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THE PHILOSOPHICAL CONFLICT AND HARMONY IN THE CO-EXISTENCE OF SCIENCE, LIBERAL ARTS AND TECHNOLOGY EDUCATION IN NIGERIA.

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ABSTRACT

The paper reviews the philosophy of science, liberal arts and technology. It presents the philosophical points in support and against the co-existence of science, liberal arts and technology education in Nigeria. At present, the system of education is biased towards science and technology as well as influenced by the philosophy of pragmatism. Since industrial and technological development can lead to economic independence, more attention is being paid to human resource production in science and engineering as well as entrepreneur development in the public and private sectors. With abundant resources, Nigeria needs scientific and technological knowledge to transfer her resources into goods and services. There is the need to nurture technology education programme so that it can grow to the desired level and status in the hands of technology educators.

INTRODUCTION

The philosophy that governs the direction of Nigerian education could be traced to the recommendation of the 1969 National Curriculum Conference in Lagos which involved all interest groups and provided a forum for Nigerians of all levels of society to express their opinion on the kind of education that the country needs. This is proper in that it is the society which sets the goals while education is provided based upon societal needs. The curriculum conference which was summoned by the Nigeria Educational Research Council, reviewed old goals and identified new ones for education at all levels. As a follow-up of the resolutions made at the curriculum conference, a seminar on National Policy on Education was held in June 1973. The results of these meetings were published by the Federal Military Government in 1977 while a revised National Policy on Education was approved in 1981.

Nigeria's philosophy of education is based on the integration of the individual into a sound and effective citizen and equal educational opportunities for all citizens of the nation at the primary, secondary and tertiary levels, both inside and outside the formal school system (Federal Republic of Nigeria, 1981). Based on the above, the education aims have been listed as:

1. the inculcation of national consciousness and national unity,
2. the inculcation of the right type of values and attitudes for the survival of the individual and the Nigerian society:
3. the training of the mind in the understanding of the world around; and
4. the acquisition of appropriate skills, abilities and competencies both mental and physical as equipment for the individual to live in and contribute to the development of his society.

This philosophy is geared towards social, cultural, economic, scientific and technological progress. The desire to achieve a rational, qualitative and functional system of education led Nigeria to make provisions for the operation of the 6-3-3-4 educational system. The system implies six years of primary education, three years of junior secondary, three years of senior secondary and four years of tertiary education. This changed the educational structure from the former 6-5-2-3 structure to 6-3-3-4 structure in September, 1982. The change is significant in that the secondary education has been split into levels - junior and Senior. Besides, the policy provides for more balanced inputs from Arts, Sciences, Technical and Vocational courses. The system emphasises practical or pragmatic orientation to problem solving. It is important to note that the National Policy on Education took care of the major weaknesses of the inherited colonial educational system which emphsized academic and literary studies to the neglect of science and technology education. The deficiency in the old school curriculum had negative effect on industrial and technological development of Nigeria.

The 6-3-3-4 system of education which Nigeria is now operating is a functional education that is supposed to equip its clientele with skills, knowledge and aptitude needed for self employment. The system provides for changing needs, interest and abilities of children as advocated by Jean Jacques Rousseau (1712 - 1778). It also agrees with practical approaches of Pestallozzi (1746 - 1827), Fellenberg and the philosophy of John Dewey (1859-

1952) which emphasizes practicality, experimentation, methods that work and scientific approach to problem solving.

The purpose of this paper is to present the philosophical points in support and against the co-existence of liberal arts, science and technology education in Nigeria. The paper therefore addressed the following:

1. The philosophies of liberal arts, science and technology
2. The philosophical conflicts in the co-existence of the fields.
3. The philosophical harmony in the co-existence of the fields
4. Contemporary developments and position of the writer on the issue.

PHILOSOPHIES OF LIBERAL ARTS, SCIENCE AND TECHNOLOGY EDUCATION

The Nigerian educational system has been influenced by liberal arts, science and technology education in different degrees. The liberal arts is greatly influenced by Aristotelian concept and other idealists who lay emphasis on the importance of human mind and see the learner as a mind to be disciplined. This line of thought is based on a psychological theory that the mind is divided into various faculties such as reason, memory and taste. These were to be strengthened through rigorous exercise and the best subjects for such training were thought to be Latin, Mathematics and other classical liberal studies. Liberal education is therefore concerned with the cultivation of the intellect for the purpose of achieving intellectual excellence (Tanner, 1975; Deighton, 1971; and Hirst, 1965). Nigeria inherited the liberal arts education from the colonial masters. Nevertheless, the overall national aspiration for development made it necessary to strengthen science education in Nigeria after independence in 1960.

Science is that form of human activity which is devoted to the production of theory related knowledge of natural phenomena and whose root function is to attain an enhanced understanding of nature (McGinn, 1991). Science started to exist in the school curriculum as nature study and rural science. Over the years, the aims and content of science curricula have been re-examined and improved. At present, the teaching of science is an important component of education in Nigeria. Science education is literacy in science for non-specialists and education in science for specialists.

Science for non-specialists make them literate in some principles which will enable them to take decisions on matters that affect their lives. It requires general or integrated science which will expose them to basic process of solving problems. This is delivered at the nursery, primary and junior secondary school levels. For specialists, they need the body of knowledge which includes principles and theories in specific areas of science. This will enable them to cultivate scientific attitudes such as rationality, curiosity, objectivity and aversion to superstition. The programme is designed for the senior secondary school level and above. The objectives of teaching of science include:

1. the exposure of students to methods used in science to discover knowledge;
2. Cultivation in students the habit of keen observation, accurate measurement and recording of data;
3. Arousal of curiosity and attitude of inquiry in students;
4. Presentation of science in ways that foster comprehension, combination of ideas into new products and organisation of data already known in order to explain unknown phenomena;
5. Giving the students skills in assessment of relative values based on specific criteria; and
6. Giving the students the opportunity of manipulating scientific reagents, apparatus and equipment for the purpose of finding out or solving scientific problems (Emina, 1991).

The philosophy of science is concerned with discovery. Each branch of science presents new ways of regarding old phenomena while the laws of nature help to explain phenomena which are presented in the form of theories, laws, hypothesis and principles (Russell, 1976; Toulmin, 1967 and Singer, 1965).

Nigeria is convinced that science and technology must play vital roles in her national development. She recognised the need for trained human resources such as scientists, engineers, technicians and other sub-professional levels (Federal Republic of Nigeria, 1981). To this end, Nigerian leaders started development plans after independence in order to expedite the growth of infrastructure, industries, agriculture and development of needed human resources. Nigeria now strives for economic independence which can only come with industrial and technological development.

The philosophy of technology rests on the tenet of pragmatism which is the philosophical basis of progressivism which is aimed at freeing education from the grips of traditionalism. The pragmatic view is that all human life depends on experience and the experience of man is responsible for the dynamic changes of ideas, values and realities. (McGinn, 1991; Ozmon and Craver, 1976; and Landes, 1972). Hence, the pragmatists advocated for child centred education, inquiry and problem solving approach, and equipping the child with knowledge and skills for social efficiency. Technology is the way of doing things through the application of knowledge derived from systematic investigations of natural forces and materials. It leads to the development of processes and devices indispensable to the enhancement of the quality of life and to human progress. (Federal Republic of Nigeria, 1986). Technology education is a comprehensive, action-based educational programme that is concerned with the acquisition of practical and applied skills as well as basic scientific knowledge. The aims of technical education (which includes technological and vocational education) are:

(a) to provide trained manpower in applied science, technology and commerce particularly at sub-professional grades;
(b) to provide technical knowledge and vocational skills necessary for agricultural, industrial, commercial and economic development;
(c) to provide people who can apply scientific knowledge to the improvement and solution of environmental problems for the use and convenience of man;
(d) to give introduction to professional studies in engineering and other technologies:
(e) to give training and impart the necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self reliant: and
(f) to enable our young men and women to have an intelligent understanding of increasing complexity of technology (Federal Republic of Nigeria, 1981).

Technology education can help the student to:
1. know and appreciate the importance of technology:
2. develop insight, understanding and application of technological concepts, processes and system:
3. apply tools, materials, machines, processes, and technical concepts safely and efficiently:
4. develop skills, creative abilities, positive self-concepts, and individual potentials in technology:
5. develop problem-solving and decision-making abilities involving human and material resources, processes and technological systems: and
6. prepare for lifelong learning in technology (The American Industrial Arts Association, 1985).

Technology education programme is based on activity - oriented instruction which enables students to reinforce abstract concepts with concrete experiences. It also emphasizes on "know - how" and "ability to do" in carrying out technological work.

THE PHILOSOPHICAL CONFLICT

Liberal education is limited to the development of knowledge and values. It merely attempts to develop skills of leadership, law-making and oration which are not scientific and technological skills. Science teaching was opposed in the early grammar schools because of the emphasis on mental training combined with the view that scientific studies could not have the intellectual value which could be obtained from the classics (Tricker, 1967). In this context, education cannot be defined in terms of knowledge and skills that will be useful. The new direction in Nigerian education is scientific and technological development. Oroka (1993) observed that liberal arts curriculum lacked cultural, scientific and technological relevance to Nigerian development process. He further declared:

> Liberal education in its traditional sense is not only undemocratic and inegalitarian but also lacks direction at the producers (scientists and technologists) needed by society. It is inegalitarian because liberal education is a reflection and reinforcement of western middle class values, and thus an instrument of social and political control.

There is the tendency, therefore, for specialists in liberal arts to aim at controlling the administration and organisation of science and technology for which they lack knowledge and experience.

People who grow up in a society in which scientifically based technology forms an essential element are more likely to perceive close relationship between science and technology. However, Forbes and Dijksterhuis (1963) observed that no matter how closely linked science and technology may be today they have developed historically along virtually separate paths. For a long time, science remined indifferent to the practical application of its conclusion. Similarly, technology had to do without the help of science for a long time. In fact technology was present on the human scene long before the arrival of anything that might be called science (McGinn 1991). Furthermore, there is no evidence that science is becoming a more important source of ideas on which technological innovations are based. Gibbons and Gummett (1984) remarked:

> Empirical research into the sources of the ideas on which technological innovations are based shows that these lie mainly in previous technology. In other words, if you examine the technical content of a given product and try to trace its antecedent, rather than finding these in prior science, they are more often found in prior technology. This is true for example, in many mechanical and a host of electrical and electronic products.

One can safely conclude that technological inventiveness is a prime source of new product.

It would be a waste of time to harmonise liberal arts, science and technology because of cultural factors and lack of resources to meet the needs in the three fields. Besides, there are more traditionalists than pragmatists in Nigerian educational system. These traditionalists have held on to the liberal arts for obvious reasons. It is possible therefore, that their beliefs might hinder the innovations in the educational system (Omatseye, 1983). Having passed through the old system themselves, they would be reluctant to introduce or really accept new innovations which may be a threat to their status quo.

PHILOSOPHICAL HARMONY

The 6 - 3 - 3- 4 system of education in Nigeria was based on the tenet of pragmatism which is the philosophical basis of progressivism that aimed at freeing education from the grips of traditionalism. The system of education plays down on traditionalism but uses eclectic approach in harmonising liberal arts, science and technology. In this way, education is made more practical and relevant to everyday life.

Science and technology use pragmatic approach to curriculum by combining knowledge and experience. When this happens, facts are united with experience and made to fit general principles. The delivery system is typified by diversified curriculum, problem-centred learning and project method of teaching. Hirst (1965) stressed that liberal arts is also concerned with developing a person's ways of understanding experience. This presupposes that liberal arts is not against experiences that are practical in nature. In this sense, the scientific and technological attitude can be developed in the presence of liberal arts education.

While it is important to continue our quest for science and technology development, it is equally important to prevent the breakdown of social norms as society changes by appreciating the contribution of the liberal arts in a fast changing world. The liberal arts could help to sensitize individuals to essential needs like fairness, responsibility and decency in public as well as private life (Omatseye, 1982).

Liberal arts, science and technology are intimately bound by concerns of citizens and government in contemporary societies especially in military power, economic strength and medical well being (McGinn, 1991). Scientific and technological resources are vital to natural security in Nigeria. An indicator of the continued importance of science and technology to the military is in the proportion of military related projects in the Federal Government budget. On the other hand, Tricker (1967) observed that there is no subject of the curriculum with science has not many contacts. Besides, science cannot provide the whole or even the major part of a complete education. While science is primarily concerned with facts, the humanities strive to create a value system in which facts are judged in the light of ultimate moral and metaphysical truths (Omatseye, 1982). In view of the above, there can no longer be any justification for a dichotomy or a doctrine of different culture

Science and technology are two fields of knowledge that interact more closely in the sense of exchanging relevant information, insights and theories. It is important to note that technology influenced the practice of seventeenth century science through.

1. the provision of scientific instrument (e.g. clock and lens)
2. giving rise to a new world view for science and
3. by influencing the research topics selected for study in early modern science (McGinn, 1991).

By the early nineteenth century, a common approach to understand nature scientifically was by mechanistic philosophy. Everything in nature was thought to be a sort of mechanism, so, one should understand and study things in parts, how they fit together and what mechanism is involved in its coordinated operation. In the late twentieth century, most technical projects have both technological and scientific components. One can safely conclude that modern science and technology are not only overlapping but also interdependent.

CONTEMPORARY DEVELOPMENT

All countries go through an evolution of technological growth and development. Countries tend to move through several levels of growth in their technological development. Todd (1985) identified five levels of technological development starting with the lowest level or indigenous, and moving through the emerging, developing, industrialized and finally to the cybernetic level (see figure 1). A country at the indigenous level derives economic benefit from exports of its natural resources or agricultural products. Its finished products are usually limited to the work of craftsmen and artisans which represent only a very small percentage of the nation's trade. This lowest level may also be termed traditional technology. A country at the 'emerging' level is involved in the transfer of technology from outside its boundaries, usually from developing and industrialized countries. Countries at the developing level make decision on the appropriateness of the technology that is being accepted or desired. This critical assessment of technology is essential in order to apply the most useful ones that will meet the need of the country or culture.

Industrialized countries include nations that are able to provide most of the products and services required for their people to maintain a relatively high standard of living. Industralised nations are also the mass producers and exporters of products for the rest of the world. The cybernetic level has an existing economic, service and communication industries that provide machines and systems which process, transmit and provide information to others. Typical products of countries in this level of technological development are computers, robots, and satellites. The United States of America, England, France, Japan and Germany could be regarded as well established industrialized countries and as new cybernetic nations.

At present, Nigeria is between the regions of technology transfer and appropriate technology levels of development. Being a developing country, her economy is dependent on the industrialized world. Nigeria has abundant resources but lack adequate scientific and technological knowledge to transfer the resources into goods and services. More attention is being paid to human resource production in science and engineering as well as entrepreneurial development in the public and private sectors. A number of strategies were set up for implementing

the National Policy on Science and Technology. For example, the ratio of science to liberal arts students as recommended in Nigerian Universities is 60:40. This was equally recommended for a ratio of 80: 20 in the specialised Universities and 70:30 in Polytechnics (Federal Republic of Nigeria, 1992).

Furthermore, the educational system makes it possible for the average child to have early contact with the concepts and materials related to science and technology before attaining primary school age. It is expected that this will influence his/her thinking and working processes. The system of education is biased towards science and technology with a focus on the creation of science and technology awareness at the primary level, orientation and exploration of technology education at the junior secondary level and preparation in technology at the senior secondary level. The actualization of technology through design, construction and production is to be achieved at the tertiary level.

There is emphasis on functional education. The secondary school curriculum incorporates pre-vocational and vocational education. This is also placed at the same level of importance with liberal arts and sciences. The educational programme emphasizes the need to teach science and technology education subjects as activities which students will 'do' and not be 'told' or just 'read'. As a result, gainful practical activities such as model making, handicrafts, gardening and farming have been introduced. The students will be able to cultivate problem solving techniques through actual experiences in the laboratories and workshops. The Government is working towards establishing at least one Trade Center/Vocational School in each local government area of the country as a means of giving practical training in various craftsmanship towards improved efficiency and self employment (Federal Republic of Nigeria, 1986).

In order to achieve the objectives of the 6 - 3- 3- 4 educational system, the Federal Military Government signed contract agreements with the Government of Bulgaria, Czechoslovakia and Hungary for the supply of Junior Secondary School (JSS) equipment. A total of 7254 units of JSS workshop equipment were distributed to the States and Federal Government institutions and agencies (Federal Ministry of Education, 1988). Besides, the JSS and SSS syllabi were distributed to the States. Training workshops were mounted for technical teachers of pre-vocational subjects using workshop equipment donated to the Federal government by friendly countries (Sweden, Hungary, Bulgaria and Britain). The Federal Government continues to train technology teachers for Junior and Senior Secondary levels. The Federal Government started the training of Technical teachers in 1981 by giving awards under the Technical Teachers Training Programme (TTTP). Recipients of the award were either trained abroad for a two-year programme leading to the B.Sc. degree in vocational education or for a one year programme for the M.Ed. degree. The TTTP started as an interim arrangement to produce technical and vocational subject teachers aborad. Currently, these teachers are being produced in Nigerian universities, Polytechnics and Colleges of Education (Technical). The training of this category of teachers is significant because the success or failure of the new National Policy on Education depends on whether or not we are able to teach the pre-vocational subject in Junior Secondary Schools (Onabamiro, 1984).

POSITION

The thrust of the educational system in Nigeria is influenced by the philosophy of pragmatism. The structure requires astute leadership, adequate financing, qualified instructional staff, facilities and equipment. Attention is needed on practical and productive aspects of education which characterise technology education. How a nation views technology education will be directly related to how it views technology. The Federal Government Policy on Science and Technology and implementation programme show positive action towards laying a solid foundation for the development of science and technology in Nigeria. In the light of this development, technology education programme should be nurtured and allowed to grow to the desired level and status in the hands of vocational educator and administrators.

Recipients of liberal arts education have been instrumental in the country's attainment of nationhood. As new goals and objectives are being pursued, attention must be paid to activities that are appropriate for achieving the desired technological development. Although technology and science are distinguishable forms of human activities, they have become critical factors of economic and social development. There is the need to train men and women intellectually and vocationally. The foundation for technology at the tertiary level is in science education; especially in mathematics, physics and chemistry. Poor performance in these sciences at the Senior Secondary School Examinations (SSSE) makes the goals of technological education unattainable for Nigeria. Emphasis must be placed on these subjects at this level.

Technological philosophy incorporates traditional values. It centres its contribution on Nigerian society around the acquisition of practical and applied skills as well as basic scientific knowledge. This will make great contribution to social and economic progress. There is the need to control and nurture the programmes of technology education from being encapsulated by general and science education.

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