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TEACHING BIOLOGY FOR CREATIVE THINKING TO INSPIRE DEVELOPMENT OF INDIGENOUS TECHNOLOGY AMONG HIGH SCHOOL STUDENTS IN PLATEAU STATE, NIGERIA

Lagan, A. N. (Ph.D.)[1], Ejigbo, J. O. (Ph.D)[2] & Otagbo, A. A. S.[3]

[(1,2,3)] Department of Science and Technology Education, University of Jos, Nigeria.

Author: 08178548543 andatlagan@yahoo.com

Abstract

This study was a survey of the awareness of Biology teachers on teaching for creative thinking with emphasis on inspiring students to think creatively to develop indigenous technology using resources around them. Survey design was used for the study and the population comprised Biology teachers in Plateau State. Purposive sampling technique was used to select 60 Biology teachers from the population. A questionnaire titled "Teaching Biology for Creative Thinking to Develop Indigenous Technology" was used to collect data. Cronbach Alpha was used to determine the reliability of the instrument which was 0.93. Data was analyzed using descriptive statistics and the results obtained revealed that a large percentage of Biology teachers are of the view that teaching strategies should be emphatic on creative thinking to enhance students' intellectual capacity to bring up new ideas and initiatives to develop indigenous technology to find solutions to the peculiar problems of society. Therefore, it is recommended that teachers should be encouraged to devise appropriate teaching strategies that can enhance creative thinking in students to inspire the development of indigenous technology during pedagogy so that the students can also contribute to national development with the novel ideas from creative thinking. The project based teaching strategy is discussed in this paper.

Key words: Indigenous technology, creative thinking and development.

Introduction

The secret of technological development of any nation lies in the study of science and in Nigeria, greater emphasis is being placed on Science, Technology and Education (STE) to meet the developmental needs and challenges of contemporary times (Lagan, 2024). Biology is one of the science subjects offered at high school level to give students a foundation or background knowledge about life and the interactions that go on in the universe. Ordinary level biology is meant to confer on students', information about living things and the interaction of these living things and the environment. The knowledge about the interactions in nature and how nature affects life is imperative and this knowledge should be passed on from one generation to the other through education. Unfortunately, teaching biology has just been about passing information to students without consideration that the students' can use the information to think creatively so as to come up with new initiatives in indigenous technology that would provide answers to the peculiar problems of society (Lagan, Agbo, John & Dawal, 2023). Some areas that have peculiarities of problems which have inclination to Biology include health and sanitation, food production, prevention of diseases, provision of medicines, refuse disposal etc. Every society has its peculiarities in terms of problems confronting it, some of the problems have a universal approach to solving them while some require unique approaches to solve them because of the peculiarity of such problems. Nigeria is not left out of this quest to utilize indigenous technology to solve peculiar problems. This study was done to draw the attention of Biology teachers to the salient issue of engaging teachers to teach students so that the students when armed with the information can develop indigenous technology to find solutions to problems confronting society. The study attempts to bring to the knowledge of biology teachers that there are strategies of teaching the subject in such a way that the students would utilize the knowledge to develop indigenous technology to proffer solutions to the peculiar problems confronting society.

The nation needs creative thinkers who would bring up novel ideas and initiatives that could provide answers to the numerous problems in society. The high school is a good starting point for inspiring learners to think creatively to find innovative ways of solving problems using indigenous technology. Therefore, teachers are encouraged to devise appropriate teaching strategies that can enhance creative thinking that will inspire development of indigenous technology in students during pedagogy so that the students can also contribute to national development with the novel ideas from creative thinking. Many developed countries have succeeded to attain economic growth and transformation through the exploitation of indigenous technology and resources within their domains. This process has seen the conversion of local challenges to opportunities which brought about economic growth and transformation by means of sustainable development (Diboye-Suku & Onuoha, 2019). The authors add that the development of indigenous technology can solve Nigeria's economic over dependence on crude oil, with potency for economic diversification resulting to economic growth and transformation and concluded that indigenous technology is solving Nigeria's problem in a Nigerian way. They advocate that priority should be given to local innovative ideas and initiatives. Therefore, reliance on foreign technology to solve peculiar problems that are indigenous is no longer tenable because

over time, experience has shown that you cannot continue doing the same thing and expect a different result. It is high time to begin to look inwards to develop and utilize indigenous technology to find solutions to some of these problems that have defied solutions over time. Not doing this will have consequences for the nation, as the nation will have to rely on foreign technology instead of indigenous technology to solve its problems which are peculiar to it.

Araoye (2016) writes that the human society has greatly explored and exploited biological knowledge over time to produce food, beverages, fibre and other raw materials and that the advent of modern technologies and new Biological knowledge has vastly expanded the application of Biology therefore making the Biological skilled-work force essential for national development. Araoye further asserts that Biology education has the potential of equipping individuals with acceptable skills for national productivity. Therefore, Biology learning requires good understanding of Biological concepts that emphasize creative thinking skills. From the foregoing, the call for creative thinking and development of indigenous technology in Biology has become imperative because creative thinking is one of the most appreciated skills in the 21st century so it has become a higher order thinking skill for proficiency and strategic engagement especially for national development (Lagan, Agbo, & John, 2022). The 21st century education requires students to ably compete in a global competition by developing survival skills and knowledge. The very rapid development of science is shown by the industrialization and global era that enforces people to acquire qualified skills which come along with science and technology development so the quest for indigenous technology has become imperative in our nation. For instance, according to Okirigwe, Ahmad, Adewole and Omimakinde (2020), Nigerians had issues providing safe drinking water for the citizens, until after the establishment of the National Agency for Food and Drugs Administration and Control (NAFDAC) in 1993 where strict compliances were enforced for the production of sachet and bottled water across the nation and in 2007 the Standard Organization of Nigeria (SON) complimented NAFDAC activities to further strengthen the adherence for producing quality clean drinking water. This gave rise to the adoption of indigenous technologies and the development of new skills in production of safe drinking water in Nigeria. Furthermore, Ibitoye (2011) writes that most poultry equipment available in Nigeria were imported and the expensive nature of these equipment, the difficulties encountered in purchasing them, coupled with the problem of lack of fund had made large-scale production of poultry very difficult in Nigeria, therefore, the need to resort to indigenous technology for the construction of poultry incubators using indigenous knowledge with the aid of local materials. Fadipe (2023) adds that the pivotal role of indigenous technology in shaping the socio-economic development of contemporary Nigeria with a particular focus on the pottery, leather, textile, craft, and iron industries cannot be overemphasized. The economic and cultural contributions of indigenous technology to contemporary Nigeria are undeniable and provides an avenue for job creation for the population to accelerate economic growth. Fadipe also advocates for scaling up of indigenous technology as a cornerstone of sustainable development and preserving and modernizing these indigenous technologies to meet with global standards while meeting the peculiar needs of the people. Nigeria can harness its full potential to improve livelihoods, promote cultural heritage, and

address pressing global challenges when students at the high school level are taught to be creative and inspired to develop indigenous technology for problem solving.

PROBLEM STATEMENT

Some of Nigeria's problems are peculiar to Nigeria and so require indigenous innovative ways and technologies to solve. Teaching and learning in high schools has been more emphatic about passing examinations for placement into higher institutions with little or no emphasis on students creative thinking. As a consequence, there is over dependence on foreign technology to solve even the smallest problems whereas, there is an abundance of local resources that could be utilized to find solutions to some of these problems that may be peculiar to the community. Society only needs creative thinkers to find innovative ideas to develop the indigenous technology to find the solutions needed to solve these problems.

RESEARCH OBJECTIVE

The research objective was to find out

1. if teachers are aware of teaching strategies that emphasize students' creative thinking to develop indigenous technology
2. the level of awareness among science teachers with particular emphasis on Biology teachers.

   This is to help the system to generate a data base that could be used as reference point when dealing with matters of improving pedagogy for national productivity.

RESEARCH QUESTION

1. What is the level of awareness of teachers of the teaching strategies for creative thinking to inspire development of indigenous technology?

METHODOLOGY

The research design was a survey aimed at appraising the awareness of Biology teachers on teaching students for creative thinking during pedagogy to develop indigenous technology. The purposive sampling technique was used to select a population of 60 Biology teachers who were administered an opinion poll instrument comprising 10 items on their awareness of teaching students for creative thinking to develop indigenous technology. The instrument was titled "Teaching Biology for Creative Thinking to Develop Indigenous Technology" (TBCTDIT). The instrument required responses from the teachers on their level of awareness on teaching Biology for creative thinking to develop indigenous technology. The instrument was given out to the respondents and then retrieved for analysis. Descriptive statistics was used to analyze the results obtained from the instrument.

Respondents were required to give opinion in a 4-point rating scale on the following;

1. Awareness of teaching for creative thinking to develop indigenous technology
2. Compliance to teaching for creative thinking to develop indigenous technology
3. Knowledge of the teaching strategy to use during pedagogy
4. Teacher's attitude to teaching for creative thinking to develop indigenous technology
5. Availability of resource materials to teach for creative thinking
6. Teacher's disposition to teaching for creative thinking to develop indigenous technology
7. Administrative support to teaching for creative thinking to develop indigenous technology
8. Educational policy on teaching for creative thinking to develop indigenous technology
9. Awareness of society on teaching for creative thinking to develop indigenous technology
10. Teacher's willingness and readiness to adapt to teaching for creative thinking to

RESULTS AND DISCUSSION

Items	No.	Respondents'	% resp.
Teacher's awareness of subject matter	60	53	88.3
Teacher's compliance	60	55	91.6
Teacher's knowledge of strategy	60	58	96.6
Teacher's attitude to teaching	60	60	100
Availability of resource materials	60	60	100
Teacher's disposition	60	57	95
Administrative support/resources	60	58	96.6
Educational policy	60	50	83.3
Awareness of society	60	50	83.3
Willingness and readiness to adapt	60	59	98.3

The findings from the study reveal that Biology teachers agree that they do not teach students for creative thinking to develop indigenous technology as 88.3% of the respondents agree that they are oblivious of it while 91.6% of the respondents agreed that due to lack of awareness

there has been no compliance with any teaching strategy that enhances creative thinking to develop indigenous technology. 100% of the respondents have a negative attitude to any ideas to teach Biology for creative thinking due to unfamiliarity with it.100% of the respondents responded that there were no resource materials for teaching for creative thinking in Biology even if there was a teaching strategy for pedagogy while 95% of the respondents were not favourably disposed to the idea. 96.6% of respondents concurred that there was no administrative support for the initiative while 83.3% were of the opinion that the initiative should be entrenched in the educational policy to get compliance by teachers. Also, 83.3% attested that the society was not aware of the new trend and 98.3% expressed willingness and readiness to adapt to the new trend to foster the drive for sustained national development.

The findings of this study may help to draw attention of policy makers to the salient issue of teaching for creative thinking to develop indigenous technology in high schools to provide a data base to serve as reference point when matters of improving pedagogy are discussed. The findings also provide an understanding of the place of creative thinking as the new trend in pedagogy so that strategies for teaching for creative thinking to develop indigenous technology can be inculcated in pedagogy to enhance the capacity of the learner to think creatively to bring up new ideas and initiatives to develop indigenous technology for problem solving. This will in turn produce a generation of creative thinkers who will add value to the efforts geared at national development because they have been equipped with the requisite skills to think creatively during pedagogy and be productive in adding value to the economy of the nation.

STRATEGY FOR INSTRUCTION IN BIOLOGY FOR CREATIVE THINKING AND DEVELOPMENT OF INDIGENOUS TECHNOLOGY

There is increasing recognition of the importance of using indigenous (traditional) knowledge for contextualizing school science instruction because it forms part of students' prior experiences and source of information that they carry to school during learning. Despite its proven effectiveness as useful teaching tool, there is yet no systematic effort to develop effective framework for incorporating knowledge of indigenous technology into school science curricula to complement instruction process in Nigerian schools (Erinosho, 2013). Studies have investigated the effects of teaching strategies on promoting creative thinking skills, however, most of the teaching strategies focus only on divergent thinking as a sub-skill to promoting creative thinking among high school students. Even though no systematic review has been carried out to propose a teaching strategy, the "project based teaching strategy" can be used to promote the creative thinking skills and a "science –scenario task orientation" can be used to incorporate students' creative thinking skills in the Biology class. The project based teaching strategy according to Nasir, Halim and Arsad (2022) has been identified as a comprehensive teaching strategy that can promote students creative thinking skills in secondary Biology classes. Divergent thinking, a sub-skill of creative thinking has been found to inspire the development of indigenous technology because of its emphasis on creative writing exercises based on the science concept being taught. So the project based approach offers students the chance to work with open ended problems or tasks that require

creative solutions which is the ultimate goal of the strategy and then followed by the development of indigenous technology with the information learnt during pedagogy.

Although many theories that have been very impactful in the understanding of the process of learning have been proposed, Vygotsky's theory on social constructivism seems to be more relevant in the case of creative thinking and development of indigenous technology which is the focal point of this study. This is because Vygotsky's pedagogical idea emphasizes the interplay of culture and social context in the construction of knowledge during learning and understanding of the events in the social setting of the environment where the learning takes place. To social constructivists, meaningful learning implies that the knowledge that a student acquires in school has an important connection with the learning acquired through everyday experience. Therefore, the role of the social context is to scaffold the learner, and provide hints that foster construction of knowledge while interacting with other elements in the environment. In the light of the foregoing, the project based teaching strategy has become a veritable strategy to use in teaching students for creative thinking to inspire the development of indigenous technology to meet the needs of the society in finding solutions to some of the peculiar problems confronting the society.

CONCLUSION

Effective science learning is believed to take place in a situation where there is harmony in the cultural experience of the learner as determined by the school, the home and the community in which the learning takes place. When there is such harmony, science instruction will tend to support the learners' view of the world and the process of enculturation tends to occur whereby, allowing for successful border crossing from the prior knowledge the learner has acquired from the cultural experiences to the new experiences in school science. Then the learner can build the confidence to develop indigenous technology from the lessons learnt by thinking creatively to come up with novel ideas and initiatives that could proffer solutions to some of life's problems.

This study highlighted a teaching framework that could be used to place formal school Biology instruction in the context of creative thinking and development of indigenous technology so as to recommend its effectiveness on learning of concepts in Biology among high school students. There is increasing recognition of the importance of using indigenous (traditional) knowledge for contextualizing school Biology instruction and the reason is not far-fetched because the growing needs of man requires that innovative ways of finding solutions to meet these needs have to be constantly thought out more especially if these needs are peculiar to the environment of the people with the needs.

RECOMMENDATIONS

Having established that there is the need to devise and utilize innovative teaching strategies that would inspire creative thinking in high school students to develop indigenous technology to utilize local resources in our communities to find solutions to the peculiar problems in our communities, the following recommendations are hereby proffered;

(a) Supervising institutions and regulatory agencies should explore ways by which when planning the school curriculum and pedagogy, innovative strategies for teaching like the project based teaching strategy could be advocated for teachers to utilize so as to

inspire creative thinking in students to develop indigenous technology by utilizing local resources around them.

(b) Teachers should be trained on the use of innovative teaching strategies like the project based strategy that could to enhance creative thinking in high school students. This could be through workshops and seminars to build capacity for effective and meaningful learning during pedagogy.

(c) Instructional materials like text books and work books should be published with emphasis on innovative teaching strategies like the project based strategy which could enhance students creative thinking and achievement with a focus on development of indigenous technology using local resources around.

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