

REBRANDING PHYSICS EDUCATION: A PANACEA FOR 21ST CENTURY
SCIENTIFIC CREATIVITY AND SUSTAINABLE NATIONAL DEVELOPMENT
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Abstract:

The aspiration of every country of the world today is to attain sustainable development through scientific creativity. This level of development can only be achieved through holistic rebranding of Physics education, which should begin from primary to tertiary level. Therefore, this study examined the imperativeness of rebranding of Physics education in Nigeria under the following subheadings: concept of creativity, characteristics of creative personalities, Physics education for sustainable development, the missing link between Physics and creativity and some rebranding perspectives in Physics education. On the basis of this, it was concluded that innovative strategy that yields the highest form of creativity should be introduced into Physics curriculum.

Keywords: Rebranding, Physics Education, Creativity, Sustainable Development.

Introduction

The study of Physics in this 21st century has become a basic necessity in order to understand the various phenomena around the world. Physics plays an important role in spearheading technological development of a nation. The knowledge of Physics can improve the quality of life and can also promote economic advancement of any nation. Recent discoveries in science, Physics in particular, have opened up new areas for space science and human development with a view to providing solution to the world's medical, food and economic problems. The implication of this is that, knowledge acquired in Physics can be applied in the areas of health, astronomy, agronomy, engineering, architecture, geology, biochemistry, pharmacy among others. All technology as established by Fasanya (2019) is hinged on Physics because of its emphasis on addressing phenomena involving the interaction

of matter and energy, which is necessary for the 21st scientific creativity. In support of this, Nwankwo and Okafor (2017) suggests that science educators and stakeholders should come up with the teaching-learning strategies that will stimulate students' creative minds. In recognition of this, Imo and Kefas (2016) emphasize that government and relevant agencies should invest on human and material resources to boost and sustain science, particularly, Physics education.

One of the goals of the senior secondary school Physics curriculum (FRN, 2009) is to enable students acquire scientific skills and attitudes as a preparation for technological application of Physics to stimulate and enhance creativity. Therefore, in order to stimulate creativity and develop process skills and correct attitude in students-activity oriented with emphasis on experimentation, questioning, discussion and problem-solving, 'Physics in Technology', which provides an opportunity for the construction and operation of workable gadgets such as X-ray machine, cars, electrical energy generation plant was introduced into the new Physics curriculum. To achieve these laudable goals, Achor (2008) and Mankilik (2019) emphasize the need for a shift from conventional way Physics is presently being taught to more creatively-friendly methods that encourage critical and logical thinking which would help students ask appropriate questions, gather relevant information and creatively sort through them and arrive at a reliable and trustworthy conclusion about the world they live in. This forms the motivating factor for this study.

In education sector, there are some higher order thinking skills such as analysis, evaluation and synthesis (creation) (Bloom, 1956) that students would not be able to achieve without assistance from the teacher. Therefore, teachers have always

been trying to use different kinds of instructional strategy in their mode of instruction. There is a popular expression that the only permanent thing in life is change. Therefore, the philosophy of change will continue to hold sway on learning processes even into the future (Emah, 2022). Since pre-independence till date, Nigerian curricula of education at all levels have experienced several upgrading to make them suitable for the current needs of the society. In view of this change, pedagogy of teaching Physics cannot also remain static. Due to the current educational demand of Nigeria, which aims to tackle the problem of unemployment, thereby creating opportunity for self-reliance, wealth creation, the tendency to depend less on the government, a new approach was evolved to cater for these responsibilities. In order to achieve this, a systematic approach that could realize the goals of education has been put in place. This is called Modern Teaching Approach for Creativity.

In a competitive market, producers devise strategies of identify their products as a means of attracting customers. This process is described as rebranding. Rebranding is a concept frequently used by manufacturer of a product and it refers to the process of advertising, use of symbols and other means of making customers associate a specific product with a specific manufacturer. Nworah (2009) noted that rebranding has been adapted by many countries to project the image of their nations to the rest of the world so as to attract foreign investment for tourism and trade. This is sequel to Nigeria's reputation as one of the most corrupt countries of the world, coupled with inadequate funding of education, poor infrastructure, poor input, poor process, poor output, among others. These issues give Nigeria a negative international image which calls for rebranding.

However, in spite of the numerous applications of Physics to human and national development, institutions in Nigeria have been producing only the theoretical Physicists and Physics educators. This has been attributed to the way Physics concepts are being presented to students. The conventional way of teaching Physics to students does not in any way encourage creativity in students, rather it makes them settle at what the teacher has to offer. With these attitudes and

disposition, Nigeria cannot forge ahead in the area of creativity and invention which aid sustainable development. This therefore, calls for rebranding of Physics education for creativity.

Concept of Creativity

Creativity is the survival skill for 21st century. This is one of the reasons some advanced countries such as China, Malaysia, America, Singapore, Australia, Britain, Germany among others have provided specific curriculum in their education system to nurture, sustain and increase creative mind in their students (Sani, Aliyu & Ibrahim, 2019). In the submission of Nwankwo and Okafor (2017), creativity is the ability to generate multiple and unique solutions to a problem. In other word, it is a way of bringing into existence something which did not exist before either as a product, a process or a thought. According to Fasanya and Danjuma (2021), creativity connotes the tendency to generate ideas, alternatives or possibilities that may be useful in solving problems. Creativity involves two processes: thinking, then producing. This implies that one has an idea and then put the idea into action. Creative thinking therefore, refers to a process through which new ideas, alternatives or possibilities are generated to solve problems. Scientific creativity depends not only on well-structured imaginations coupled with habits of hard work, but more importantly on the ability to integrate in functional ways, a wider range of ideas, concepts, and skills, which can be enhanced through the use of discovery method. Creative thinking is based on two aspects namely divergent thinking and convergent thinking. Convergent thinking, according to Olatoye, Akintunde and Ogunsanya (2010) deals with intellectual ability to think of many original, diverse and elaborate thought, while divergent thinking is the intellectual ability to logically evaluate, critique and choose the best ideas from selection of ideas. This implies that creativity is a mental process that involves the production of new ideas. It can therefore be considered as key to students' mastery of Physics.

Characteristics of Potential Creative Personality

A creative personality is always motivated because he/she sees the need for events, varied

and complex simulations, communicating values and ideas, and the need to solve problems. These attributes are put to test not only by the number of alternatives he/she can generate, but also by the uniqueness of those alternatives. In view of this, Franken (2014), Sani, Aliyu and Ibrahim (2019) identify some attributes of a creative personality as follows: flexibility, tolerance of ambiguity, good sense of humour, working towards achieving set objectives, derive pleasure by viewing natural phenomena, thinking differently, sensitive, smart, great deal of energy, passionate about his/her work, intuitive and hardworking.

However, there are two factors that influence creativity. These factors are environment and culture. A favourable environment where students are allowed freedom of interaction and participation, provision of adequate learning materials, will enhance creativity. On the other hand, where all these are absent can impede creativity. In Africa, particularly in Nigeria, some cultures still encourage their females to imbibe personality traits of quietness, submissiveness, passiveness because people believe that a woman's place is her husband's kitchen. This, according to Offor (2012) implies that males are more creative than females, a factor that can greatly discourage female students from getting involved in creative ventures.

Physics Education for Sustainable Development

One of the sustainable developments proposed by General Assembly for 2030 agenda is sustainable quality education. Sustainable development, according to Ejigbo, Wudil, Daramola, Inedu, and Mbanefo (2019) is the development that addresses the needs of the present without compromising the ability and needs of future generations. This can only be achieved by teaching Physics for creativity. According to Nwankwo and Okafor (2017), Nigeria needs scientists, particularly Physicists who are inventive such as Valentia Tereshkova- the first woman in space; Philip Emeagwali who did great work in the field of computer by designing the first programme to apply pseudo-time approach to reservoir modelling; Nikola Tesla who invented alternating current (A.C.), hydroelectricity plant, transistors, remote control, neon lightning, modern electric motor, radio

wave recorder; Einstein who contributed immensely on theoretical Physics and discovered photoelectric effect-an invention that gives birth to solar energy in our present day; Isaac Newton, who discovered the law of gravity and invented reflecting telescope; Margaret Geller an astrophysicist who headed a project called HectoMAP, which uses large data bases of information to map clusters of galaxies; John Tyler Bonner, a world leading biologist who led the way in making *Dictyostelium discoideum* (Nwankwo & Okafor, 2017).

The Missing Link Between Physics Education and Creativity

In Nigeria, the recently planned 6-3-3-4 curricula (Mankilik, 2019) have not been fully implemented. In view of this, creative-oriented science subject, especially Physics is urgently needed in Nigeria in order to rescue her out of poverty. There is equally need to motivate and encourage young scientists, particularly Physics educators who come up with creative and innovative proposals. In addition to this, the Nigeria national curriculum should be transformed with strong foundation in creativity. This will enhance sustainable national development.

Teaching Physics for creativity will enable students to be inventive and imaginative. Therefore, inventiveness and creativity are essential for science, technology and mathematics education. Physics can be taught creatively using science process skills to engage students' minds and hands on, that is, minds-on and hands-on strategy. Others teaching strategies that promote creativity include constructivist-based strategy, such as conceptual change or teaching with analogy model, metacognitive models, inquiry-based model, field trip among others. These strategies would expose students to explore their environment, ask questions and propose answers which will enable them develop new insight from what already existed.

Nigeria as a developing country needs developmental agenda through the knowledge of Physics, which encourages creativity and not just reading and memorizing the concepts. As stated in the National Policy on Education (FRN, 2014)

the core science subjects for Senior Secondary Schools are Biology, Chemistry and Physics. The combination of the three would enable students to pursue science related courses such as medicine, engineering, pharmacy, nursing, geology among others at tertiary level. However, most of the secondary schools in Nigeria lack both human and material resources to adequately prepare their students for national examinations such as the West African Examinations Council (WAEC), National Examinations Council (NECO) and the likes. Hence the only way to ensure that these students do not fail these science subjects especially, Physics is to assist them during these examinations. With this mindset, Nigeria may not be able to produce students who will have creative mind and skills for 21st century scientific creativity.

In addition to this, the Nigeria Physics curriculum do not make provision for studying of Physics right from primary school level. Nigeria should copy the steps of developed countries for creativity. In New Zealand, as described by Novintanurulsari and Agus (2017), primary and secondary education are meant to develop scientifically and technologically liberate society that is able to utilize knowledge, skills and opportunities for social, environmental and economic betterment of the country. To achieve these goals, teachers of science, technology and mathematics are released from school to work for the project of their choice, hosted by industries or tertiary institutions, communities, group or research institutes. This creates a better understanding and appreciation of the importance of science and technology education in schools by the teachers as well as exposing students to the world of creativity.

In Australia, according to Wals (2012), the curricula combine both the traditional primary, secondary and vocational subjects so that on completion of secondary school, students are awarded diploma which is recognized by both industries and universities. Sciences, mathematics, technology and engineering are pivotal to American education for economic competitiveness and quality of life of the citizens. In Germany and Britain, according to Edem (2005), the school system trains a good number of

young people in technological skills like electronics, craft, design, mechanics and new technologies as part of preparation for living in a technological society. In Singapore, as described by Cirfat (2019), the curriculum addresses the needs of the present and future goals of the learners. The curriculum also enhances learners' entrepreneurial and creative spirit that enable the young people think independently. This should be emphasized in Nigeria.

Aspect that Needs Rebranding in Physics Education

Ineffective Methodology: Teachers' methodology needs to fit the new paradigm. In spite of global shift in teaching pedagogy from textbook direct teaching to more interactive technology-based methods, most Physics teachers are still holding on to the textbook, lecture, note taking methods which are suicidal to life-long learning and cultivation of high-level thinking skills such as analytical, problem-solving and creative skills. Innovative teaching methods that produce highest form of life-long learning in students include problem-based learning and thinking, science process skills to engage students' minds and hands (minds-on and hands-on activities), field trip, soft scaffolding in cooperative condition, constructivist strategy, concept map, collaborative/team teaching among others should be adopted (Basil, Ene, Uzosike & Oparaku, 2020). These type of methods will enable students to explore their environment, ask questions and propose answers that would enhance them to develop new insight from what already exist should

Poor Knowledge of the Subject Matter: For effective creative teaching to take place, Physics teacher has to be expert in Physics concepts. However, in Nigeria we often find people who did not specialize in Physics in the University or College of Education teaching the subject. For example, someone who studied engineering can be asked to teach Physics or mathematics. Such teacher will rely solely on textbooks for teaching the subjects (Adeyemi & Olajide, 2019). This necessitates rebranding in the training of teachers in the institutions of Teacher Education as expertise in Physics at secondary school. This would make Physics teachers subject-matter

experts with training background that inculcate methods, techniques, instructional materials and assessment strategies necessary for that discipline. This would help them integrate various content areas into coherent lessons.

Unsatisfied Attitude: Most Physics teachers are not satisfied with teaching and are looking forward to leave the job probably due to low financial remuneration. This attitude would reflect in the commitment of such teachers to their job and would not significantly enrich, encourage, direct the students on how to explore their environment for creative thinking for self-reliance (Emeka, & Ikwen, 2019; Joseph, 2019).

Unethical Professional Behaviour: Morality has to do with the principles of right and wrong. Taking part in any immoral attitudes is highly unacceptable in teaching profession (Okegbile, 2019). Physics teachers need to cultivate ethical professional behaviour such as commitment, professional relationship with their students, mentoring and interest in improving practices.

Poor Teacher/Students' Relationship: Effective creative teaching/learning entails the teacher having proper understanding of his students. This understanding comes through the knowledge of child development characteristics and learning styles of the students he/she teaches. This knowledge strengthens the relationship that exists between the teacher and the students and ensures formative assessment as individual differences may arise in mental abilities, slow and fast writers, physical challenges, extroverts and introverts. Knowledge of students will enhance effective physics classroom delivery (Usman, Orji & Fasanya, 2019).

Teaching Physics in Isolation: There should be topics linkage. There should be integration between topic and topic, between concept and concept and between subject and subject. Physics teacher should link the topic or concept to be taught to other topic or concept. For example, resistance in current electricity can be linked to capacitance in static electricity.

Employment/Recruitment: Teachers hold the power to either distort, pervert or twist the minds

of the young or set their minds on the path of actualization (Haggai, 2012). In view of this, at the point of recruitment, only Physics applicants that possess inner motivation and passion for teaching and love for students should be employed as Physics teachers.

Poor Research: Physics teachers cannot perform their work well without research, especially action research. Physics teachers interact with the students on daily basis, study certain learning behaviour in them and report their findings in form of seminars, conferences, and workshops. Teachers who teach Physics for creativity are also researchers (Adeosun & Bragiwa, 2019).

Ineffective Training: Effective training helps Physics teacher to acquire pedagogical and technological skills (Usoro, 2022). Therefore, the teacher training programmes in Nigerian Colleges of Education and Faculties of Education in the Universities needs to be overhauled to make them more effective in training and retraining of Physics teachers in the new emerging methods of teaching.

Information Communication and Technology (ICT): This is the technology-driven age with various learning packages such as Computer Assisted Instruction (CAI), Computer Assisted Learning (CAL) among others, which are meant to improve teaching-learning process and enhance research (Bande, 2023). Therefore, it should be made as one of the prerequisites for recruitment. Hence, Physics teachers should do their best in acquiring ICT skills as this would greatly transform their teaching skills and make them internationally marketable.

The Mass Media: Mass media include newspapers, magazines, radio and television and internet, which can be applied to facilitate effective communication (Wusa, Soliu & Elisha, 2019). These should be used to promote the image of Physics teachers through advertisements and documentaries with captivating titles such as “Be a Teacher, be a Hero”, “Tribute to my Physics Teacher”, “A Nation that neglect Physics Teacher is a Nation Drifting towards its Doom”, “My Physics My Angel”.

Funding of Physics Education: To reposition or rebranding Physics education, the government and all stakeholders should allocate more funds to physics education to address the deficiencies of Physics instructional materials that would help students adequately equipped with the necessary skills for 21st century scientific creativity

Curriculum Policy: The change in educational curriculum is often ill-equipped with deficits in both human and material resources for execution. For students to be taught relevant scientific skills and knowledge of Physics that will prepare them for the challenges of the 21st century scientific creativity, the Physics curriculum should be updated to reflect the Nigeria current realities and future needs (Gwang, 2019).

Conclusion

The study examined the imperativeness of rebranding Physics education in Nigeria. In the foregoing discourse, the study highlighted various issues for holistic rebranding of Physics education for creativity and sustainable development in the 21st century. Perhaps what is urgently required for Nigeria citizens to benefit maximally from Physics education is the imperativeness of the teaching-learning of the subject in such a way to stimulate and nurture creativity in the learners right from primary to tertiary level. This would help close the gaps between Physics and creativity as the case is with some developed countries of the world. Aspects that needs rebranding such as teaching methodology, content mastery teacher's ethical professional attitudes, funding, policy, among others should be prioritized by the government and other stake holders. Therefore, it was concluded that innovative teaching that yields the highest form of creativity should be introduced into Physics curriculum.

Recommendations

Based on the issues discussed, the following suggestions were made.

1. Concept of creativity should be introduced into the Physics curriculum, which would accommodate the learning of the subject from primary to tertiary level.
2. Government should prioritize standard

professional development of physics teachers to maintain a reasonable level of content mastery, ethical professional attitudes, technological skills and others. These would yield qualitative creative minds.

3. Physics curriculum planners should be called upon by the government to reform the curriculum so that innovative teaching strategy that promotes creativity should be introduced into primary and secondary schools' curriculum as the case is with some developed countries.

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