the share of the people with high-level qualifications will rise to more than a third of the labour force with people with minimum-level accounting for about half. Some of the greatest skill shortages are forecast to occur across STEM-related careers because too few students are choosing to study these discipline (Cedefop, 2012). And unfortunately, women are also less likely to end up working in science bases occupations than men. What is to be done is Collaboration between science educationalists, formal, non-formal and informal education providers, research centres, enterprise and industry and other professionals can play a vital role in increasing interest in science and science careers. Recent works show the benefit of drawing on expertise in innovation beyond school to co-create knowledge and stimulate innovation (Influencer, 2014). Partnerships between teacher, students and stakeholders in science related fields can offer exciting ways to introduce real-life challenges, with their ethnical and social issues, into a classroom setting while also aiding problem-solving skills. In a global competitive environment it has become increasingly important that professionals and enterprises have early and fluent access to the latest research findings and emerging technologies.

Building and developing networks that foster sharing of knowledge, life-long learning, innovation and co-creation of better solutions should form an internal part of formal education. Research also shows the value of collaborating across schools, science educators, families, researchers, enterprises and industry and civil society organisations (Bell, Cordingley and Goodchild, 2010). Collaboration may involve museums, science and leisure centres. Zoological parks, botanic gardens nature centres, science and technology business parks, etc. Where learning activities are carried out within partnership, all parties benefit as appropriate to their different agendas. 6Important result can derive from applying to real-world problems, focusing on the relevance meaning of the ideas and topics discussed and improving the all-over quality of teaching and learning. Public and private sector organisations and university students can play important role and help stimulate a desire to work in the field or even in the same organisation while gaining a deeper understanding of the challenges of school science. Collaboration is wide-ranging and it includes:

- Development or co-creation of ore-science and CPD courses, modules, materials
- Promoting STEAM entrepreneurship.
- Networks of companies supporting schools.
- Competitions, festivals, web quests.

- Cooperation with/between science museums, science centres, zoological gardens, botanical gardens, planetaria, observations
- Cooperation with/between NGOs, foundations academies of science and other community and society organisations
- After-school science programmes, at universities and research centres, with targeted for girls and marginalized groups
- Involving students as researchers and participant in the design, development and evaluation of innovation
- Support structures that help schools or local, regional authorities develop science education strategies
- Mentoring by entrepreneurs, SMEs and other stakeholders. Through mutual investigation and innovation, collaboration can produce better outcomes than working alone (Bolam, et all, 2005). But, care needs to be taken to ensure these collaborations are meaningful, with clear objectives and respectful evaluation of intended and unintended outcomes, to ensure the benefit is shared (Fothergill and Beard, 2012). Above all there is need to involve citizens, young and old, as active agents of the heart of inquiry-oriented science learning- in identifying and framing the research programmes and leading to the discovery of solutions and innovations which help situate science in every-day life (Jenkins and Isenga, 2013). In this way, we involve a richer pool of talent in framing a more responsible and ethical approach to research and innovation. Collaboration and team learning enhances key competences essential for the 21st century and highlights the benefit of portraying positive view of science. Working collaboratively, in spirit of co-creation, leads to benefits that are greater than the sum derived from the constituent part.

Greater attention should be given to promoting Responsible Research and Innovation: Over recent decades, there has been growing acknowledgement that knowledge of science and knowledge about science are essential for an ethical, sustainable and progressive society (Osborne and Dillon, 2008). Yet, surveys consistently show that while many Nigerians are interested in science and technology they feel inadequately informed. Less than half have studied science or technology at any level and many feel that our government are doing too little to stimulate young people's interest in science (EC, 2013). Quality science education involves a range of actors in different learning settings, including social, cultural and enterprise organisations. Many organisations are already involved in science based activities without thinking of themselves developing science understanding, including for example: recycling initiatives, patient support groups, community, health and environmental groups, gardening clubs and children's computer coding groups.

A key characteristic of meaningful participation is the emphases on self-discovery, curiosity and fun. Quality science education is not evenly distributed across Nigeria. Many sections of our population miss out during compulsory school and then cut off from many of today's big decisions about the future of the society. There are also big gabs between our highest and our lowest achievers. This presents a serious challenge. Finding solutions to society's complex challenges involves a broader understanding of

social and technological innovation. Valuing and evaluating the quality outcomes of science education and science education research should take account of collaboration and stakeholder involvement, adherence to Responsible Research and Innovation (RRI) values, internalization and societal impact and benefit (Schuyt,2014). This requires new ways to defile and measure what counts as success in order to match the objective of science education for active and responsible citizenship (Lang, 2012). Novel approaches that place an emphasis on learning and collective change such as those at the centre of health promotion, community arts and community and social development should be encouraged. This would help bring about more inclusive forms of science education and help reduce disparities. The intended shift to more active participation by citizens in science reflects the growing realization and participatory approaches, which respect human right and meet the ethical standards, bring tangible benefits for all (IDS,2006). Science and society benefit when RRI principles are embedded in projects from outsets and in all spaces where people learn. Promoting research integrity is an essential element; it is the basis of the trust the society vests in a specific endeavour. It is not only a way to protect and to be in harmony in the society but should also be seen as a prerequisite for achieving quality in research. These include non-formal and informal learning spaces, in the identification of research questions, as well as co-creation of approaches, resources and solutions (Eden, 2014). Adherences to the principles of RRI is necessary to ensuring stakeholders are involved throughout the process.

CONCLUSION

For Nigeria to cope with the global challenges, science education should focus on how to improve the transversal competencies such as ethical awareness and behaviour, persistence, critical thinking skills, autonomy, collaboration etc of science students of all levels in order to ease transaction from education to employment and throughout working life.

RECOMMENDATIONS

The following are recommended based on the facts discussed in this paper.

- ✓ Actions should be taken to continually improve teaching quality, with greater focus on teacher competencies, disciplinary knowledge, avoiding gender stereotyping and students and teachers learning together.
- ✓ Promote partnership between teachers, students, researchers, innovators, professionals in enterprise and other stakeholders in science–related fields, in order to work on real-life challenges and innovations including associated ethical, social and economic issues.
- ✓ The link between scientists, researchers, science educators and the media should be strengthened to ensure more effective public communication, in a way that makes the underlying issues and consequences understandable by citizens.

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