INNOVATION CULTURE AND SCIENCE EDUCATION FOR NATIONAL INTEGRATION

Daniel Okolo
okoloeyeso@gmail.com

Christine Agbowuro (Ph.D)

And

Tabitha Kamji Delmang (Ph.D)
Department of Science and Technology,
Faculty of Education,
University of Jos

Abstract
This paper looked at innovation culture and science education for national integration. The tool for every nation that wishes to grow, develop and be productive is education. Education can only be a successful tool if it is innovative. Innovation is a tool to enhance sustainable development in education for national growth, development, productivity and integration. National integration is the creation of a feeling of oneness where diversities are recognized and respected by imbibing a sense of nationhood. Education should be an important channel for developing the next generation of innovators and creative thinkers. The paper discusses innovation culture in science education, strategies for building innovation culture in schools. The paper further discussed the concept of science education and national integration, implication for national integration to include bringing people to share a developmental idea, facilitate inter-ethnic mixing and national integration to engender the spirit of loyalty to the nation.

KEYWORDS: Innovation culture, Science education, National integration

INTRODUCTION
Science education is a tool for growth, development and productivity in every nation. It is central to the development of individuals and the society in general. Science education is meant to provide knowledge that can transform the individual into a rational and creative thinking personality. Cornali (2012) states that today’s educational system is required to be both effective and efficient. This should automatically make the individual innovative. Education should become an important channel for developing the next generation of innovators and creative thinkers. However, the adoption and exploration of innovative ideas in education is often slow as many educators still cling to old and increasingly ineffective methods of teaching. Innovation is a tool to enhance sustainable development in education. Innovation
should intentionally bring into existence and practice something new, so as to enhance performance and growth through improvement in efficiency and effectiveness.

Innovation is the engine that powers prosperity and national competitiveness, especially in this 21st century. According to Unogu (2018), innovation is positively planned and provides specific changes that are initiated to facilitate the achievement of some defined goals. Also, according to Selman (2011), innovation is viewed as intentionally bringing into existence something new that can be sustained and repeated and which has some value or utility.

Innovation could be described as the introduction of something new relating to ideas, methods or devices. From the perspective of education, David (2018) defined innovations in education as those new, creative ideas which are meant to bring effectiveness and change to the educational sector and the society. Guest (2015) opined that the most compelling careers in the future are those that people create for themselves. Innovation is an incremental, radical, and revolutionary change in thinking, products, processes, or organization. Therefore, innovation should focus on creating values, ideas and better methods of doing things. The earlier there is interaction and understanding of the needs in the system, the better stimulators of new possibilities and the motivation for implementing them and the dream for national integration.

National integration is the creation of a feeling of oneness where diversities are recognized and respected by imbibing a sense of nationhood. National integration has educational, social, political, religious, regional and economic dimensions (Edosa, 2014). The main objective of national integration is to encounter all fissiparous forces. According to Raji and Ajibade (2014), there are three basic factors which are embedded in national integration policy: Firstly, structural equality which simply means that equal opportunity must be provided for all especially those who are socially and economically backward. Secondly, cultural unity which means caste discriminations like untouchability and inapproachability should be eradicated. Thirdly, ideological unity which means awareness about ‘national objectives’ should be created among the people who hold divergent views on political, religious and similar other fields.

INNOVATION CULTURE IN SCIENCE EDUCATION

Science is not only a body of knowledge to be learned and understood, it represents a powerful method in identifying and solving problems with a significant creative component. Well-planned and structured enquiry is fundamental to science teaching as it reflects scientific methods such as curiosity based on existing knowledge, hypothesis formulation, systematic observation, measurement and experimentation, leading to new insights, among others. According to Kampylis and Berki (2014), a deep understanding of the scientific method provides powerful knowledge to students, preparing them for further study in science and
helping them to understand applications beyond science. This definition made room for innovation. Innovation culture and practices in science education are believed to have positive influence on the students and can help to enhance their academic achievement in science subjects. Hence, the prerequisite for scientific and technological development of every nation lies in the placement of science education programme. This is possible if innovation and creative thinking become the culture and practice in science education programmes in schools and colleges. Placing emphasis on the creative teaching of science education and innovativeness can place a nation among developed and/or developing nations. Appropriation of innovation culture in the teaching of science education can provide learners with opportunities to acquire relevant functional knowledge and skills that are associated with scientific processes needed for advancement in science and technology, which have the capacity of breeding an economically sustainable society or nation. Innovation culture can help students to create new ideas in the areas of science that would bring positive changes.

For effective and efficient inculcation and successful practice of innovation culture in science education, the science curriculum must be revisited. Curriculum, as it is well known represents the total experiences to which all learners must be exposed. The content, performance objectives, activities for both teachers and learners, teaching and learning materials and evaluation guides are provided (Ejidike & Oyelana, 2015). Also, Akomolafe (2011) described the curriculum as a document which involves the learner, teacher, content, subject, resources, methods of teaching and evaluation, as well as the physical and psychological environment, which must be adequate and conducive for learning to take place. Invariably, curriculum serves as a vehicle through which education takes place. In appropriating innovation culture in science education curriculum, David (2018) identified three major issues shaping the development of nations and influencing the world of knowledge today. The issues are globalization, information and communication technology (ICT), and entrepreneurship. The science education curriculum content should focus on practical activities with emphasis on locally available materials to inculcate into the learners the spirit of inquiry and creativity. Innovation is not a project, it is a culture, a way of thinking that must be embedded into the school policy and practice in order to create a sustainable culture. Innovative values and practices must also become part of the school system.

To introduce innovation culture in science education curriculum and teaching, teachers are expected to have a good level of competence and mastery of innovation concept in the classroom. Teachers need to excite the interest and attitude of the students with regard to innovation culture in their teaching. According to David (2018), teachers are expected to be experts who have good exposure and experience in science to use innovative teaching strategies
which will help to foster the adjustment of students, matching curricular offerings to levels of mental development, understand students’ basic cognitive and social problems, making curricular specifications relevant, and motivate the students in the learning of science. The teacher needs to be familiar with how to apply innovations in science education teaching and learning. This will enable the teacher to be able to determine the most suitable strategy for an effective lesson delivery. As the teaching strategy adopted by a teacher either promotes or inhibits learning, David (2018) opines that teachers must use different innovative teaching strategies that will help to arouse the students’ interest and encourage them to develop positive attitude for effective learning outcomes. They have to lead in the active development of innovative teaching and learning materials using innovations and also in constructing a rich and enabling learning environment for the students.

**STRATEGIES FOR BUILDING INNOVATION CULTURE IN SCHOOLS**

Building innovation culture in schools simply means to build structures and processes that make innovation a daily way of life. Building a successful innovation culture in schools demands trust. Bryan (n.d) supported this by stating that trust is the first law of building the innovation culture and if one cannot create it or is unwilling to create it, then he should not proceed with the process. The most daring innovation may include within it a degree of new-found efficiency that spells the end for certain types of practices. Trust in the innovation culture does not mean a guarantee of success or a guarantee of freedom from pain and suffering. It does mean that whatever happens, we are committed to facing it together and supporting one another through the process, often with some personal sacrifice. Trust ameliorates the fear that grows from believing that innovation will lead to pain. Internal resiliency is another strategy for building innovation in schools. Internal resiliency proves that we can survive no matter what. Internal resiliency brings about self-confidence or self-reliance and self-reliance itself, is a foundation for trust (Langdon, 2007).

Innovation is synonymous with risk-taking. Schools and educators must create a culture of innovation by encouraging self-discovery and risk-taking. The schools must take proactive steps to prevent an atmosphere of suppression and fear, and build an environment of trust among teachers and students. Innovation is about challenging the status quo. That cannot happen in a risk-averse environment, or an environment in which new ideas are shut down (PageUp, 2017). Innovation culture comes into being when people actively engage in filling three essential roles. Firstly, look for insights to develop into ideas, and then into value adding innovations. This is what innovation’s creative geniuses do. Secondly, support innovation by helping creative people overcome the obstacles that otherwise inevitably impede their
innovation efforts. This is what innovation champions do. Thirdly, define firm’s expectations and policies to favour innovation. This is what innovation leaders do.

For effective planning of innovation, there are elements to be considered in the innovation process. These elements, according to Unogu (2018), include personnel, the specification of what is the actual task, method, equipment needed, plant, building or environment, cost, other social contexts, time, scheduling or coordination of activities, rationale for undertaking the innovation and evaluation of effects. Also, according to OECD (2016), skills for innovation can be grouped into three broad categories: firstly, subject-based skills which represent knowledge and knowhow in a particular field. Secondly, thinking and creativity, including both higher-order skills and creative cognitive habits. These competencies include critical faculties, imagination and curiosity.

Thirdly, behavioural and social skills, including skills such as self-confidence, leadership and management, collaboration and persuasion. For a successful practice of innovation culture, teaching methods need to be loose and not to be stiff and strict. A loosely organized strategy is much more innovative than a stiff and strictly organized strategy. The school system must embrace series of variables in which culture of innovation can be made manifest. Some of the series that must be embraced include teaching and learning strategies, pedagogy, instructional resources, technology in teaching and learning, ICT in administration, student administration, teaching and learning evaluation, resourcefulness, improvisation, instructional technology, and counselling strategies.

There are quite a few areas where innovations in education will help improve the system for everyone. These areas as spelt out by Phil (2018) and include: Firstly, focusing on STEM by preparing and empowering students with the foundational skills they need to succeed later in life. Secondly, addressing the needs of individual students as each student has individual learning style. Thirdly, practical education and soft skills that will prepare students for living in the real world. Technology allows teachers to individualize lesson plans to different students and their unique styles of learning. When it comes to actually teaching students how to become innovative thinkers, they need to learn and be encouraged to think creatively. They need to be taught independent thinking and learning. Innovative classrooms should place more emphasis on the soft skills needed to thrive in today’s world. As part of the effective process and strategy to implement innovation culture for national integration, time and cost of implementation must be considered. According to Kotelnikov (2011), the cost and time required to create a new product or service are so large that lack of a perfectly aligned and executed innovation strategy can be extremely wasteful.
The culture of innovation comprises ingredients for its sustenance. If top management do not embrace innovation, it will be hard to expect the organization to practice innovation culture. According to Otara (2012), the problem is that most senior executives in the educational system do not have a highly developed and deeply practical understanding of what innovation looks like as a corporate-wide capability. If the management embraces the culture of innovation, the people can be more comfortable about sharing ideas without fear of unpleasant consequences. Management and school heads should therefore attempt to make innovation an encompassing capability in the system.

**STRATEGIES FOR BUILDING INNOVATION CULTURE IN SCIENCE EDUCATION**

Developing strategies for building innovation culture in science education is a necessary step for transforming science education into a knowledge-based and innovation-led discipline. Building strategies for innovation culture to thrive in science education will provide the necessary foundation to achieve a sustainable national renaissance. It is envisaged that the collaborative and coordinated implementation of the strategies for building innovation culture in science education will integrate and prosper the nation, where citizens are assured of quality education and skills training, efficient and sustainable management of natural and scientific resources and environments to secure the interests of future generations.

Hampson, Patton and Shanks (n.d) discuss ten ideas for building effective innovation strategies in science education for the 21st century education as follows:

- **Open up lessons**: Which show that teachers should not be forced to execute their lesson plans with military precision.
- **Think outside the classroom box**: Learning should not be restricted to activities done only in the classroom. In line with this, STEM 2026 (2016) also recognizes and aims to capitalize on the opportunity to create more flexible and inclusive learning spaces using flipped classroom approaches and technology-enabled tools if an effective mechanism for ensuring equity of access and use of these methods and tools is established. Flipped classroom innovation strategy is where students gain content and technical knowledge through online videos outside of the classroom or school day to prepare them for more active, applied learning of the content in the classroom, and other technology advancements that can expand students’ access to authentic and interdisciplinary science education learning experiences. According to Hamden, McKnight, McKnight and Arfstrom (2013), flipped learning suggests that students benefit from this approach with respect to improved test scores, course completion rates, and attitudes toward learning.
Get personal: Getting personal on the students is an innovation culture that could enhance innovation in science education. Project-based learning is another way of getting personal in teaching that offers even more radical opportunities for personalization, as this allows students to draw on their passions, skills, and interests.

Tap into students’ digital expertise: For innovation culture to be built in science education, science teachers should be willing to tap into students’ digital expertise. This is because today’s students are natural investigators, researchers and synthesizers of information and are fast in mastering technology.

Get real with projects: Science is all about discovery, therefore, to build and sustain the culture of innovation in science education, learners should be allowed to embark on projects that require them to carry out research across subject boundaries, create a professional quality product that demands multiple drafts, and publicly present their work to their peers, their parents and the wider world. Projects help students develop into lifelong learners and in this rapidly changing, digital age, we need people who are good at learning. According to National Academies Press (2014), tasking students with tackling a grand challenge provides them with the opportunity to understand the relevance of science education to their lives and to see the value of it in addressing issues that are important to their communities.

Expect and help students to be teachers: Students should be allowed to play a more active part in shaping their own education and that of their peers. After all, they have a natural sense of what their peers find interesting, and can thus act as effective tutors.

Help and expect teachers to be students: The most inspiring teachers are the ones who are passionate about learning and who are as excited as their students to learn the answers to their enquiries, and who are constantly gathering new insights and ideas from a range of sources, both from within the teaching profession and beyond it.

Measure what matters: If innovation culture must thrive in science education, we will need to make sure students have experienced and mastered the skills they will need in a context that accurately reflects the world outside the school walls. Science education in the 21st century will be innovative, creative and beneficial if we measure only what matters for personal and national growth. In agreement, Duckworth and Yeager (2015) revealed that it will remain important in the future, as it is today, to assess the extent to which students are equitably developing facility with, and mastery of core content knowledge, value the enduring skills and personal qualities that demonstrate academic tenacity and competence, and other lifelong learning skills that will remain relevant in the years ahead.
Work with families, not just children: It is widely recognized that involving parents in their children’s education is crucial. This will help in finding holistic and innovative approaches that form bridges between the school, learners, parents and the community.

Power to the student: ‘Student voice’ – That is, giving students the opportunity to have a say in issues that affect their studies. This is about giving students real power over strategic decision making at all levels. Participation in high-level strategizing and decision-making also helps students to gain the attributes that are more in demand in the 21st century.

SCIENCE EDUCATION AND NATIONAL INTEGRATION

Science education plays the role of balancing the educational opportunities of the nation for better national integration, most especially, innovative and creative education. This was supported by OECD (2016) that an attempt made by government towards national integration was the recommendation to balance the educational structure between the north and the south in order to diffuse the rising tension over the imbalances in educational opportunities between the north and south. OECD (2016) further revealed that the establishment of national high schools, and unity schools which was based on the recognition and conviction that in bringing students of one ethnic group into contact with members of other ethnic groups, tolerance and mutual understanding would be festered, thus checking to some extent inter-ethnic differences among the educated youths. According Shehu (2013), throughout human history, education has remained the only essential and most significant tool/instrument with which the overall experiences, cultural norms and civilizational values of a given community/nation are transmitted across generations. This implies that the effective tool for national integration is education. It therefore means that education must braze up to be much more functional and creative. National integration might to a large extent, depend on the innovative strength of a nation’s education. This is in line with the assertion by Fairclough (2011) that the modern world is swept by change as new technologies emerge constantly and there emerge new patterns of competitions but also great new opportunities; success depends on how well we exploit our most valuable assets: our knowledge, skills and creativity as qualitative education that thrives is the key to designing high-value goods and services and is at the heart of a modern, knowledge driven economy. Oluniyi (2011) asserts that education reduces fear, ignorance, and personal detachment; it eliminates stereotyping, prejudice, racism, and bigotry; it provides alternative points of view to information already taught in most educational systems; it gives ethnic minorities a sense of belonging and a sense of being inclusive in history, science and so on.

IMPLICATION OF SCIENCE EDUCATION ON NATIONAL INTEGRATION

The implication of innovation culture and science education for national integration can never be over emphasized. National integration is crucial to the creation of a strong united
nation which is an essential precondition for every form of progress. It is a very strong condition for national survival and a blend of sentiments resulting in love for the country which may lead to the inculcation of knowledge of the nation, its pride, respect for the best in national environment, aspiration and traditions.

In summary, the implication of innovation culture and science education on national integration could include some of the following:

1. Innovation culture brings people to share a developmental idea that can boost national integration irrespective of socio-economic, cultural, religious and regional background or differences. This is in the view to foster the growth and development of the nation for better national integration.

2. Innovation culture can facilitate inter-ethnic mixing and national integration.

3. Innovation culture has the capacity to engender the spirit of loyalty to the nation, development of positive attitudes through shared experiences and ideas towards mobilization in national interest.

4. Innovation culture can make employers of labour employ persons with creative and innovative minds irrespective of their states of origin.

5. Innovation culture is the only knowledge that can sustain education and make the nation viable and productive.

RECOMMENDATIONS

From the foregoing, the following recommendations are made:

1. System of education should make innovation to be a culture that can become a sustained over time as part of its educational activity.

2. Schools should create and maintain the culture of innovation.

3. Students should be encouraged to engage actively in in-class and outside-the-class knowledge sharing activities that are innovative to add value to the future endeavours after school.

4. Innovation culture should be part of the school’s curriculum.

5. Innovation culture in education should be regarded as one of the parameters for building and sustaining national integration.

6. Capacity building workshops should be organized to train or retrain school heads, leaders and teachers on the need for innovation culture so as to address the observed gaps between qualification and experiences.

CONCLUSION

Innovation is the curiosity that connects educationists, professions, industries and even cultures together for common national integration. Any nation around the world that will
successfully lay the foundations for stronger sustainable growth in the future must focus on policies that encourage innovation. To have a successful innovation culture practiced in the school system, we must work hard to design and implement new approaches to education that we believe can be more effective for students than those we currently have in place. Education system desires innovation in teaching and learning, and assessment practice. Technology and other changes in society demand innovation in education. While many schools face challenges such as underfunding, unengaged students, and outdated curricular, innovation offers a path forward. In many ways, education stands to benefit the most from both utilizing and teaching innovation in the classroom. By exploring new and better ways to educate students and also teaching the skills students need to become innovators themselves, today’s educators can have a tremendous impact on the future of the world. Education systems should create environments that promote risk-taking and new approaches. Innovation requires a certain amount of dedicated time; therefore, we must adopt policies that will give similar dedicated time and space to learn and innovate in schools to enable us pursue new ideas that may prove successful.

REFERENCES


